

SHORT REPORT

# The First Record of a Pre-Columbian Domestic Dog (*Canis lupus familiaris*) in Brazil

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**ABSTRACT** Archaeological excavations of the PSG-07 earthen mound at Pontal da Barra in Rio Grande do Sul, southern Brazil have revealed the earliest known evidence for the presence of domestic dog (*Canis lupus familiaris*) in Brazil. This is the first reported pre-Columbian example in the country. Analysis of morphology, morphometry, and dental enamel laminae identified a left maxillary molar 1, left maxillary molar 2 and attached fragments of the maxilla of *C. l. familiaris*. A direct radiocarbon date on a fragment of the maxilla provided an age range between 1701 and 1526 cal BP (2 $\sigma$ ). This is within the range of other dates for the site, which indicate intermittent occupation between 2024 and 1027 cal BP (2 $\sigma$ ). Data from carbon isotope analysis indicates a potential marine diet. However, nitrogen isotope analysis values are lower than expected for a marine diet. The sparse records of pre-Columbian *C. l. familiaris* in the region emphasise the importance of the present work. Copyright © 2016 John Wiley & Sons, Ltd.

**Key words:** *Canis lupus familiaris*; Brazil; zooarchaeology; isotope analysis; earthen mounds

## Introduction

Within South America, securely identified remains of pre-Columbian *Canis lupus familiaris* (*C. l. familiaris*), the domestic dog, are mostly limited to the Andes and neighbouring regions. The paucity of remains elsewhere contrasts with the broad expansion of dogs from ca. 10 000 BP throughout North and Central America (Morey, 2006). In South America, their introduction appears to take place later, between ca. 7500 and 4500 BP (Cabrera, 1934; Gallardo, 1964–1965; Mendoza España & Valadez, 2006, 2006; Pozzi-Escot *et al.*, 2012; Prates *et al.*, 2010a; Schwartz, 1997; Wing,

1989; Zetti, 1973). Beyond the Andes, finds pertain to pre-Columbian *C. l. familiaris* in Argentina (Acosta & Loponte, 2010, 2011), yet there are just six undisputed published cases. Two are from north Patagonia (Prates *et al.*, 2010a) and four from the lower Paraná wetlands (Acosta & Loponte, 2010; Acosta *et al.*, 2011, 2015). In Uruguay, there is further evidence from perhaps four earthen mound sites, although several of the zooarchaeological analyses remain in unpublished literature (González, 1999; Bracco *et al.*, 2000; López Mazz & Castiñeira, 2001; Rudolph, 2014).

This report presents the first archaeological record of pre-Columbian *C. l. familiaris* from Brazil. The evidence comprises two complete maxillary molars – M1 and M2 – with a small fragment of a left maxilla attached (ID: 115-04). These are from a complex of 18 earthen mounds in Pontal da Barra, southern Brazil

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(Figure 1) (Milheira, 2014). The mounds are archaeological deposits known as *cerritos de índios* or *aterros*. Such sites appear across the Pampa biome in the lowlands of the La Plata Basin, its southern coast including areas of modern Brazil, Uruguay and Argentina (López Mazz, 2001). Research indicates that these developed through successive occupation by complex hunter-gatherers in the wetland environments of the region over a long period, from as early as ca. 5000 BP until 200 BP (Schmitz, 1976; Iriarte, 2006; Bracco et al., 2008; Gianotti, 2015). PSG-07 is a sub-circular mound with a greatest width of 36 m, aligned with three other earthen mounds on a North–South axis. The molars were recovered from Level 2 of the excavation. Lithic

fragments, potsherds, faunal and fragmented human remains were recorded across other levels (Milheira, 2014). Radiocarbon dates from the complex suggest intermittent occupation between 2024 and 1027 cal BP ( $2\sigma$ ) (Table 1). Evidence indicates hunter-gatherer use of lacustrine resources from *Lagoa dos Patos*, a post-glacial coastal lagoon.

## Methods

The excavation of a  $3 \times 1$  m unit at PSG-07 during 2013 revealed the *C.l.familiaris* remains. Members of the research team compared both molars with *C.l.*

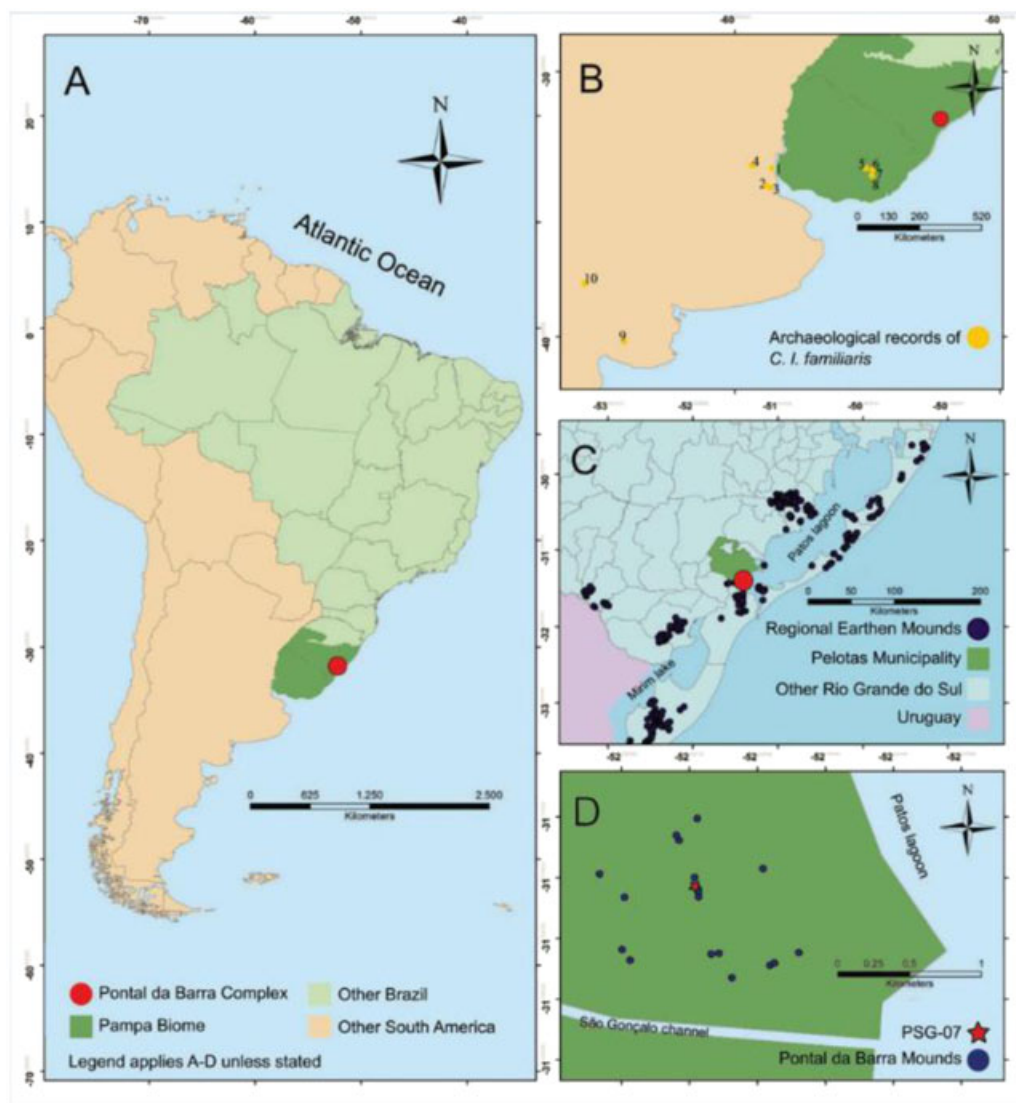


Figure 1. (A) Location of the Pontal da Barra complex in South America, and (B) in the coastal region of southern Brazil with other records of pre-Columbian dogs as per Table 3 shown in yellow. (C) Location in relation to regional mound sites. (D) PSG-07 within the complex at UTM 22J 383093/6483337.

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Table 1. Radiocarbon dates from PSG-07 at the Pontal da Barra earthen mound complex after Milheira *et al.*, 2016b. Type 1 = date on *C. l. familiaris* taxon; 2 = date from context. \*Calibrated with OxCal 4.2 using SHCAL13 for terrestrial flora and fauna, Marine13 curve used for marine fauna (otoliths) (Bronk-Ramsey, 2009; Hogg *et al.*, 2013; Reimer *et al.*, 2013)

PSG-07 sample	Cal BP (2σ)*	<sup>14</sup> C yr BP	Type	Excavated at depth (cm)	Lab code
<i>C. l. familiaris</i> maxilla (bone)	1701–1526	1720 ± 30	1	2.5	Beta-415598
Otolith (bone)	1686–1368	1696 ± 28	2	5.0	LACUFF-140396
Otolith (bone)	2024–1289	2340 ± 150	2	22.5	LACUFF-13052
Otolith (bone)	1654–1027	1214 ± 22	2	42.5	LACUFF-140393
Charcoal	1675–1323	1660 ± 190	2	57.5	LACUFF-140394
Otolith (bone)	1705–1408	1756 ± 28	2	57.5	LACUFF-140395
Otolith (bone)	1608–1356	1670 ± 30	2	67.5	Beta-389013
Charcoal	1545–1407	1630 ± 30	2	82.5	Beta-389014

*familiaris* specimens at the Museo de La Plata, Argentina, including a pre-Columbian individual (INAPL/CL1-UE-3) from the Paraná Delta, morphologically and genetically identified as *C. l. familiaris* (Acosta *et al.*, 2011). Furthermore, the team made comparisons with American foxes including *Chrysocyon brachyurus*, *Lycalopex gymnocercus*, *Cerdocyon thous* and *Dusicyon avus*, and to bibliographic data on *Lycalopex vetulus* (Dalponte, 2009). Molar enamel laminae patterning was examined by binocular microscope and compared with reference material, as the arrangement of dental enamel laminae (Hunter-Schreger bands) may distinguish dogs from foxes (Stefen, 1999). Standard measurements (Hillson, 1996) were completed three times by the same individual with digital callipers, and the mean value provided to the nearest 0.01 mm. Isotope values and radiocarbon ages derive from collagen samples of the maxilla fragment (Milheira *et al.*, 2016b).

## Results

The left first and second upper molars are identified as domestic dog (*C. l. familiaris*) along with fragments of the respective maxilla. Measurements are comparable with other medium-sized specimens of *C. l. familiaris* specimens of the region (Table 2). This means that

individuals of similar sizes were circulating in the area during the late Holocene (González, 1999; Loponte & Acosta, 2016).

Morphological features distinguish these teeth from those of South American wild canids. In *C. l. familiaris*, tooth cusps are blunter and more robust than in wild species; the paracones of both molars are conspicuously larger than their respective metacones; the lingual cinguli and hypocones of both molars are reduced compared with those of wild foxes (Tedford *et al.*, 1995; Prates *et al.*, 2010a). These features are observable on the specimens from PSG-07. Moreover, other features of the molars of South American foxes differ. The molars of *C. brachyurus* are larger and proportionally narrower in their mesiodistal length; those of *L. gymnocercus* and *C. thous* are more extended transversely; those of *L. vetulus* are subquadrate, with little buccolingual extension (Figure 2).

Dental enamel laminae patterning in both molars differ from South American foxes. *C. l. familiaris* molars transition from an undulating arrangement of the Hunter-Schreger bands to a zigzag arrangement. The bands of compared wild South American species undulate, an observation that agrees with previous studies (Stefen, 1999; Prates *et al.*, 2010a). The zigzag arrangement is associated with carnivorous canid species that also consume bone to some extent, such as *C. l. familiaris*

Table 2. Measurements of the PSG-07 *C. l. familiaris* dentition compared with data on the left maxillary M1 from Chenque 1 and from Cerro Lutz. The M1 from PSG-07 is similar in size to that at Cerro Lutz; the Chenque 1 M1 is smaller than the other two. Estimates of height at the shoulder were calculated from the long bones of the individuals found at Cerro Lutz (Tibia and Femur) and Chenque 1 (Humerus, Radius, Ulna and Tibia). No M2 was found at the other two sites

Specimen	Element	Mesiodistal length (mm)	Labiolingual width (mm)	Est. Height at Shoulder (cm)	Reference
115-04 PSG-07, Brazil	Maxillary left M1	12.49	14.54	n/a	This work
115-04 PSG-07, Brazil	Maxillary left M2	6.84	9.91	n/a	This work
INAPL/CL1-UE-3 Cerro Lutz, Argentina (Table 3: ID 1)	Maxillary left M1	12.2	16.00	47	Acosta <i>et al.</i> , 2011
ME E 41-2 Chenque 1, Argentina (Table 3: ID 10)	Maxillary left M1	9.39	11.53	47	Prates <i>et al.</i> , 2010b

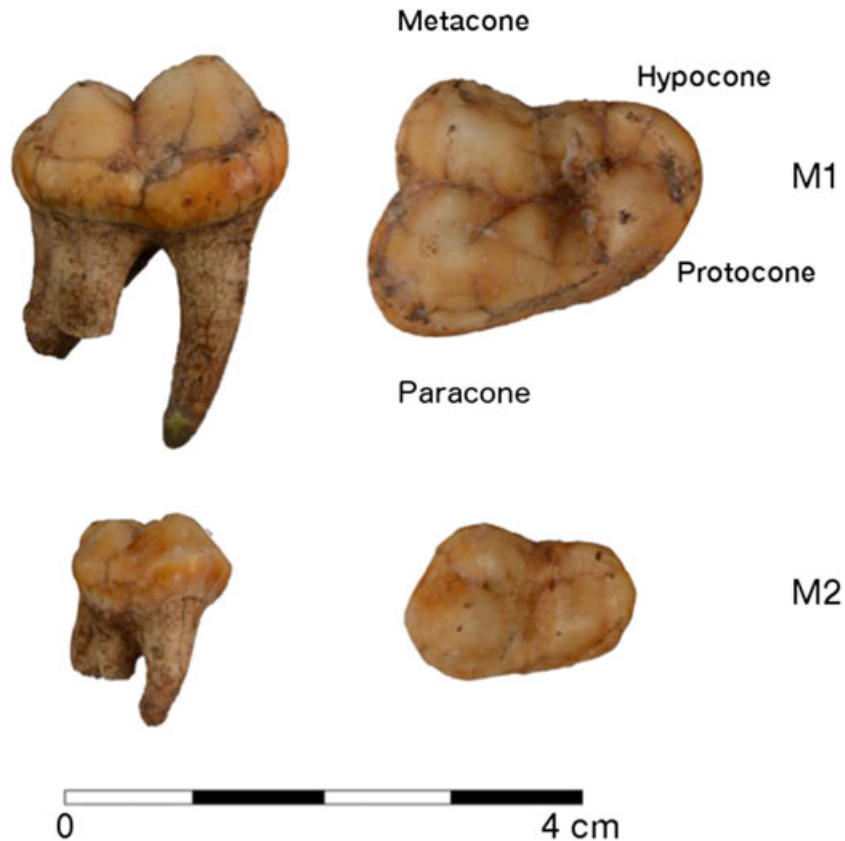


Figure 2. The upper image is of the left maxillary molar 1, the lower is of the left maxillary molar 2 of *C. l. familiaris* recovered from PSG-07 (ID: 115-04). Labial view to the left, occlusal view to the right.

(Stefen, 1999). The simpler undulating arrangement observed in all South American foxes compared here is likely linked to their omnivorous diet.

A direct date obtained from bone collagen of the maxilla yielded a conventional radiocarbon age of 1701–1526 cal BP ( $2\sigma$ ) (Beta-415598) consistent with the date range for human occupation of the site (Milheira *et al.*, 2016a, 2016b) (Table 1). Results of isotope analysis (C/N: 3.1) of the maxilla were Carbon:  $\delta^{13}\text{C} -11.4\%$ , Nitrogen:  $\delta^{15}\text{N} -10.6\%$ .

## Discussion and conclusion

The spread of *C. l. familiaris* throughout South America occurs later than in North and Central America, and appears limited in extent beyond the Andean region until the period of European contact. The handful of sites in the south of the continent with clearly identified pre-Columbian *C. l. familiaris* remains are close to PSG-07 in distance and date. Confirmed finds come from the Pampas, at Cerro Lutz in the lower Paraná basin in Argentina, about 700 km away (Acosta *et al.*,

2011), the more distant Chenque I, as well as northern Patagonia at Angostura I (Prates *et al.*, 2010a). Evidence from Uruguay reveals perhaps four sites approximately 450 km south, like PSG-07 these are earthen mounds (González, 1999; Bracco *et al.*, 2000; López Mazz & Castiñeira, 2001; Rudolph, 2014; Loponte & Acosta, 2016). The date of 1701–1526 cal BP ( $2\sigma$ ) for the Pontal da Barra remains is in the upper range associated with *C. l. familiaris* at regional sites, and within the range of those in Eastern Uruguay. Remains found further west in the Lower Uruguay River, Paraná River and North Patagonia are later in date. This may relate to the expansion of pre-Columbian *C. l. familiaris* in this region (Table 3).

While Andean sites with pre-Columbian *C. l. familiaris* pertain to sedentary agricultural societies (Gallardo, 1964–1965), sites across Patagonia and the Pampas of Brazil, Argentina and Uruguay relate to hunter-gatherer occupations. Many authors suggest the value of the dog in the cooperative hunting of larger-sized prey (Lupo, 2011), but although dogs supported hunting in some neotropical societies, in many they served only as pets or as a food source (Koster, 2009). Thus, it

Table 3. Records of pre-Columbian dogs in south-eastern South America: Type 1 = date on taxon; 2 = date from context (after Acosta *et al.*, 2011, 2015), (OxCal 4.2, SHCAL13). See Figure 1 for their locations in relation to the study site

ID	Sites	Cal BP (2σ)	<sup>14</sup> C yr BP	Type	Lab code	Location
1	Cerro Lutz	906–689	916 ± 42	1	AA-77312	Lower Uruguay River
2	La Bellaca sitio 2	721–518	680 ± 80	2	LP-1263	Lower Paraná River
3	Anahí	1050–735	1020 ± 70	2	Beta-147108	Lower Paraná River
4	La Argentina	928–758	979 ± 44	2	AA-103642	Lower Paraná River
5	CH2D01 (Elevación B)	1160–788	1090 ± 70	2	URU 002	Eastern Uruguay
6	CH2D01 (Microrelieve)	1568–1352	1610 ± 50	2	URU 030	Eastern Uruguay
7	Potreriño Sta. Teresa (Cerrito A)	2420–2150	2320 ± 50	2	URU 082	Eastern Uruguay
8	Puntas de San Luis (Elevación 1)	3888–3399	3430 ± 100	2	URU 0099	Eastern Uruguay
9	Angostura 1	918–730	938 ± 45	2	AA-2551	North Patagonia
10	Chenque 1	905–730	930 ± 30	1	UGA 02006	North Patagonia

is important to understand the niche that dogs occupied in each society, both economically and symbolically. In this case and regional examples, their deposition in potential funerary contexts may point to a possible interpretation (Morey, 2006). At Chenque I, a complete *C.l.familiaris* skeleton was apparently buried deliberately with a sub-adult human male (Prates *et al.*, 2010a). At Cerro Lutz, Acosta *et al.* (2011) argue that the complete and articulated dog remains result from deliberate burial by humans, and there is evidence for later human burials on site. There is a strong association between *C.l.familiaris* remains and human burials in the earthen mounds noted in Uruguay at Potrerillo de Santa Teresa (López Mazz & Castiñeira, 2001), Puntas de San Luis (Bracco *et al.*, 2000) and CH2D01, San Miguel, where one of two articulated canid skeletons was recovered close to human remains (González, 1999), although Rudolph (2014) was not able to confirm the identification of these remains as *C.l.familiaris*. At PSG-07 the *C.l.familiaris* remains appeared approximately 40–60 cm above three dispersed fragments of human cranial bone and an unerupted crown of human left maxillary M1. Current research aims to contextualise these finds.

Analysis of carbon and nitrogen isotopes provides dietary information. The carbon value,  $\delta^{13}\text{C}$  –11.4‰, is typical of a marine diet and close to others obtained from samples at archaeological sites on the seashore of the adjacent state of Santa Catarina (Colonese *et al.*, 2014; Bastos *et al.*, 2015; Loponte *et al.*, 2016). The value obtained in nitrogen,  $\delta^{15}\text{N}$  –10.6‰, is lower than expected for diets based on marine resources. This value cannot be discarded as an outlier as the nitrogen value might be influenced by the intake of plants within a C<sub>4</sub> photosynthetic pattern such as maize, whose cultivation is being evaluated on the basis of other lines of evidence (Milheira, 2014; Mühlen, 2014). Future isotopic analysis of human remains recovered at this site will permit improved

interpretation of these results, given the similarity between human and domestic canid diets (Bartelink, 2009; Rick *et al.*, 2011; Byrd *et al.*, 2013).

In conclusion, the presence of *C.l.familiaris* at PSG-07 provides evidence for the first known pre-Columbian domestic dog in Brazil. This find expands the data set of identified remains at earthen mound sites on the Atlantic coast of South America, contributing to the discussion on the distribution and expansion of domestic canids in the region (Koster, 2009; Pozzi-Escot *et al.*, 2012; Stahl, 2013). The discovery aids our interpretations of past excavations and raises both questions and expectations in the archaeology of south-eastern South America.

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## References

- Acosta A, Loponte D. 2010. Registro de perros prehistóricos (*Canis familiaris*) en el sector centro-oriental de la Región pampeana. *Arqueología Argentina en el Bicentenario de la Revolución de Mayo V*, JR Bárcena, H Chiavaza (eds.). INCIHUSA: Mendoza, 1823–1828.
- Acosta A, Loponte D. 2011. Reseña histórica sobre los perros prehistóricos de la República Argentina (Parte 1). *AMMVEPE, Revista de la Asociación Mexicana de Médicos Veterinarios Especialistas en Pequeñas Especies* 22(4): 100–105.
- Acosta A, Loponte D, García Esponda C. 2011. Primer registro de perro doméstico prehistórico (*Canis familiaris*) entre los grupos cazadores recolectores del humedal de Paraná inferior (Argentina). *Antípoda Revista de Antropología y Arqueología* 13: 175–199.

- Acosta A, Buc N, Ramírez M, Prevosti F, Loponte D. 2015. Producción y uso de objetos ornamentales elaborados sobre dientes de carnívoros en contextos arqueológicos del humedal del Paraná inferior. *Revista del Museo de Antropología* 8(2): 33–46.
- Bartelink EJ. 2009. Late Holocene dietary change in the San Francisco Bay area: stable isotope evidence for an expansion in diet breadth. *California Archaeology* 1(2): 227–252.
- Bastos MQR, Santos RV, Tykot RH, Mendonça de Souza SMF, Rodrigues-Carvalho C, Lessa A. 2015. Isotopic evidences regarding migration at the Archaeological Site of Praia da Tapera: New data to an old matter. *Journal of Archaeological Science: Reports* 4: 588–595.
- Bracco R, Montaña J, Nadal O, Gancio F. 2000. Técnicas de Construcción y Estructuras Monticulares. Termiteros y Cerritos: Desde lo Analógico a lo Estructural. Arqueología de las Tierras Bajas, A Duran Coirolo, R Bracco (eds.). Ministerio de Educación y Cultura. Comisión Nacional de Arqueología: Montevideo; 285–300.
- Bracco R, Puerto L, del Inda H. 2008. Prehistoria y Arqueología de la Cuenca de Laguna Merín. Entre la Tierra y el Agua. Arqueología de Humedales de Sudamérica, D Loponte, A Acosta (eds.). AINA: Buenos Aires; 1–60.
- Bronk-Ramsey C. 2009. Bayesian analysis of radiocarbon dates. *Radiocarbon* 51(3): 1023–1045.
- Byrd BF, Cornellas A, Eerkens JW, Rosenthal JS, Carpenter TR, Leventhal A, Leonard JA. 2013. The role of canids in ritual and domestic contexts: new ancient DNA insights from complex hunter-gatherer sites in prehistoric Central California. *Journal of Archaeological Science* 40: 2176–2189.
- Cabrera A. 1934. Los perros domésticos de los indígenas del territorio argentino. 25° Congreso Internacional Americanistas 1: 83–93.
- Colonese A, Collins M, Lucquin A, Eustace M, Hancock Y, Almeida R, Ponzoni R, Mora A, Smith C, De Blasis P, Figuti L, Wesolowski V, Plens R, Eggers S, Farias D, Gledhill A, Craig O. 2014. Long-term resilience of late holocene coastal subsistence system in southeastern South America. *PLoS ONE* 9(4e93854): 1–13.
- Dalponete JC. 2009. *Lycalopex vetulus*. *Mammalian Species* 847: 1–7.
- Gallardo G. 1964–1965. Perros americanos precolombinos. *Cuadernos del Instituto Nacional de Antropología y Pensamiento Latinoamericano* 5: 31–69.
- Gianotti C. 2015. *Paisajes Sociales, Monumentalidad y Territorio en las tierras bajas de Uruguay*. Santiago de Compostela. Thesis.
- González R. 1999. *Canis familiaris* y constructores de cerritos: una perspectiva funeraria. Taller II de Arqueología: FHCE – Montevideo Unpublished.
- Hillson S. 1996. *Teeth*. Cambridge University Press: Cambridge.
- Hogg AG, Hua Q, Blackwell PG, Niu M, Buck CE, Guilderson TP, Heaton TJ, Palmer JG, Reimer PJ, Reimer RW, Turney CSM, Zimmerman SRH. 2013. SHCal13 Southern Hemisphere calibration, 0–50,000 years cal BP. *Radiocarbon* 55(4): 1889–1903.
- Iriarte J. 2006. Transformation, mounded villages and adopted cultigens: The rise of early formative communities in South-Eastern Uruguay. *World Archaeology* 38(4): 644–663.
- Koster J. 2009. Hunting dogs in the lowland Neotropics. *Journal of Anthropological Research* 65: 575–610.
- López Mazz JM. 2001. Las estructuras tumulares de la Cuenca de la Laguna Merín. *Latin American Antiquity* 12(3): 231–255.
- López Mazz JM, Castiñeira C. 2001. Estructura de sitio y patron de asentamiento en la Laguna Negra (depto. de Rocha). Arqueología Uruguaya hacia el fin Del Milenio: IX Congreso Nacional de Arqueología. Asociación Uruguaya de Arqueología: Uruguay; 147–174.
- Loponte D, Acosta A. 2016. Nuevos Registros de *Canis familiaris* (Carnivora, Canidae) en la Cuenca del Paraná. Argentina: Mastozoología Neotropical In press.
- Loponte D, Carbonera M, Corriale MJ, Acosta A. 2016. Horticulturists and oxygen ecozones in the tropical and subtropical forests of Southeast South America. *Environmental Archaeology: The Journal of Human Palaeoecology* 1–21. DOI:10.1080/14614103.2016.1211382.
- Lupo K. 2011. A dog is for hunting. *Ethnozoarchaeology: The Present and Past of Human-Animal Relationships*, U Albarella, A Trentacoste (eds.). Oxbow Press: Oxford; 4–12.
- Mendoza España V, Valadez R. 2006. El perro prehispánico andino: función y tipos a partir del análisis arqueozoológico. Anales de la XIX Reunión Anual de Etnología. Museo Nacional de Etnografía y Folklore: La Paz, Bolivia; 31–38.
- Milheira RG. 2014. Arqueologia e História indígena do Pampa: estudo das populações pré-coloniais na bacia hidrográfica da Laguna dos Patos e Lagoa Mirim. Unpublished Report.
- Milheira RG, Garcia AM, Ulguim PF, Silveira CS, Ricardo Ribeiro BL. 2016a. Arqueologia dos cerritos na Laguna dos Patos, sul do Brasil: uma síntese da ocupação regional. *Cadernos do Ceom. Estudos regionais de arqueologia* 45(2In press).
- Milheira RG, Macario K, Chanca I, Alves EQ. 2016b. Archaeological earthen mound complex in Patos Lagoon, Southern Brazil: chronological model and freshwater influence. *Journal of Environmental Radioactivity* In Press.
- Morey DF. 2006. Burying key evidence: the social bond between dogs and people. *Journal of Archaeological Science* 33: 158–175.
- Mühlen CV. 2014. *Humanos, Plantas e Paisagem: A Arqueopalinologia como Ferramenta para Análise dos Processos Formativos do Cerrito PSG-02 Valverde, Pelotas, RS. UFPel: Pelotas*.
- Pozzi-Escot D, Cornejo Rivera I, Costaneira EA, Bernuy Quiroga K. 2012. Estudio preliminar de los hallazgos de *Canis familiaris* en la Pirámide con Rampa nº7, Santuario de Pachacamac, Perú. *Revista del Museo de Antropología* 5: 171–184.
- Prates L, Prevosti FJ, Berón M. 2010a. First records of prehispanic dogs in Southern South America (Pampa-Patagonia, Argentina). *Current Anthropology* 51: 273–280.

- Prates L, Berón M, Prevosti FJ. 2010b. Los perros prehispanicos del Cono Sur: Tendencias y nuevos registros. *Mamül Mapu: Pasado y Presente Desde la Arqueología Pampeana*, M Berón, L Luna, M Bonomo, C Montalvo, C Aranda, M Carrera Aizpitarte (eds.). Editorial Libros del Espinillo: Ayacucho; 215–228.
- Reimer P, Bard E, Bayliss A, Beck J, Blackwell P, Bronk Ramsey C, Buck C, Cheng H, Edwards R, Friedrich M et al. 2013. IntCal13 and Marine13 Radiocarbon Age Calibration Curves 0–50,000 Years cal BP. *Radiocarbon* 55(4): 1869–1887.
- Rick T, Culleton C, Brendan J, Smith C, Johnson B, Kennett J, Douglas J. 2011. Stable isotope analysis of dog, fox, and human diets at a Late Holocene Chumash village (CA-SRI-2) on Santa Rosa Island, California. *Journal of Archaeological Science* 38: 1385–1393.
- Rudolph FM. 2014. La gestión de los Recursos Animales en la Prehistoria del este de Uruguay (4000 años AP - siglo XVI). Universitat Autònoma de Barcelona. Thesis.
- Schwartz M. 1997. A History of Dogs in the Early Americas. Yale University Press: New Haven.
- Schmitz PI. 1976. Sítios de Pesca lacustre em Rio Grande, RS, Brasil. UNISINOS. Thesis.
- Stahl P. 2013. Early dogs and endemic South American canids of the Spanish main. *Journal of Anthropological Research* 69: 515–533.
- Stefen C. 1999. Enamel microstructure of recent and fossil Canidae (Carnivora, Mammalia). *Journal of Vertebrate Paleontology* 19: 576–587.
- Tedford RH, Taylor BE, Wang X. 1995. Phylogeny of the Caninae (Carnivora: Canidae): the living taxa. *American Museum Novitates* 3146: 1–37.
- Wing E. 1989. Human use of canids in the central Andes. Advances in Neotropical Mammalogy, K Redford, J Eisenberg (eds.). Sandhill Crane Press: Gainesville; 265–278.
- Zetti J. 1973. Paleoetnozoología del Tastil. Tastil, una Ciudad Preincaica Argentina, EM Cigliano (ed.). Museo de la Universidad Nacional de la Plata: Buenos Aires; 565–578.