

**LANDSCAPE DYNAMICS IN THE LA PLATA BASIN DURING THE MID AND LATE  
HOLOCENE**  
DINÂMICAS DE PAISAGEM NA BACIA DO PRATA DURANTE O HOLOCENO MÉDIO E  
TARDIO

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# Landscape dynamics in the La Plata Basin during the mid and late Holocene

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**Abstract:** In this article, we focus on three case studies, which show how the climatic fluctuations that took place during the mid and late Holocene had a major impact on the native groups that inhabited the La Plata Basin region. First, we summarized the archaeological and the paleoenvironmental records of the mid-Holocene related to the emergence of “Constructores de Cerritos” in south-eastern Uruguay. Then, we review the evidence for a late Holocene more intense occupation of the southern Brazilian Highlands by the southern proto-Jê groups and its association to the expansion of mixed Araucaria forest in this region. After that, we review the evidence for sea-level fluctuations and changes in settlement patterns of the mid and late-Holocene Sambaqui people that lived along the Atlantic coast of south-eastern Brazil. Finally, we briefly discuss the implications of these environmental changes for the development and dynamics of these cultures in the La Plata Basin region.

**Keywords:** Landscape, Archaeobotany, Palaeoecology, La Plata basin.

**Resumo:** Neste artigo vamos abordar três estudos de caso, avaliando como as variações climáticas que aconteceram durante o Holoceno médio e tardio produziram grandes impactos sobre as populações nativas que habitavam a região da Bacia do Prata. Primeiramente, é apresentado um resumo dos registros arqueológicos e paleoambientais do Holoceno médio relacionados com a emergência das sociedades de “Constructores de Cerritos” no Sudeste do Uruguai. Em seguida, são revisadas as evidências da mais intensa ocupação humana nas terras altas do sul do Brasil, pelos grupos proto-Jê do Sul, e a associação destes com a grande expansão da floresta de Araucária nesta região, durante o Holoceno tardio. Depois disto, resumimos as relações entre as flutuações do nível do mar e as mudanças no padrão de assentamento dos grupos sambaquieiros ao longo da costa do Atlântico, no sul brasileiro durante o Holoceno médio e tardio. Por último, é apresentada breve discussão sobre as implicações destas mudanças ambientais no desenvolvimento e dinâmicas destas culturas na região da Bacia do Prata.

**Palavras-Chave:** Paisagem, Arqueobotânica, Paleoecologia, Bacia do Prata.

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## INTRODUCTION

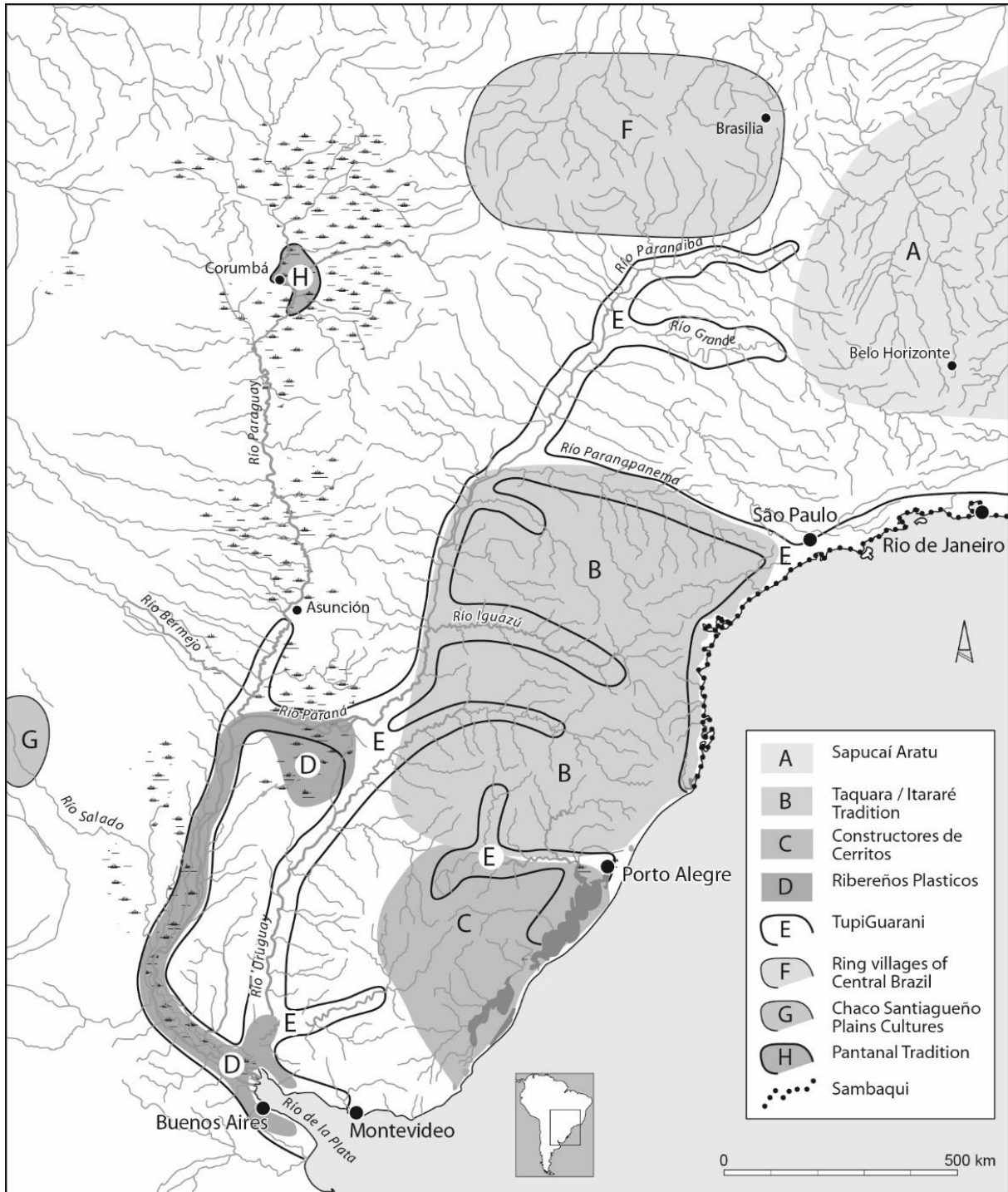
The archaeology of the mid and late Holocene of the Río de la Plata Basin (hereafter LPB) and its adjacent littoral Atlantic coast has received a new impetus in the last two decades through the development of several new archaeological projects (e.g., BONOMO et al. 2011; BRACCO 2006; CÁRDENAS et al. 2015; CORTELETTI 2012; DEBLASIS et al. 2007; DEMASI 2009; DURÁN and BRACCO 2000; GIANOTTI 2005; IRIARTE 2006a; MAZZ 2001; MAZZ et al. 2014; POLITIS et al. 2001; SCHMITZ et al. 2010; VILLAGRAN and GIANOTTI 2013) (Figure 1). In parallel, new paleoecological work carried out in the region has substantially expanded and refined our understanding of the mid- and late-Holocene environments (e.g., BEHLING 1995, 1997a, 1997b; BEHLING et al. 2004, 2005; BRACCO et al. 2011; CRUZ JR. et al. 2005; IRIARTE et al. 2004; IRIARTE 2006b; LEDRU et al. 1998; RODRIGUEZ 2005). These improved environmental reconstructions have in turn allowed archaeologists to explore human-environmental dynamics in more precise ways similar to the work that is being carried out in Amazonia (e.g., MAYLE and IRIARTE 2014).

In this article we focus on three case studies, which show how the climatic fluctuations that took place during the mid and late Holocene in this region had a major impact on the native groups that inhabited the region. First, we summarized the archaeological and the paleoenvironmental records of the mid-Holocene related to the emergence of early Formative societies in southeastern Uruguay. Then, we review the evidence for a late Holocene more intense occupation of the Southern Brazilian Highlands (hereafter SBH) by the southern proto-Jê groups and its association to the expansion of mixed *Araucaria* forest in this region. After that, we review the evidence for sea-level fluctuations and changes in settlement patterns of the mid and late-Holocene Sambaqui people that lived along the Atlantic coast of southeastern Brazil. Finally, we briefly discuss the implications of these climatic changes for the development and dynamics of these cultures in the region.

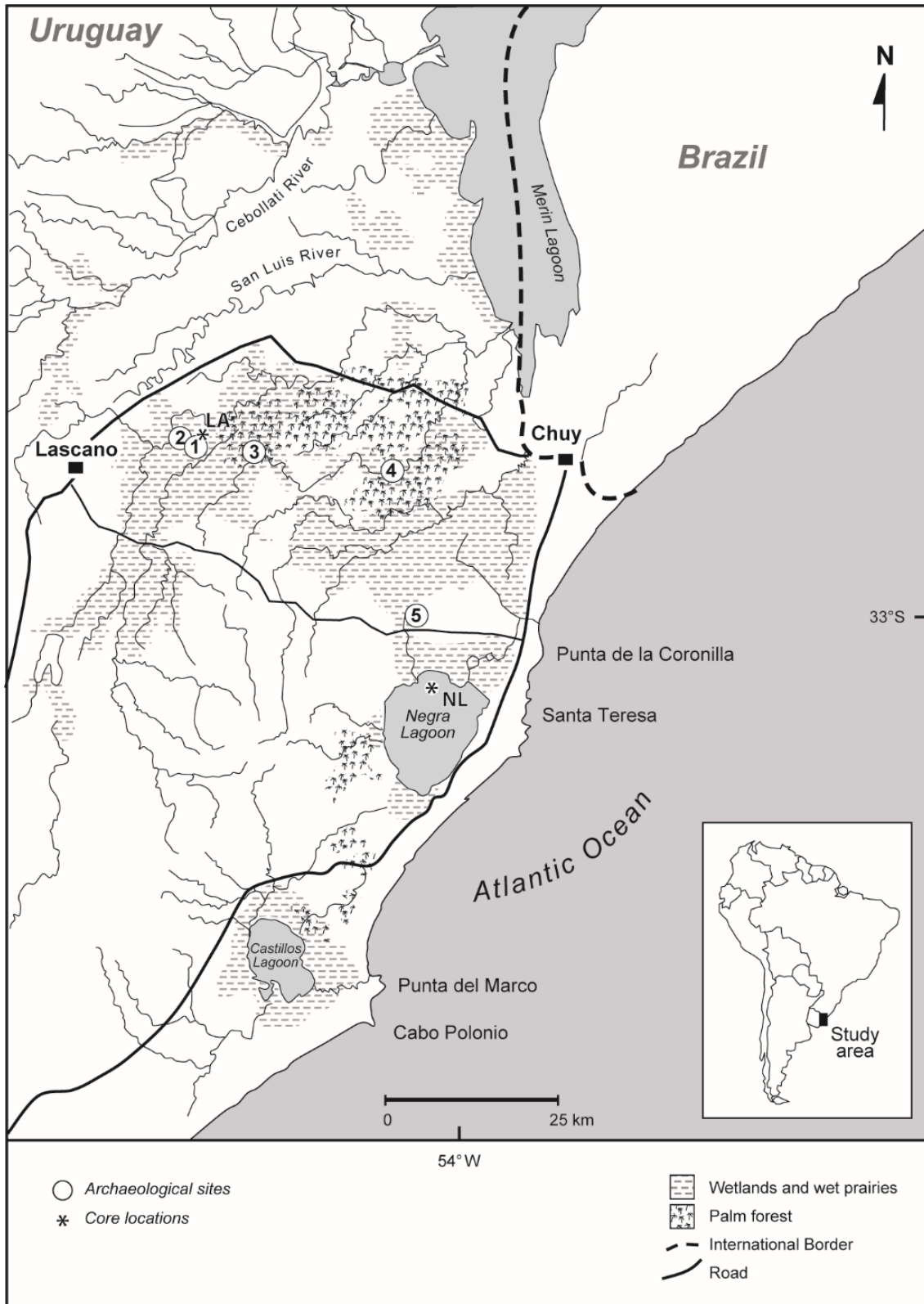
### THE MID-HOLOCENE EARLY FORMATIVE SOCIETIES OF SOUTHEASTERN URUGUAY

The mound-builder native culture dating back to c. 4736 cal. yr BP (4190 <sup>14</sup>C yr BP) are generally referred to as '*Constructores de Cerritos*' in Uruguay and are divided into the Umbu (Archaic Preceramic) and Vieira (Ceramic) traditions in southern Brazil. They extend along the coastal and inland wetlands and grasslands that occur in the Atlantic coast between around 28° and 36°S (DURÁN and BRACCO 2000; IRIARTE 2003; MAZZ 2001; MAZZ et al. 2014; SCHMITZ et al. 1991) (Figure 1). The southern sector of the Laguna Merin basin (Figure 2), is characterized by a patchwork of closely packed environments including wetlands, wet prairies, grasslands,

riparian forests, large stands of *Butia* palms and sand dunes of the Atlantic Ocean coast. It has a subtropical humid climate with high average temperatures of 21.58°C during the summer and low average temperatures of 10.88°C during the winter. Total annual rainfall averages 1123mm (PROBIDES 2000).



**Figure 1:** Map showing approximate locations of major archaeological traditions in southeastern South America during the mid and late Holocene.



**Figure 2:** Map of the southern sector of the Lagoon Merin basin showing India Muerta wetlands around archaeological sites Los Ajos (1); Estancia Mal Abrigo (2); and Puntas de San Luis (3); The map also show the archaeological sites CH2DOA (4) and Los Indios (5) and cores position of Los Ajos (LA) and Negra Lagoon (NL).

The 'Constructores de Cerritos' are divided into two main periods: a Preceramic Mound Period (hereafter PMP), which begins around 4736 cal. yr BP (4190 <sup>14</sup>C yr BP) and ends with the appearance of ceramics in the region around 3200 cal. yr BP (3000 <sup>14</sup>C yr BP) and a Ceramic Mound Period, which extends from around 3200 cal. yr BP to the Contact Period (BRACCO et al. 2000; IRIARTE 2003; MAZZ 2001) (see Figure 2 in IRIARTE 2006a:648).

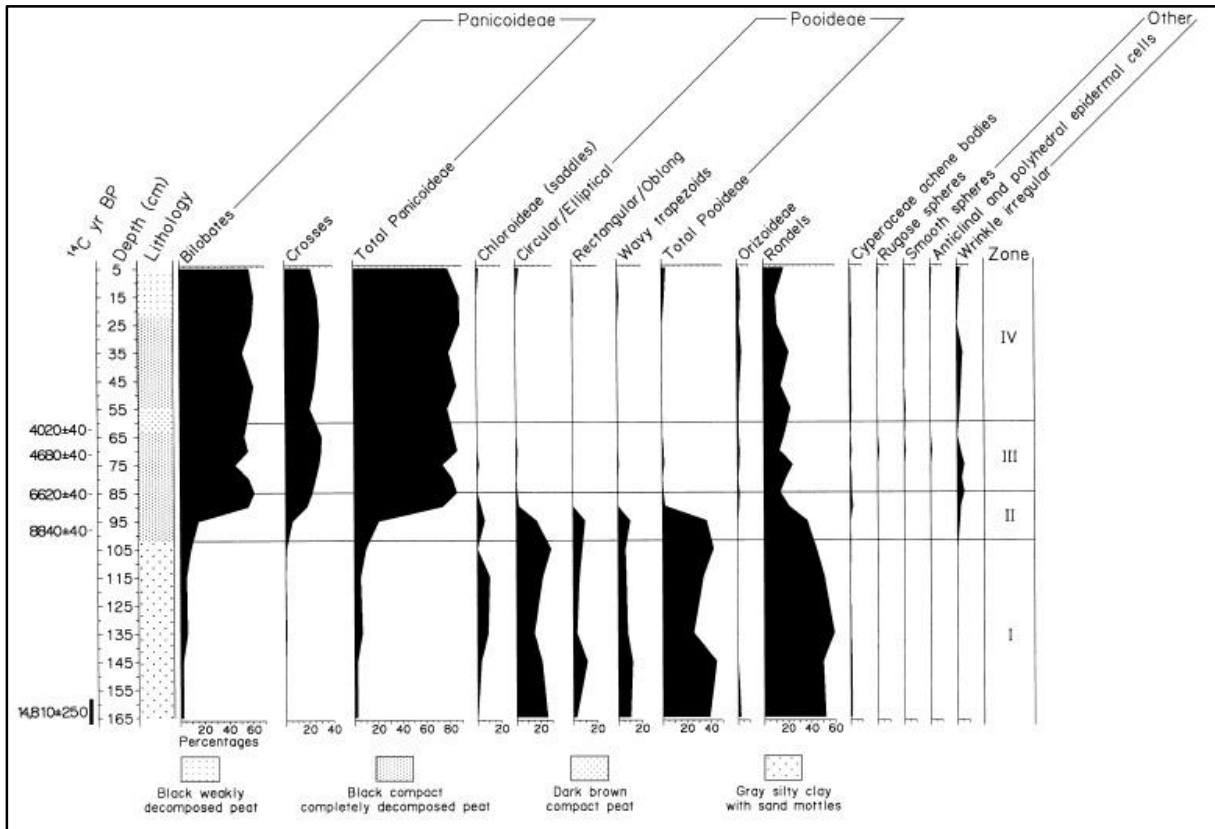


Figure 3: Los Ajos phytoliths diagram (from Iriarte, 2006).

Paleoecological data from the region shows that as in other regions of the world, the mid-Holocene was characterized by significant climatic and ecological changes (e.g., MAYLE and POWER 2008), and that these perturbations were associated with important cultural transformations (e.g., SANDWEISS et al. 1999). The combined pollen and phytolith records from the India Muerta wetlands indicate that the mid-Holocene between c. 7516 and 4495 cal. yr BP (c. 6620 and 4020 <sup>14</sup>C yr BP) was a period of significant climate fluctuations marked by increasing aridity (Figure 3 and 4). At around 4495 cal. yr BP a maximum drying episode occurred, as evidenced by a massive spike of Amaranthaceae/Chenopodiaceae coupled with a sharp drop in wetland species. The maximum drying episode that took place around 4495 cal. yr BP likely caused a decrease in the surface water recharge to the inland wetlands and waterways, which in turn resulted in the desiccation of grasslands. This caused increasing diminishing returns from grasslands, deepening the resource gradient between wetlands

and grasslands. Although reduced in extent, wetlands became attractive places for native populations by providing abundant, now more highly circumscribed plant and animal resources and a stable source of water. Archaeological data from the Los Ajos mound complex (IRIARTE 2006a) suggest that during this period of increased dryness, local populations did not disperse (e.g., disaggregate into smaller groups and increased mobility) or out-migrate to other regions but appear to have opted for orienting their settlement towards the upper freshwater wetlands where they established more permanent communities. A series of major social and economic changes took place at that time during the PMP.

Los Ajos people began to live in a circular household-based community, partitioning the site into discrete domestic and public areas characterized by the placement of residential units around a central plaza area. Plant and animal remains at Los Ajos indicate that PMP people adopted a mixed economy shortly after they began to live in more permanent villages. Phytolith and starch grain analyses documented seeds, leaves and roots from a variety of wild and domesticated species marking the earliest occurrence of at least two domesticated crops in the region: corn (*Zea mays*) and squash (*Cucurbita* spp.) shortly after 4736 cal. yr BP (IRIARTE et al. 2004). The close association between large mound complexes and the most fertile agricultural lands in the region suggest that PMP people likely practiced flood-recessional farming. During the spring and summer months, organic soils are exposed on the wetland margins. These superficial peat horizons are highly fertile, hold moisture and are easy to till. Furthermore, the floodwater of the nearby Cebollatí River periodically inundates the area and replenishes the soils with nutrients, which makes the India Muerta wetlands an ideal locale for the practice of wetland margin seasonal farming (IRIARTE 2003; 2007).

The exploitation of palms is evidenced by the recovery of palm nut endocarps from butia (*Butia capitata*) and pindo (*Syagrus romanzoffiana*) in addition to the presence of abundant palm phytoliths in the basal PMP at Los Ajos, Islas, and Estancia Mal Abrigo (Iriarte et al., 2001) (Figure 5). Dense stands of *Butia* palm groves, whether wild, encouraged or cultivated, constitute an extremely rich seasonal resource for prehistoric populations living in the area (MAZZ et al. 2014)

At a regional scale, we witness the development of large and spatially complex mound sites circumscribed to wetland floodplains situated in ecotonal areas. In the more stable locations of the landscape, like flattened spurs adjacent to wetland floodplains, which are secure from flooding and have immediate access to the rich-resource and fertile wetlands, mound sites are large, numerous and spatially complex covering up to 60 ha (e.g., Estancia Mal Abrigo site; see Figure 6.1 in IRIARTE et al. 2001:64). These sites contain varied mounded architecture geometrically arranged in circular, elliptical and horseshoe formats surrounding a central communal space accompanied by vast outer sectors, which generally exhibit more disperse and less formally integrated mounded architecture (IRIARTE 2003, 2013) (Figure 5). Collectively, the combined archaeological and

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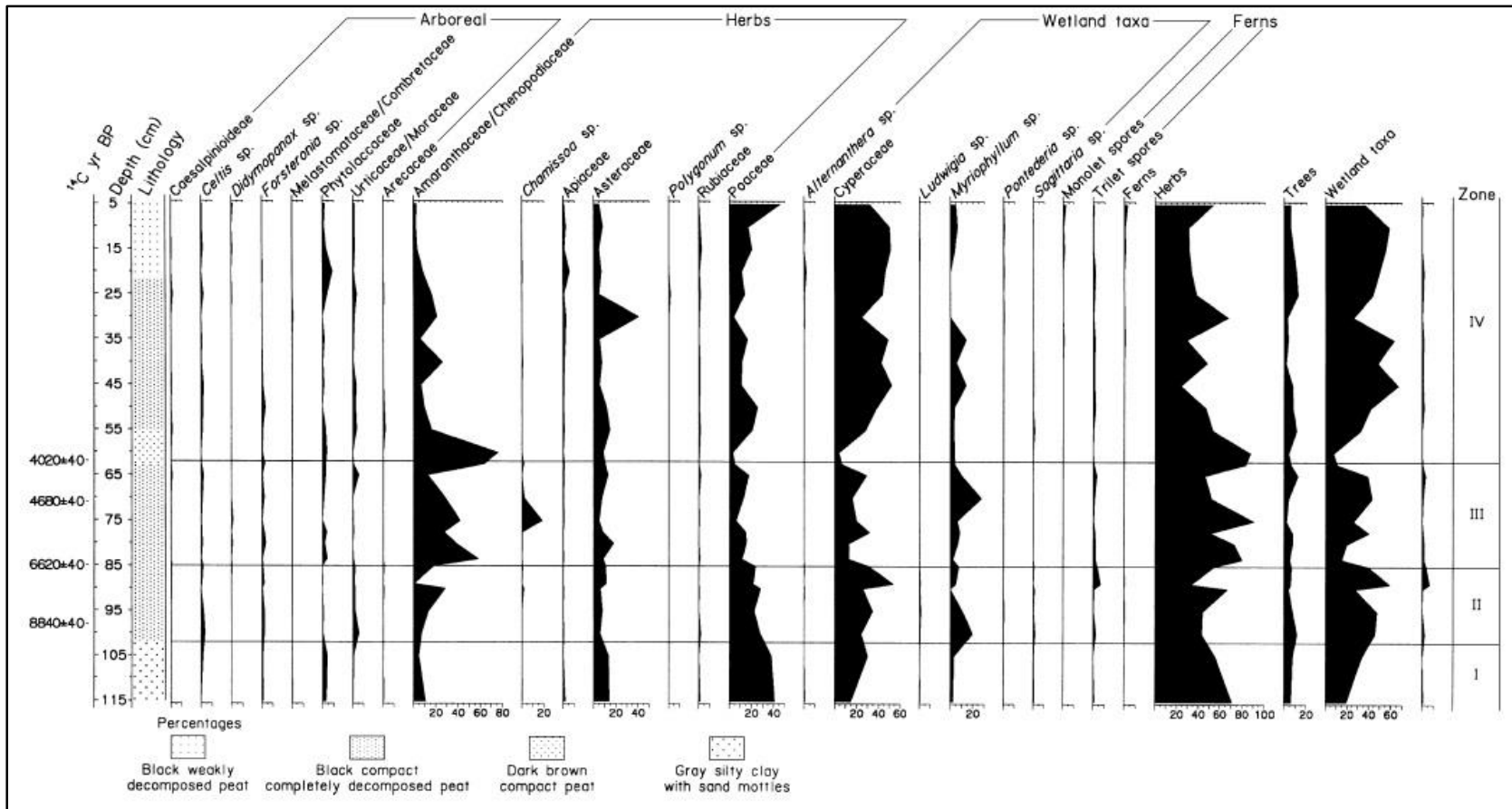
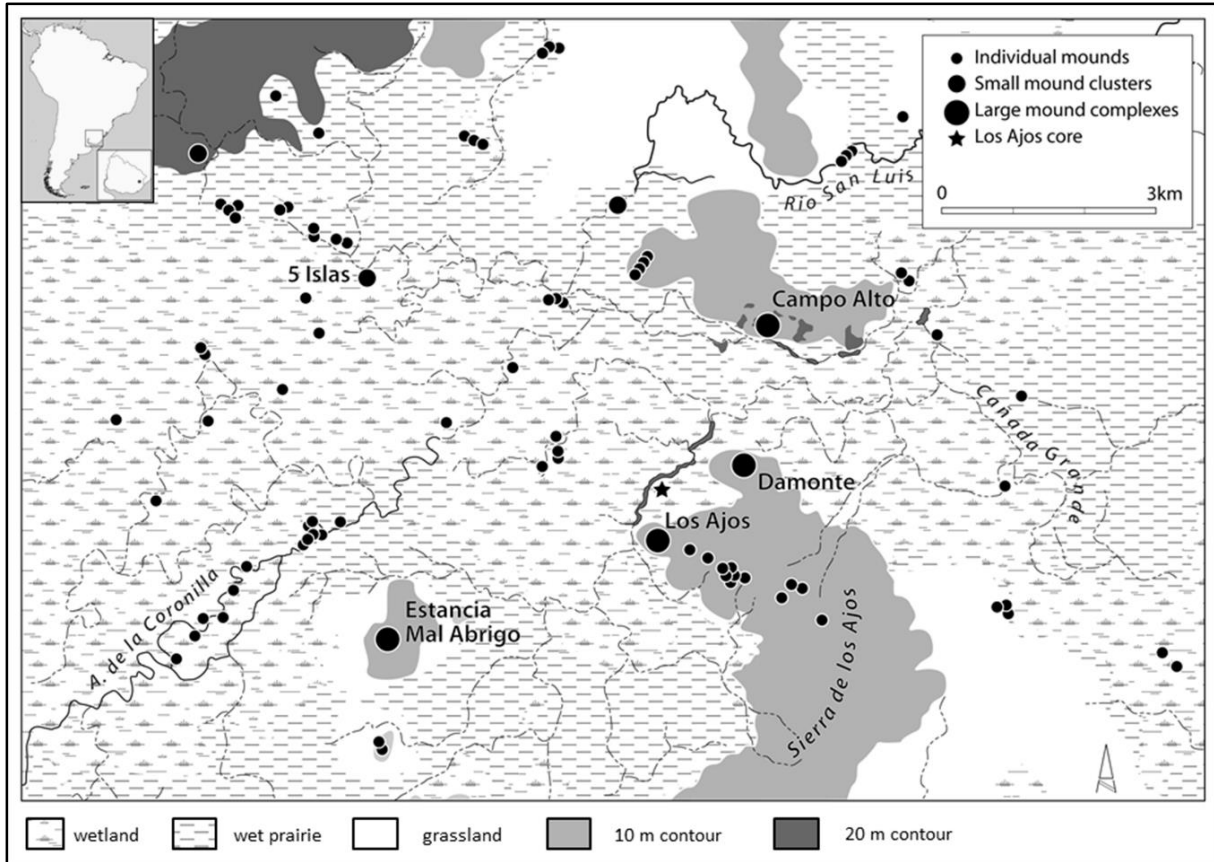


Figure 4: Los Ajos pollen diagram (from Iriarte, 2006).



paleoecological evidence from Los Ajos suggest that increased sedentism was a response to local resource abundance in wetland areas in the face of regional resource scarcity produced by the drying trend of the mid-Holocene.



**Figure 5:** Distribution of mound sites in the India Muerta wetlands in the southern sector of Laguna Merin

Along the Atlantic coast, Bracco et al. (2005) carried out a multi-proxy paleoenvironmental reconstruction of the Negra lagoon covering the last four millennia. The gastropod and diatom records show that the lagoon was a brackish water body between around 4000 and 2000 <sup>14</sup>C yr BP and a freshwater one between 2000 <sup>14</sup>C yr BP and the present. Based on the Twiss (1992) generalizations about the global distribution of C3 and C4 grasses, these authors inferred regional climatic changes in temperature and humidity based on the percentages of C4 Chloridoid – characteristic of warm and dry climates – vs. C3 Pooid phytoliths – common in cool and humid conditions. Based on the high percentages of C4 Chloridoid phytoliths between around 4000 and 2000 <sup>14</sup>C yr BP, they inferred that this period was arid or highly seasonal with respect to the following two millennia before present. More recently, Bracco and his collaborators (BRACCO et al. 2011) carried out a more refined analysis of the Negra Lagoon, Blanca Lagoon and Rocha Lagoon, collectively dating them back to 7000 <sup>14</sup>C yr BP. These records have a hiatus for the crucial period between 3500 and 2600 <sup>14</sup>C yr BP. Using the same

climatic indexes they arrived to similar conclusion as in their previous study: before 2000  $^{14}\text{C}$  yr BP the climate was colder and dryer and after 2000  $^{14}\text{C}$  yr BP, the climate was hotter and more humid. However, they detected that the Rocha Lagoon appear to present drier and colder conditions during the 5300 to 4500  $^{14}\text{C}$  yr BP interval in comparison with the preceding period dated between 7000 and 5300  $^{14}\text{C}$  yr BP. In the Negra Lagoon, they also documented two peaks of extreme humid and wet climate between at 1200 and 600  $^{14}\text{C}$  yr BP. They also noticed that these coastal records are in partial agreement with the geomorphological models of Iriando and Garcia (1993) and Bombin and Klamt (1976), both of which are of extremely low chronological resolution. However, their interpretations are in marked contrast with the higher resolution pollen and phytolith records from the Los Ajos interior freshwater wetlands (IRIARTE 2006b; IRIARTE et al. 2004) and the pollen records from southern Brazil (BEHLING et al. 2004, 2005), which indicate that a more humid period started after 4000  $^{14}\text{C}$  yr BP not 2000  $^{14}\text{C}$  yr BP.

These differences could be attributed to several factors. In the first place, it could be related to the fact that these different reconstructions could be reflecting different local vegetation histories, i.e. the different environmental histories of these Atlantic coast lagoons vs. the interior freshwater wetlands of India Muerta. While phytoliths are generally deposited locally and thus tend to reflect local phytolith source areas (e.g., ALEMAN et al. 2013), pollen tend to produce a more regional signature of the vegetation (at least with respect to wind-pollinated taxa such as Poaceae, Cyperaceae, Moraceae, *Celtis*) (e.g., JACOBSON JR. and BRADSHAW 1981). The size of lakes and wetlands also is associated with the pollen catchment area (e.g., SUGITA 1993); the larger the lake, the larger the catchment area that it generally reflects. Unfortunately, the Los Ajos oxbow is small and though multi-proxy pollen and phytolith records has been analysed, it only represent the local vegetation history. Although the Negra Lagoon is larger, its phytolith record is likely to represent the local vegetation history around the lagoon. In addition, the interpretations of the temperature and humidity indexes made by Bracco and his collaborators (BRACCO et al. 2005, 2011) should be taken with extreme caution. As previously argued by Iriarte and his collaborators (IRIARTE 2006b; IRIARTE et al. 2008a), salt marshes in the region are dominated by particular Poaceae taxa specifically adapted to saline conditions that render a distinctive phytolith signature dominated by Chloridoid and Pooid phytolith morphotypes in an otherwise Panicoid dominated subtropical grasslands characteristic of the region. The presence of Chloridoid and Pooid phytolith morphotypes in Bracco et al. (2005) study are likely to simply reflect the local dynamics of a salt marsh between 4000 and 2000  $^{14}\text{C}$  yr BP in the Negra lagoon and should not be used as evidence for broader climatic reconstruction in the region in terms of temperature and humidity. A more nuanced approach to phytolith morphology like the one used by Puerto et al. (2013) should prove more fruitful – though these latter records suffer from the same interpretative problems highlighted above. The local nature of the phytolith records from

these coastal lagoons should prevent these authors to make generalisations about the broader region. The local phytolith records from these coastal lagoons that were likely connected to the Atlantic Ocean during the mid-Holocene cannot be used to infer the environmental conditions for the Merin Lagoon basin during the mid-Holocene. Instead these data should be used to resolve the controversy about the timing and nature of the relative sea-level during the Late Holocene in Uruguay (BRACCO et al. 2014; MARTÍNEZ and ROJAS 2013). From the above discussion, it become clear that Bracco et al. (2005, 2011) conclusions about regional landscapes derived from the phytolith records of these coastal lagoons should be revised. In turn, the Los Ajos record, though local in nature, is certainly more appropriate to reveal this mid-Holocene environmental history, the pivotal time when the 'Constructores de Cerritos' emerged.

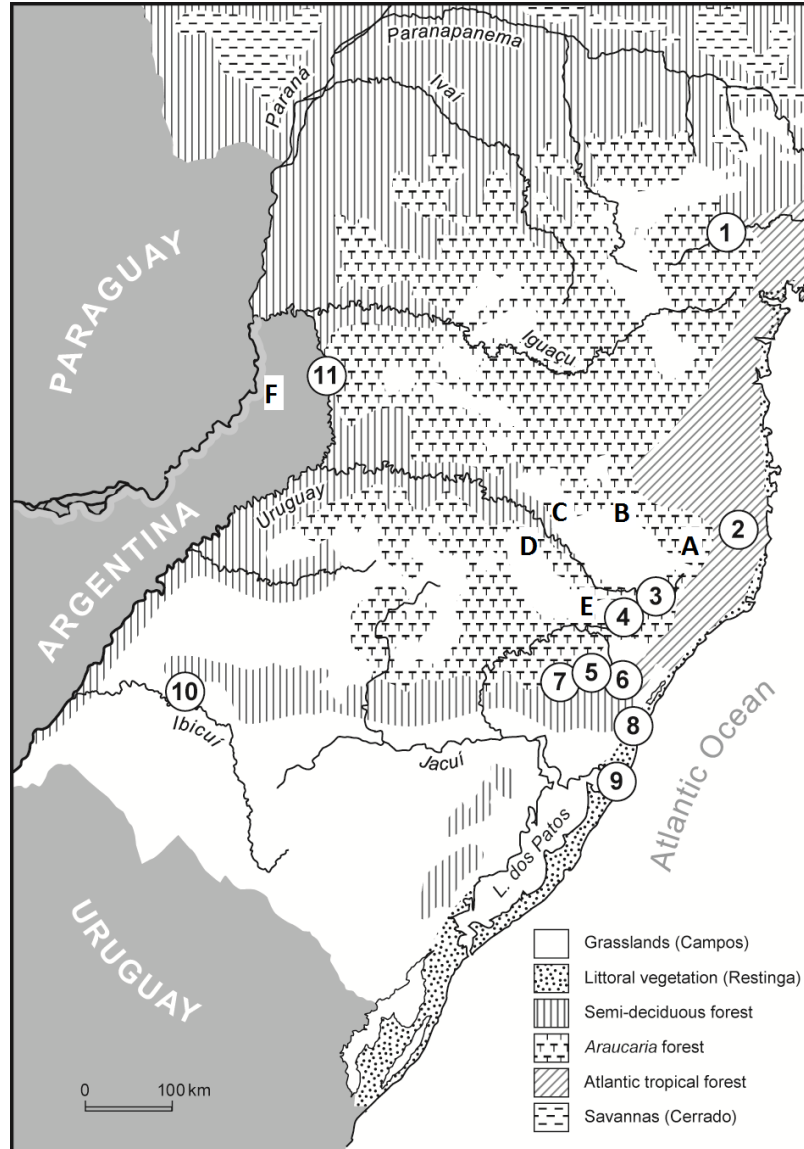
Another contended issue that is crucial to understand human-environmental relationships in the southern sector of the Merin lagoon basin are the sea-level fluctuations that took place during the Holocene. Current data by Martínez and Rojas (2013) indicate that the present sea-level was reached in Uruguay by around 6000 cal. yr BP and that there was a major marine highstand attaining 3.75 m on average at around 5000 cal. yr BP. However, this data is contested by (BRACCO et al. 2014). In southern Brazil, Angulo et al. (2006), claim that the sea level has been above that of the present and has been smoothly declining since the last ca. 5000–5800 cal. yr BP, with a maximum height of no more than 4 m. Despite this controversy, a general pattern emerges showing that the present sea-level was reached in the region between 6000 and 5000 cal. yr BP and that there was a marine high stand of 5-3 m.a.s.l. at around 5000 cal. yr BP, which certainly converted the lower sectors of Merin Lagoon basin closer to the Atlantic Ocean into salt lakes as shown in the gastropod record of the Negra lagoon (BRACCO et al. 2005), where freshwater conditions only became dominant after 2000 yr BP. As the sea levels become lower, we progressively see a colonization of the lower regions of the area by the 'Constructores de Cerritos' (BRACCO et al. 2011). In this regard, the upper (15 m above sea level) freshwater wetlands of the region, like the wetlands of India Muerta, which were not directly affected by these mid-Holocene marine highstands had more favourable conditions during the mid-Holocene and promoted the aggregation of populations along these restricted and limited resource-rich areas, which later expand to lower areas of the basin as the marine waters recede.

### **SOUTHERN JÊ LANDSCAPES: THE LATE HOLOCENE EXPANSION OF *ARAUCARIA* FOREST**

The second case study is related to the development of the southern proto-Jê groups, which spreads along the SBH and the adjacent lowlands (Figure 1 – region B in the map). The SBH encompasses the southern

Brazilian states of Rio Grande do Sul, Santa Catarina, and Paraná as well as part of Misiones Province, Argentina, and Paraguay. The SBH decrease in altitude from east to west, from more than 1800 m close to the Atlantic coastal plain to 100 m in the Paraná and Uruguay rivers floodplains. The climate is mesothermic very humid with mean annual temperatures between 15-20°C and 1500-2500 mm of mean annual precipitation. Temperature is mild in the central part of the plateau. The eastern area has higher elevations and a cold climate with sporadic snowfall during the winter months. Four major vegetation types dominate the region including highland grasslands (*Campos*), mixed *Araucaria* forest, semideciduous forest, and the Atlantic tropical forest (*Mata Atlântica*) (Figure 6). Campos vegetation dominates the southern lowland portion of the area. *Araucaria* forest mainly occurs above 400 m, but becomes more important as a canopy component above 600 m elevation. *Araucaria angustifolia* (Paraná pine) species covers large areas between 24° and 30° S at elevations between 600 and above 1700 m in southern Brazil, and in isolated islands between 18° and 24° at elevations 1400 to 1800 m in southeastern Brazil (HUECK 1953). Semideciduous subtropical forest grows along the Paraná and Uruguay rivers' systems and the southern escarpment of the plateau following the tributaries up to 500-800 m elevation and the tropical Atlantic forest occurs in southern Brazil as a belt along the Atlantic coastal plain and in the eastern slopes of the plateau at elevations up to 1000 m.

First defined by (MENGHIN 1957) as El Doradense in Misiones Province, this archaeological tradition is known as Itararé and Casa de Pedra in Paraná (CHMYZ 1967) and Taquara in Santa Catarina and Rio Grande do Sul states (MILLER 1967). In this article, we will refer interchangeably to the broadly defined Taquara-Itararé archaeological tradition (BEBER 2005) as the southern proto-Jê. The prefix proto is meant to encompass in this tradition all the ancestors of modern southern Jê people also including the former speakers of the extinct southern Jê languages, *Ingain* and *Kimdá* (in JOLKESKY 2010; see also IRIARTE et al. 2013; SILVA 2001). Dating back to c. 2220 cal. yr BP (2180 <sup>14</sup>C yr BP) and extending to present, this broadly-defined tradition is mainly characterized for its diagnostic ceramics, the construction of pit houses in the highlands, and its elaborated mound and enclosure complexes. Details about the southern proto-Jê can be found in the literature published by Brazilian researchers over the last two decades and our own research in the region (e.g., BEBER 2005; COPÉ 2006, 2015; CORTELETTI 2008, 2012; CORTELETTI et al. 2015; DEMASI 2009; DESOUZA et al. 2016; IRIARTE et al. 2008b, 2013; NOELLI 2000; RIBEIRO 1999/2000; SALDANHA 2005, 2008; SCHMITZ 1999/2000; SCHMITZ et al. 2002, 2010, 2013a). The reader is referred to these works for more detailed information.



**Figure 6:** Southern Brazilian Highlands and its major vegetation types showing some archaeological localities and pollen sites previously investigated (modified from IBGE, 1990). Key: Archaeological regions: A. Urubici; B. São José do Cerrito; C. Lower Canoas River; D. Pinhal da Serra; E. Bom Jesus; F. El Dorado; Pollen cores: 1. Serra dos Campos Gerais\*; 2. Serra de Boa Vista; 3. Morro da Igreja; 4. Serra do Rio do Rastro; 5. Aparados da Serra; 6. Cambará do Sul\*; 7. São Francisco de Paula; 8. Terra de Areia; 9. Lagoa dos Patos; 10. São Francisco de Assis\*; 11. Cruce Caballero (\* indicate sites cited in the text).

Southern proto-Jê ceramics are characterized by simple, tall, small vessels exhibiting fine walls. They are generally tempered with sand and hematite grains, have homogenous paste, and reduced firing. Decoration is more frequent in the southern Taquara phases and includes several incised types, punctuations, as well as fingernail and basket impressions. The economy of these groups is thought to be based mainly on the exploitation of *Araucaria* seeds complemented with horticulture, hunting, and fishing (BEBER 2005; CORTELETTI 2012; CORTELETTI et al. 2015; RIBEIRO 1999/2000; SCHMITZ 2001/2002).

Generally constructed on lateritic soils and decomposed basalt, pit houses are concentrated between 600-1200 m elevation closely overlapping the distribution of *Araucaria* forest (BITENCOURT and KRASPENHAR 2006). Pit houses are generally located in the upper slope and flat tops of interfluvial ridges close to small streams. The diameter of a pit house ranges between 2 m and 25 m, but the majority do not exceed 5 m. Pithouses are habitation sites containing the remains of everyday activities including hearths, post-holes, ceramic sherds, lithic tools and debris, and charred *Araucaria* seeds. Pithouses may be isolated or form villages of up to 107 houses. The ground plan of pit house villages may exhibit a linear layout paralleling a stream, may be arranged in parallel lines, or form an approximate circle. Detailed topographical survey of pit house settlements also suggests that these are well-planned settlements, with evidence of terracing, track ways and particular alignments with others enclosures or mounds at the landscape level (COPÉ 2006, 2007; IRIARTE et al. 2008b, 2013; SALDANHA 2008). São José do Cerrito SC-CL-70/71 (Rincão dos Albinos) pit house village is one of these examples. It is constituted by two groups of houses; one consists of 39 pits concentrated in an area of 50 m x 80 m (Schmitz, 2014); the other group has 68 pit houses organised in discrete clusters and accompanied by mounds. Small clusters of houses have a linear or semi-circular layout, in one case surrounding a large mound. Not far from the two groups of houses, in the highest part of the hill, there is a concentration of mounds (SCHMITZ 2014). The site also exhibits early dates, around the 6th to 8th centuries AD. Reviewing the palynological data, Schmitz et al. (2013b) have speculated that SC-CL-70/71 was located in an attractive area during the early stages of expansion of *Araucaria angustifolia*, and that the many pit houses reflect a palimpsest of small camps of Southern Jê groups that exploited the forest resources during part of the year, but were otherwise still mobile. In this model, a permanent focus for these mobile groups would have emerged later in the form of ceremonial sites, namely the mound and enclosure complexes, but also possibly the platform mounds (SCHMITZ et al. 2010, 2013a).

Surface sites associated with pit house clusters are common and have been interpreted as probable special-activity areas such as agricultural plots and quarry sites (e.g., BEBER 2005; DEMASI 2005; KERN et al. 1989; RIBEIRO and RIBEIRO 1985; SALDANHA 2005). At lower altitudes, in the upper river valleys and the southern escarpment of the plateau where *Araucaria* forest is sparser and semideciduous forest dominates, pit houses become rare and surface sites are more abundant. In some areas like the lower Antas and Pardo rivers, situated below 600 m elevation, southern proto-Jê surface sites are characterized by discrete circular patches of dark earth (*terra preta*) forming villages that cover up to 4000 m<sup>2</sup> (e.g., MILLER 1967).

Other types of site associated with southern proto-Jê people were characterized by circular, elliptical, rectangular, and key-shape earthworks generally located in the most prominent hills of the area. The rims were 30-50 cm tall, 3-4 m wide, and 20-200 m in diameter. Their formal layout and lack of domestic debris indicate

that these sites were ceremonial spaces where geographically dispersed groups came together to bury an important chief, host inter-group gatherings, foster group reciprocity, forge inter-group alliances or perform cyclical rituals (e.g., COPÉ et al. 2002; IRIARTE et al. 2008). Some of them, like the complex of earthworks in EIDorado (Misiones, Argentina) are constituted by more than 8 circular enclosures (IRIARTE et al. 2008b; MENGHIN 1957; WACHNITZ 1984). Recent work in Pinhal da Serra shows that these mound and enclosure complexes have been positioned in carefully chosen locations in the landscape, exhibit recurrent paired oppositions, alignments, orientations and viewsheds (DESOUZA and COPÉ 2011; IRIARTE et al. 2013; SALDANHA 2005, 2008). Furthermore, detailed topographical surveys of entire plateaus, like the Avelino locality (RS-PE-29), are revealing a cultural landscape in which funerary/ceremonial structures and habitation pit-house villages were carefully oriented and aligned (IRIARTE et al. 2013).

Eleven pollen sequences from the Brazilian states of Rio Grande do Sul, Santa Catarina, and Paraná and Misiones Province, Argentina, document the beginning of a more humid period starting around 4480-3780 cal. yr BP (4000-3500 <sup>14</sup>C yr BP), which became more intense between about 1410-900 cal. yr BP (1500-1000 <sup>14</sup>C yr BP) depending on the region (Figures 6-8). Significantly, the archaeological data indicate that this pronounced late-Holocene environmental change is associated with a more intense occupation of the SBH as evidenced by the more intense occupation of the southern Brazilian plateau by the southern proto-Jê groups.

Located in the highlands of north-eastern Rio Grande do Sul state, Cambará do Sul (1040 m) (hereafter CDS) provided one of the more recent and well-dated pollen sequences for the region (Figure 7) (BEHLING et al. 2004; BEHLING and PILLAR 2007). Similar to the records in the highlands of Paraná and Santa Catarina states, an initial expansion of *Araucaria* forest, which at that time, formed gallery forests along streams within a landscape dominated by grassland vegetation, was observed around 4320 cal. yr BP (3950 <sup>14</sup>C yr BP). By that time, the Atlantic forest was well established on the upper coastal slopes, located 6-10 km from the study site. Carbonized particles abruptly increased in abundance during this period.

Between c. 1100 and 430 cal. yr BP (1140 and 410 <sup>14</sup>C yr BP), the representation of Campos pollen taxa, primarily Poaceae, was markedly lower than in the previous period and its abundance continued to decrease toward the top of the zone (from 55 to 24%). Pollen of *Araucaria* forest increased continuously (from 39 to 80%) indicating a remarkably strong expansion of this forest, such that within a period of 100 years it replaced the Campos vegetation. At c. 1100 cal. yr BP, there were fewer carbonized particles than before, although fires continue to be frequent in the wider region where patches of grassland still existed (BEHLING et al. 2004). The Figure 8 summarizes *Araucaria angustifolia* pollen curves from other representative pollen sequences from the SBH.

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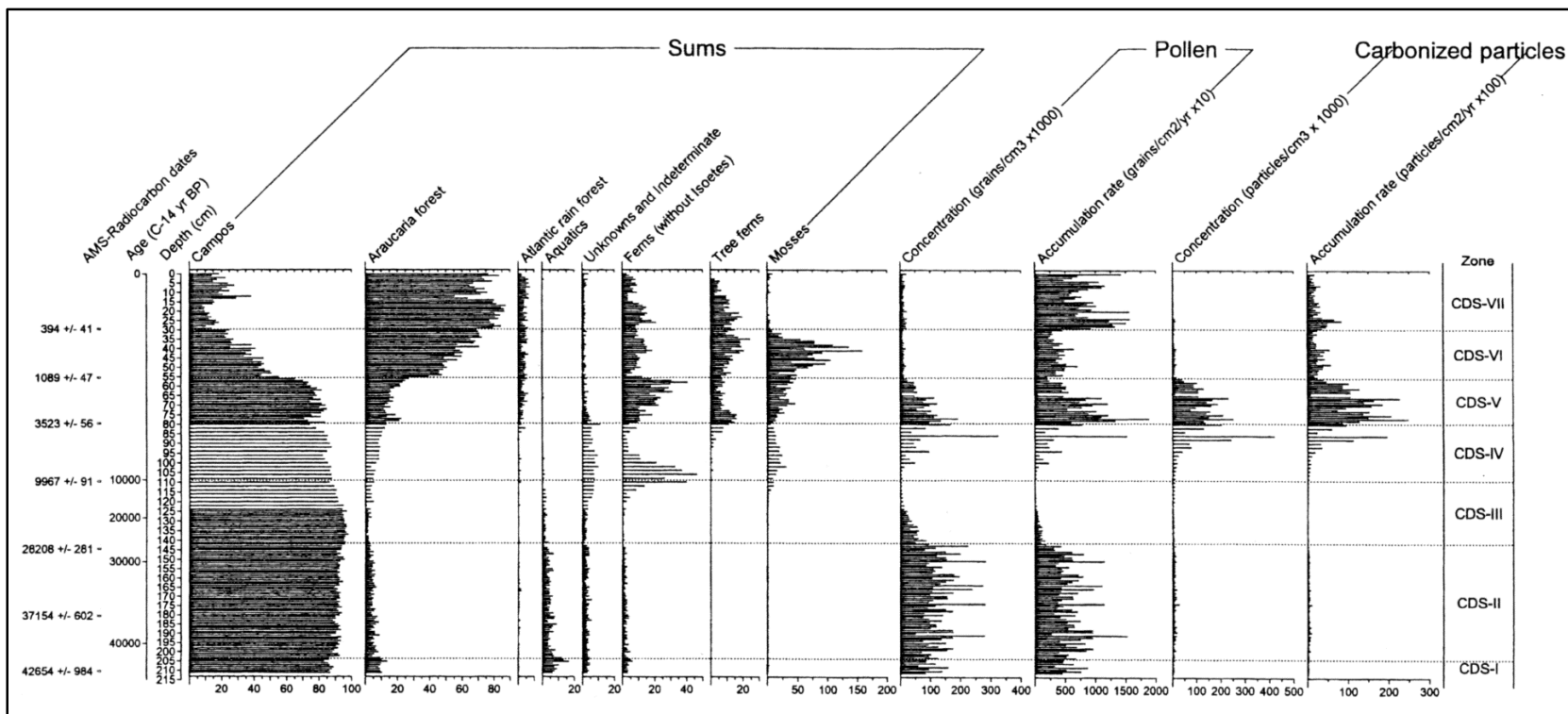
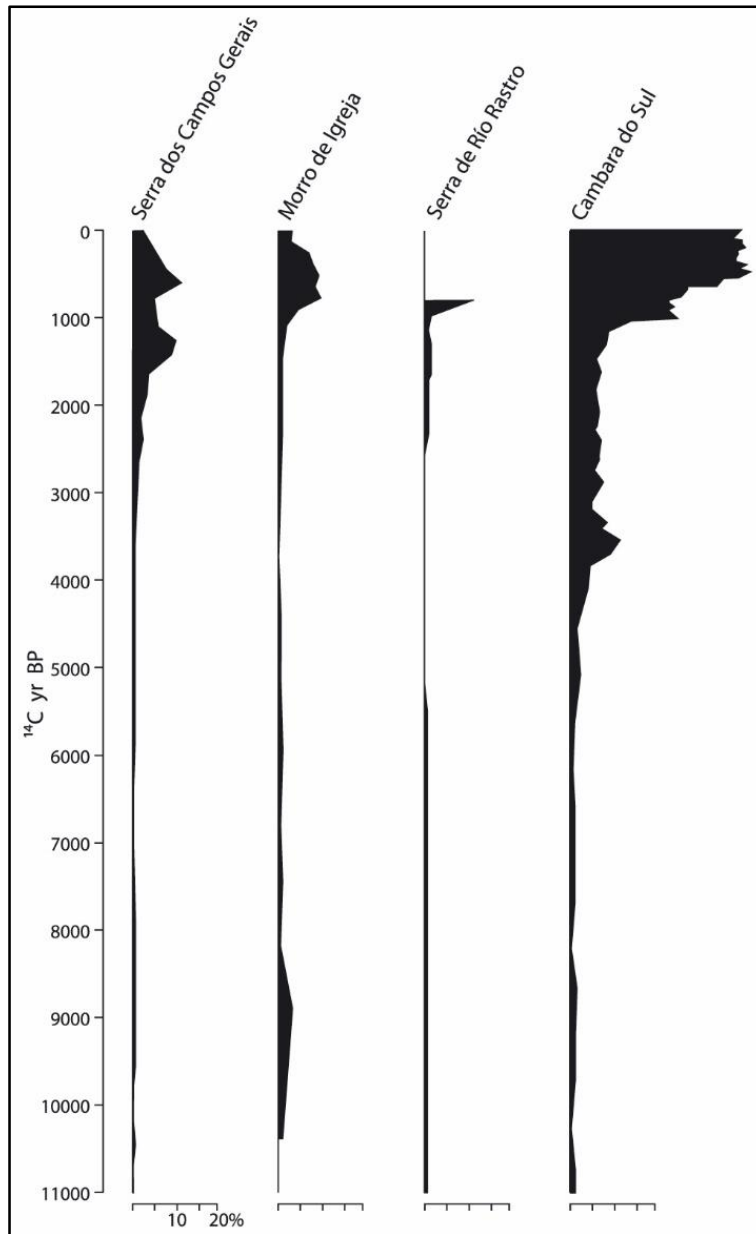


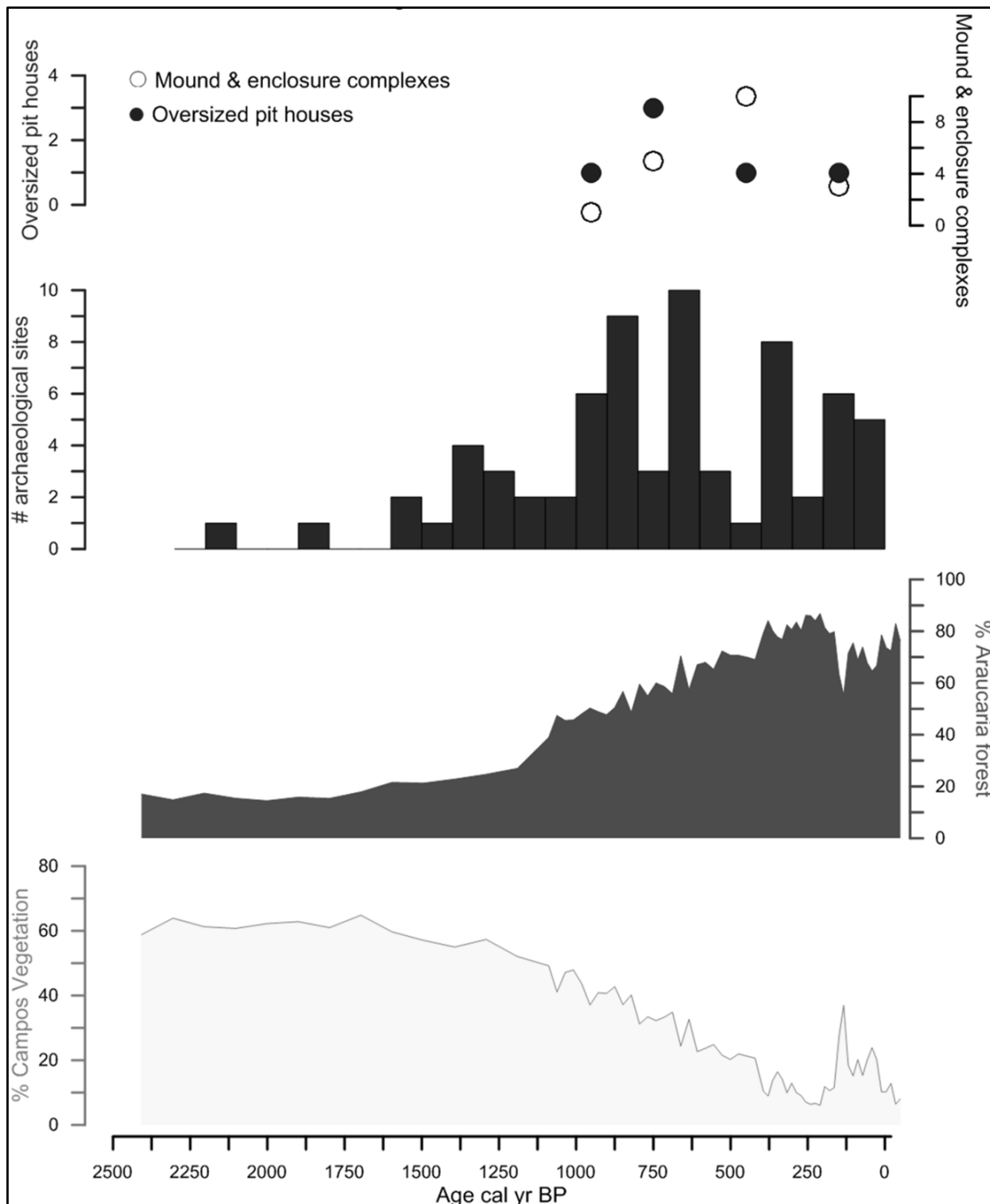
Figure 7: Cambará do Sul pollen and particle charcoal diagram (from Behling and Pillar, 2007).





**Figure 8:** *Araucaria angustifolia* pollen percentage curves from selected pollen diagrams.

The available 193 radiocarbon dates indicate that southern proto-Jê sites began to spread in the second millennium BP, became more common around 1400 cal. yr BP and peaked between 900 and 600 cal. yr BP before the arrival of Europeans to the region and when the *Araucaria* forest was already fully expanded. The proliferation of southern proto-Jê sites appears to be related to the exploitation of a newly available, abundant, and rich resource: *Araucaria* seeds. Furthermore, unprecedented high magnitude charcoal frequencies despite this more humid period appear to mark the onset of human landscape transformation that could be associated with agricultural practices between around 4320 and 2980 cal. yr BP (3950 and 2850 <sup>14</sup>C yr BP) (Figure 9).



**Figure 9:** Composite graph showing dates of all archaeological sites, mound and enclosure complexes, and oversized pithouses combined with *Araucaria* forest and Campos (high altitude grasslands) pollen curves from Cambará do Sul record (Behling et al. 2004). The composite graph illustrates the correlation of major cultural transformations (increase in archaeological sites, appearance of oversize pit houses and the arrival of monumental architecture) with the expansion of *Araucaria* forest.

*Araucaria* seeds, called ‘pinhão’, were a major element in the diet of the ethnohistorically and ethnographically recorded indigenous people living in and around the range of the *Araucaria* trees (MABILDE 1988; MÉTRAUX 1946). *Araucaria* trees are very productive. Each tree produces up to thirty large cones, each of which contains an average of 112 seeds (5.8 cm long) (FAO 1986). Unfortunately, we do not possess data about the modern density of *Araucaria* trees in different regions, but the pollen data suggest

that they were very abundant in the SBH since c. 1410-900 cal. yr BP (1500-1000 <sup>14</sup>C yr BP). *Araucaria* seeds are a good source of starch (37%), dietary fibre, Mg, and Cu. They also have a low content of protein (~3%) and lipids (~1.3%), which is comparable to other starchy foods such as rice and beans (BELLO-PÉREZ et al. 2006; CORDENUNSI et al. 2004). The seeds are mainly harvested during the months of March and June, but production is meagre during the spring and summer (October-February). However, the seeds of different subspecies of *Araucaria angustifolia* are ripe during different months of the year, which potentially make them available all year round (BEBER 2005). The seeds could be eaten raw, roasted, or grounded into a paste. Ethnohistoric sources describe how pine nuts could be stored in tightly closed baskets soaked in water for a month and a half (MABILDE 1988). *Araucaria* trees also provide an accessible and renewable wood supply. Because *Araucaria* nuts are also an important item in the diet of several faunal resources targeted by humans, including a variety of mammals, reptiles, and birds, its fruiting period should have coincided with an increase in the availability of game.

As *Araucaria* forest began to expand in the highlands, pre-Hispanic groups may have been motivated to migrate or foray seasonally to the highlands to collect *Araucaria* seeds in areas of concentrated production. The replacement of grassland by *Araucaria* forest that took place between 1410 and 900 cal. yr BP (1500 and 1000 <sup>14</sup>C yr BP) may have allowed higher permanent settlement in the highlands. At some records, like Cambará de Sul, it happened in about 100 years, the rapidity and timing of which raises the possibility of an anthropogenic cause (BITENCOURT and KRASPENHAR 2006; IRIARTE and BEHLING 2007). The cultural development adapted to this new environment is inferred based upon the proliferation of southern proto-Jê pit house villages. Sites located within ecotones comprised by *Araucaria* forest, Campos (grasslands), and subtropical deciduous forests would have been privileged locations in terms of abundance and diversity of resources. Ethnohistoric sources describe how paramount Kaingang chiefs divided the *Araucaria* exploitation territories among their subordinates and determined their settlements' locations, therefore controlling access to important resources. The limits of the territories were signalled in the bark of the *Araucaria* trees with carved motifs that also appeared in the decoration of the Kaingang chiefs' arrows (MABILDE 1988).

Recent data point to an increased role on domesticated plants than previously thought. Carbon isotopes on human remains (DEMASI 1999) and on charred residues from ceramic containers (DEMASI 2007) dating to c. 1225 and 2285 cal. yr BP, respectively, show a strong C<sub>4</sub> signature suggesting the consumption and preparation of maize (*Zea mays*) by southern proto-Jê groups in Santa Catarina state, Brazil. Maize cobs and squash seeds (*Cucurbita* sp.) associated to burial contexts dated to c. 1740 cal. yr BP were recovered at the at the Matemático rockshelter in Bom Jesus, Rio Grande do Sul state (MILLER 1971). Maize cob phytoliths from charred residue containers have been retrieved from PM01 site in Eldorado, Misiones province, Argentina, dating between 680 and 480 cal. yr BP (IRIARTE et al. 2008b). In addition, maize pollen grains have been documented in the São Francisco de Assis, Rio Grande do Sul, record at ca.

1814 cal. yr BP (Behling et al., 2005) and at the Morro Santana (Porto Alegre, Rio Grande do Sul) site between 1239 and 580 cal. yr BP (BEHLING et al. 2007). Starch grain and phytolith residue analyses from 14 ceramic fragments recovered in two domestic cooking structures from a pit house at the Bonin site, Urubici, Santa Catarina, dating to 1350 and 1340 cal. yr. A.D documented the consumption of manioc (*Manihot esculenta*), beans (*Phaseolus* sp.), and possibly yams (cf. *Dioscorea* sp.) in addition to maize and squash (CORTELETTI 2012; CORTELETTI et al. 2015). Overall, the combination of *Araucaria*-nut collection and other wild plants, combined with the growing of tropical cultigens and hunting, would have been able to support rather sedentary populations in the highlands. Contrary to traditional models of southern proto-Jê mobility, these novel data suggest that food production may have allowed populations to settle in the southern Brazilian highland plateau year round without the need for seasonal movements to the Atlantic forest escarpment and the Atlantic coast environments to procure food (CORTELETTI 2012; CORTELETTI et al. 2015). Collectively, the combined palaeoecological and archaeobotanical data complement archaeological evidence for increased sedentism and social complexity among southern proto-Jê groups, including the construction of large, well-planned pit-house villages, and the creation of a highly structured landscape revolving around funerary/ceremonial structures.

The full expansion of *Araucaria* forest coincides with the development of novel forms of domestic and ceremonial architecture which suggest changes in the social and political organisation of the southern proto-Jê groups. Mound and enclosure complexes appear after c. 1060 cal. yr BP and become more frequent between c. 600 and 300 cal. yr BP (CORTELETTI 2012; CORTELETTI et al. 2015; DESOUZA et al. 2016). Oversized pithouses, reaching 18 m to 20 m of diameter and sometimes accompanied by clusters of smaller structures, appear between c. 1270 and 900 cal. yr BP (COPÉ 2006; DEMASI 2005; SCHMITZ et al. 2013). The abundance of resources represented by the *Araucaria* forest, coupled with a more intensive use of domesticated plants, which are also present in the archaeobotanical record, might have provided the basis for the mortuary feasting events at mound and enclosure complexes, as well as leading to increased population density and territoriality, and the emerge of disparities in house size. All of those processes, plus the foreign pressure of Tupiguarani groups, potentially relate to the foundations of political complexity among the southern proto-Jê groups (COPÉ 2006; CORTELETTI 2012; DESOUZA et al. 2016; IRIARTE et al. 2008b, 2010).

To what extent did southern proto-Jê groups manipulate or encourage the expansion of *Araucaria* forest is an important issue that requires further clarification through further research closely integrating archaeology and paleoecology. During the late Holocene there is also a clear pattern in certain regions characterized by the increase of carbonized particles when *Araucaria* and the tropical forest began to expand and a decline in carbonized particles as climates became wet and less seasonal about 1410 and 900 cal. yr BP (1500 and 1000 <sup>14</sup>C yr BP). The Serra dos Campos Gerais (hereafter SCG) pollen record shows an abrupt increase in charcoal particles between 2980 and 1440 cal. yr BP (2850 and 1530 <sup>14</sup>C yr BP) with a

subsequent decline associated with the expansion of *Araucaria* forest beginning around 1440 cal. yr BP (BEHLING 1997b). A similar pattern was recorded in the southern highlands at CDS, where the pollen diagram showed a sudden rise in charcoal abundance between c. 4320 and 1100 cal. yr BP (3950 and 1140 <sup>14</sup>C yr BP), followed by a sharp decline. The archaeological data indicate that this pronounced late-Holocene environmental change is associated with a more intense occupation of the SBH as evidenced by the more intense occupation of the southern Brazilian plateau by the Southern Jê groups.

Two aspects suggest that these fires were not natural and were predominantly set by humans. The first was that by the time the fires increased dramatically in SCG and CDS, the climate was wetter and less seasonal than previous periods; arguing against an increase in natural fires triggered by droughts. The second was the frequency and magnitude of these charcoal increases. The abrupt and frequent occurrence of charcoal particles at 4320 (CDS) and 2798 (SCG) cal. yr BP in systems that had not previously been fire prone is a strong indicator of human occupation (BUSH et al. 2000; BUSH et al. 2007). These data may represent the onset of slash-and-burn agriculture within the semideciduous forest that grew along the major tributaries up to 500-800 m elevation, and in the Atlantic tropical forest in the case of CDS. However, a more intriguing possibility to ponder is that the groups that inhabited the region before the southern proto-Jê were employed fire to stop the advance of the forest. In addition, the decline in charcoal in correlation with the increase in *Araucaria* forest may certainly represent the management of these forest without the use of fire. Unfortunately, the archaeological record of that period is very incomplete and poorly understood. New data from surface sites in the lower Canoas River dating to c. 2540 cal. yr BP (2450 <sup>14</sup>C yr BP) appears to indicate that the occupation of the lowland by southern proto-Jê groups may have preceded the colonization of the highlands. Further clarification of these patterns requires more archaeological and palynological research in lowland areas.

### COASTAL MID TO LATE HOLOCENE SOCIETIES FROM SOUTHERN BRAZIL

Sambaquis, or shell-mounds, of the Brazilian coast have been described since the sixteenth century. Many have disappeared as a result of urban development and intensive mining for construction fill and lime production. They occur all along the extensive Atlantic coast, usually clustering in rich bay or lagoonal areas, where a range of land and aquatic resources is available. Sambaquis are more common along the southern Brazilian coast, from Rio de Janeiro to Santa Catarina, including Paraná and São Paulo (GASPAR 1998, 2000; LIMA and MAZZ 1999; PROUS 1992) (Figure 1). Shell mounds further north have only occasionally been described (e.g., BANDEIRA 2008; CALDERÓN 1964; SIMÕES and CORREA 1971), while to the south of this region the mounds become smaller and infrequent (PESTANA 2007; ROGGE and SCHMITZ

2010). Along the Atlantic coast of Rio Grande do Sul, Brazil and Uruguay, the mounds were replaced by the Cerritos.

Sambaquis typically occur in highly productive bay and lagoon ecotones where the mingling of salt and freshwater supports mangrove vegetation and abundant shellfish, fish, and aquatic fowl. This cultural tradition spans a time interval roughly between c. 8000 and 1600 years ago, but the bulk of radiocarbon determinations on coastal shell mounds are concentrated between approximately 5000 and 2000 cal yr BP, which can be considered “the golden age” of the sambaqui culture (GASPAR et al. 2008; LIMA 2000; PROUS 1992) (Figure 10).

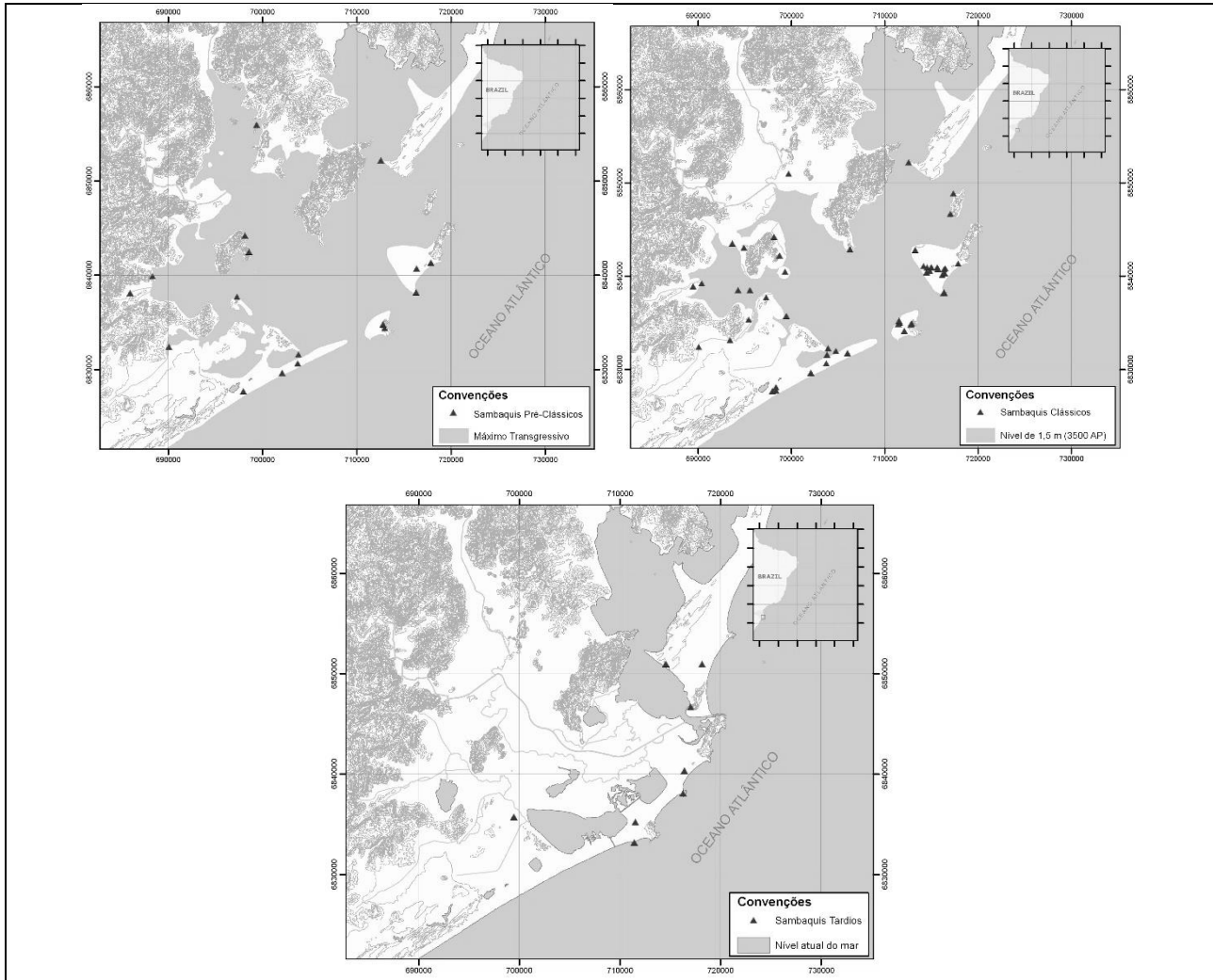


**Figure 10:** The sambaquis Figueirinha I and Figueirinha II, in Jaguaruna, Santa Catarina.

The Southern Brazilian shoreline conforms a long and narrow (10 to 20 km at most) lowland strip between the ocean and the hilly country that rolls right before the escarpment of the highland plateau, here designated as SBH. All along this strip, a series of lagoonal systems disperses among marine and eolian depositional sequences and occasional rocky outcrops, where elongated strandplain beaches and dune fields can be found (GIANNINI et al. 2010). Shellmounds are mostly located along these lagoonal areas, to which they are closely related. A sample research area located at the southern coast of the Santa Catarina State has been studied in considerable detail in terms of both regional settlement patterns and formation processes (DEBLASIS et al. 2007; GASPAR et al. 2008), providing most of the data herein discussed.

Climate history on the coast is poorly known, but seems to follow closely the fluctuations documented in the nearby SBH area described above. The area was densely covered by Atlantic rain forest

(*Mata Atlântica*), and the forested sand strips (*Restingas*) show a rather distinctive vegetation composition. Anthracological studies from one of the shell mounds revealed that, by 5000 cal. yr BP, mangrove vegetation, extinct in the area today, was part of the natural setting at the lagoon, thus suggesting an environment more open to the sea, and possibly warmer (SCHEEL-YBERT et al. 2006).



**Figure 11:** Coastal changes and sambaqui settlement evolution in the southern shores of Santa Catarina (images from Assunção, 2010, chapter 5).

In fact, oscillation of the sea level seems to have influenced coastal landscape transformations more than any other factor. Angulo et al. (2006) have provided a detailed curve for the sea level changes for the study area, which has prompted the approximate reconstitution of the coastal changing configuration along the sambaqui occupation era (GIANNINI et al. 2010; KNEIP 2004). By the maximum sea transgressive episode (2.5 meters higher around 5700 BP), the area was formerly a deep bay wide open to the sea, which has progressively evolved to a closed lagoon system; today, just a small canal connects the lagoon to the sea. From even before the maximum transgressive, sambaqui occupation displayed a close link to the fringe of the water bodies, a pattern that has continued throughout its occupational history (Figure 11).

Thus the sambaquis have been recognized as a product of societies very well adapted to coastal environments (GASPAR 2000), displaying demographic and organizational patterns much more complex than thought until not long ago (DEBLASIS et al. 1998; GASPAR et al. 2008). Recent research has shown that the sambaquis are long-lived mounded sites encoding messages with deep symbolic meaning (GASPAR et al. 2014).

These mounds are built by means of recurrent and incremental deposition of food remains and other cultural debris, associated to a very ritualistic programming of mortuary practices and periodical return to these sacred places connected to the ancestors, both real and mythological (FISH et al. 2013; GASPAR et al. 2008). Its complex stratigraphy includes remains of in situ activities as much as remobilized materials from activity areas outside the mound itself, configuring intricate sequences of mounding architecture, where habitation contexts seem to be absent (KLÖKLER 2008; VILLAGRÁN et al. 2009). Chronology for the sambaqui culture goes as back in time as around 8000 cal. yr BP, intensifying around 5000 and 2000 yr BP approximately, with dozens of sites concomitantly active (DEBLASIS et al. 2007; GIANNINI et al. 2010). Some of these mounds have been used for more than two thousand years, thus acquiring gigantic proportions (up to sixty meters high). These long-standing funerary structures thus configure an enduring cultural pattern on the same focal places into the open lagoonal landscapes, thus becoming monumental references for ancestry, social memory and territoriality (FISH et al. 2013).

By two thousand years ago, shell mounds give place to “dark-earth” smaller heaps made of massive food remains (mostly fish) enmeshed in dark sandy packages rich in organic matter and charcoal (VILLAGRÁN et al. 2009). Besides the distinctive faunal profile, these sites are also marked by the presence of Taquara-Itararé ceramics typical of the Je occupations at the hinterland plateaus and escarpments of Southern Brazil, where these ceramic styles are associated to pit houses and earthen engineering (COPÉ 2007; CORTELETTI 2012; IRIARTE et al. 2013). Depositional sequences on the coast seem to display a long connection and mutual influences between sambaqui and Je cultures, interrupted around six hundred years ago by the abrupt arrival of the fierce Guarani people, which massively occupied the coastal plains from the southern shores up to the arrival of the first European settlers (DEBLASIS et al. 2014; MILHEIRA and DEBLASIS 2011).

## FINAL WORDS

Recent archaeological and palaeoecological data in the southern portion of the Rio de la Plata basin is allowing us to carry out much more informed comparative analyses between regional-scale cultural sequences and their environments. The interdisciplinary project in southeastern Uruguay is showing that as in other regions of the world (SANDWEISS et al. 1999), the mid-Holocene was characterized by significant



climatic and ecological changes, and that these perturbations were associated with important cultural transitions involving permanent mounded settlements situated within resource rich, circumscribed wetlands. The Los Ajos record provide us with a detailed reconstruction of the Pleistocene/Holocene transition, which will now allow for a broader consideration of the role that human–environment interactions played in the peopling of Uruguay and later developments throughout the Holocene. Along with other records in southeastern South America, the record from southern Uruguay shows that the mid-Holocene was a time of profound environmental changes. In the region, this period of environmental flux was associated to cultural transitions involving permanent mounded settlements situated within resource-rich, circumscribed wetlands by people who subsisted on mixed economies and adopted major crop plants such as maize and squash around 4000  $^{14}\text{C}$  yr BP (IRIARTE 2003; IRIARTE et al. 2001, 2004). This study also reinforces the utility of using phytoliths as significant indicators of vegetation dominated by grasses and non-grasses alike. Like in many other grass dominated and forested regions of the world, multiproxy studies combining phytolith and pollen data will allow researchers to obtain finer-grained and more complete reconstructions from archaeological and paleoecological contexts.

An examination of pollen cores from the SBHs coupled with the archaeological record for the region indicates that the development of the southern proto-Jê is strongly associated with the advance of *Araucaria* forest in the region during the late Holocene. The frequency of radiocarbon dates indicates a more intense human occupation of the SBHs after c. 1410 cal. yr BP, which peaks after around 900 cal. yr BP. Not only does the human occupation intensify during this period, but also novel forms of domestic and ceremonial architecture make their appearance, suggesting important changes in the organisation of the southern proto-Jê groups.

Our interpretations are in agreement with Araújo et al. (2005), who based on 273 dates from sites of various archaeological traditions in the southern states of Brazil, shows that there are two major peaks on the frequency of dates: an earlier one between 10500 and 9000  $^{14}\text{C}$  yr BP (12430 - 10190 cal. yr BP) and a later one representing an increase ca. 1500  $^{14}\text{C}$  yr BP (1360 cal. yr BP). Araújo et al. (2005) argue that these data is in good agreement with the paleoenvironmental scenario proposed for inland Southern Brazil when the climate became moister and warmer through the Holocene, especially after 3000  $^{14}\text{C}$  yr BP (3210 cal. yr BP) and *Araucaria* forest started to expand.

The appearance of pithouse villages in addition to large and elaborate ceremonial centres appears also to be a reflection of more permanent and territorial populations in the region. The increased abundance of *Araucaria* seeds and a major reliance on food production appear to have played a major role in the subsistence economy of these groups allowing them to settle the highlands more permanently and at greater densities than before. Ecotonal areas where *Araucaria* forest, semideciduous forest, and grasslands converge may have been particularly attractive places in terms of abundance and diversity of resources. Mounting evidence also points to an increasing use of domesticated plants by these populations in addition

to the collection of *Araucaria* nuts, other wild plants, hunting, and fishing. The charcoal records from SCG and CDS suggest that slash-and-burn agriculture at lower altitudes in the Atlantic forest started c. 4320 cal. yr BP. Further clarification of these patterns requires more archaeological and palynological research in lowland areas, something that we have already started to carry out (for more details see CÁRDENAS et al. 2015).

As regards the coastal moundbuilding societies from southern Brazilian shores, the evolution of the dynamic Quaternary environment seems to have been quite steady and continuous, allowing for the enduring sambaqui cultural permanence and development on rich ecotone areas of salty and fresh waters. The progressive enclosuring of the lagoonal area must have caused considerable drifting of mangrove and forest patches, but a regional overall stability as regards resource disponibility seems to have been in place until, at least, around 2000 yr BP. Such a stability might have helped the contact with acknowledgeable local species (both vegetal and animal), favoring the development of capture technologies and, possibly, the use of domesticated plant foods, as suggested by micro remains present in dental calculus (BOYADJIAN 2007; WESOLOWSKI et al. 2007, 2010).

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## REFERENCES

- ALEMAN, J. C. et al. Estimating phytolith influx in lake sediments. *Quaternary Research*, v. 80, n. 2, p. 341-347, 2013.
- ANGULO, R. J.; LESSA, G. C. and SOUZA, M. C. D. A critical review of mid- to late-Holocene sea-level fluctuations on the eastern Brazilian coastline. *Quaternary Science Reviews*, v. 25, n. 5–6, p. 486-506, 2006.
- ARAÚJO, A. G. D. M. et al. Holocene dryness and human occupation in Brazil during the "Archaic Gap". *Quaternary Research*, v. 64, p. 298-307, 2005.
- ASSUNÇÃO, D. C. *Sambaquis da paleolaguna de Santa Marta: em busca do contexto regional no litoral sul de Santa Catarina*. Master Dissertation. São Paulo: Universidade de São Paulo, Museu de Arqueologia e Etnologia; 2010.
- BANDEIRA, A. M. *Ocupações humanas pré-históricas no litoral maranhense: um estudo arqueológico sobre o sambaqui do Bacanga na ilha de São Luís - Maranhão*. Master Dissertation. University of São Paulo, 2008.
- BEBER, M. V. O sistema do assentamento dos grupos ceramistas do planalto sul-brasileiro: o caso da Tradição Taquara/Itararé. *Documentos*, v. 10, p. 5-125, 2005.
- BEHLING, H. Investigations into the Late Pleistocene and Holocene history of vegetation and climate in Santa Catarina (S Brazil). *Vegetation History and Archaeobotany*, v. 4, n. 3, p. 127-152, 1995.
- BEHLING, H. Late Quaternary vegetation, climate and fire history from the tropical mountain region of Morro de Itapeva, SE Brazil. *Palaeogeography, Palaeoclimatology, Palaeoecology*, v. 129, n. 3-4, p. 407-422, 1997a.
- BEHLING, H. Late Quaternary vegetation, climate and fire history of the *Araucaria* forest and campos region from Serra Campos Gerais, Paraná State (South Brazil). *Review of Palaeobotany and Palynology*, v. 97, n. 1-2, p. 109-121, 1997b.
- BEHLING, H., PILLAR, V. D., MÜLLER, S. C., AND OVERBECK, G. E. Late-Holocene fire history in a forest-grassland mosaic in southern Brasil: Implications for conservation. *Applied Vegetation Science*, v. 10, n. 1, p. 81-90, 2007.
- BEHLING, H.; PILLAR, V.D.; ORLÓCI, L. and BAUERMANN, S.G. Late Quaternary *Araucaria* forest, grassland (Campos), fire and climate dynamics, studied by high-resolution pollen, charcoal and multivariate analysis of the Cambará do Sul core in southern Brazil. *Palaeogeography, Palaeoclimatology, Palaeoecology*, v. 203, n. 3–4, p. 277-297, 2004.
- BEHLING, H. and PILLAR, V. D. P. Late Quaternary vegetation, biodiversity and fire dynamics on the southern Brazilian highland and their implication for conservation and management of modern

- Araucaria* forest and grassland ecosystems. *Philosophical Transactions of the Royal Society of London: Biological Sciences*, v. 362, n. 1478, p. 243-251, 2007.
- BEHLING, H.; PILLAR, V. D. P. and BAUERMANN, S. G. Late Quaternary grassland (Campos), gallery forest, fire and climate dynamics, studied by pollen, charcoal and multivariate analysis of the São Francisco de Assis core in western Rio Grande do Sul (southern Brazil). *Review of Palaeobotany and Palynology*, v. 133, n. 3-4, p. 235-248, 2005.
- BELLO-PÉREZ, L. A. et al. Isolation and Characterization of Starch from Seeds of *Araucaria brasiliensis*: A Novel Starch for Application in Food Industry. *Starch - Stärke*, v. 58, n. 6, p. 283-291, 2006.
- BITENCOURT, A. L. V. and KRASPENHAR, P. M. Possible prehistoric anthropogenic effect on *Araucaria angustifolia* (Bert.) O. Kuntze expansion during the Late Holocene. *Revista Brasileira de Paleontologia*, v. 9, p. 109-116, 2006.
- BOMBIN, M. and KLAMT, E. Evidências paleoclimáticas em solos do Rio Grande do Sul. *Congresso Brasileiro de Geologia*, p.183-193, 1976.
- BONOMO, M.; POLITIS, G. and GIANOTTI, C. Montículos, jerarquía social y horticultura en las sociedades indígenas del delta del Río Paraná (Argentina). *Latin American Antiquity*, v. 22, n. 3, p. 297-333, 2011.
- BOYADJIAN, C. H. C. *Microfósseis contidos no cálculo dentário como evidência do uso de recursos vegetais nos sambaquis de Jabuticabeira II (SC) e Moraes (SP)*. Dissertação de Mestrado. Universidade de São Paulo. 2007.
- BRACCO, R. Montículos de la cuenca de la Laguna Merín: Tiempo, espacio y sociedad. *Latin American Antiquity*, p. 511-540, 2006.
- BRACCO, R.; CABRERA, L. and LÓPEZ, J. M. La Prehistoria de las Tierras Bajas de la Cuenca de la Laguna Merín. In: DURÁN, A. and BRACCO, R. (Ed.). *Arqueología de las Tierras Bajas*. Montevideo: Ministerio de Educación y Cultura, Comisión Nacional de Arqueología, 2000, p.13-38.
- BRACCO, R., PUERTO, L., INDA, H., and CASTIÑEIRA, C.. Mid-late Holocene cultural and environmental dynamics in Eastern Uruguay. *Quaternary International*, v. 132, n. 1, p. 37-45, 2005.
- BRACCO, R., PUERTO, L., INDA, H., PANARIO, D., CASTIÑEIRA, C., and GARCÍA-RODRÍGUEZ, F. The relationship between emergence of mound builders in SE Uruguay and climate change inferred from opal phytolith records. *Quaternary International*, v. 245, n. 1, p. 62-73, 2011.
- BRACCO, R., INDA, H., DEL PUERTO, L., CAPDEPONT, I., PANARIO, D., and CASTIÑEIRA, C. A reply to "Relative sea level during the Holocene in Uruguay". *Palaeogeography, Palaeoclimatology, Palaeoecology*, v. 401, n. 0, p. 166-170, 2014.
- BUSH, M. B. et al. Two histories of environmental change and human disturbance in eastern lowland Amazonia. *The Holocene*, v. 10, p. 543-554, 2000.
- BUSH, M. B. et al. Holocene fire and occupation in Amazonia: Records from two lake districts. *Philosophical Transactions of the Royal Society of London: Biological Sciences*, v. 362, p. 209-218, 2007.

- CALDERÓN, V. O Sambaqui de Pedra Oca. *Instituto de Ciências Sociais 2*. Universidade da Bahia, Salvador, Brazil. 1964.
- CÁRDENAS, M. L.; CORTELETTI, R.; ROBINSON, M.; ULGUIM, P. F.; DeSOUZA, J. G.; IRIARTE, J.; MAYLE, F.; FARIAS, D. S. and DEBLASIS, P. Integrating archaeology and palaeoecology to understand Jê landscapes in southern Brazil. *Antiquity* (Cambridge), v. 89, p. 4, 2015.
- CHMYZ, I. Dados parciais sobre a arqueologia do Vale do Rio Paranapanema. In: *Publicações Avulsas No. 6.*, Programa Nacional de Pesquisas Arqueológicas – Resultados Preliminares do Primeiro Ano 1965-1966. Belém: Museu Paraense Emílio Goeldi, v.6, p.59-78, 1967.
- COPÉ, S. M. *Les Grands Constructeurs Précoloniaux du Sud Brésil: Etude de Paysages Archéologiques a Bom Jesus, Rio Grande do Sul, Brésil*. PhD Thesis, Paris I Panthéon-Sorbonne, Paris. 2006.
- COPÉ, S. M. El uso de la arquitectura como artefacto en el estudio de paisajes arqueológicos del altiplano sur brasileño. *Revista de Arqueología*, Universidad de Mar del Plata, v. 2, p. 15-34, 2007.
- COPÉ, S. M. A gênese das paisagens culturais do planalto sul brasileiro. *Estudos Avançados*, 29 (83), p. 149-171, 2015.
- COPÉ, S. M.; SALDANHA, J. D. and CABRAL, M. P. Em busca de um sistema de assentamento para o Planalto Sul-Rio-Grandense: Escavações no sítio RS-AN-03, Bom Jesus, RS. *Pesquisas Antropologia*, v. 58, p. 107-120, 2002.
- CORDENUNSI, B. R. et al. Chemical Composition and Glycemic Index of Brazilian Pine (*Araucaria angustifolia*) Seeds. *Journal of Agricultural and Food Chemistry*, v. 52, n. 11, p. 3412-3416, 2004.
- CORTELETTI, R. *Patrimônio Arqueológico de Caxias do Sul*. Porto Alegre: Nova Prova, 2008.
- CORTELETTI, R. *Projeto arqueológico Alto Canoas - Paraca: um estudo da presença Jê no planalto Catarinense*. PhD Thesis. Universidade de São Paulo, São Paulo. 2012.
- CORTELETTI, R., DICKAU, R., DEBLASIS, P., and IRIARTE, J. Revisiting the economy and mobility of southern proto-Jê (Taquara-Itararé) groups in the southern Brazilian highlands: starch grain and phytoliths analyses from the Bonin site, Urubici, Brazil. *Journal of Archaeological Science*, 58, 46-61, 2015.
- CRUZ JR, F. W. et al. Stable isotope study of cave percolation waters in subtropical Brazil: Implications for paleoclimate inferences from speleothems. *Chemical Geology*, v. 220, n. 3–4, p. 245-262, 2005.
- DE BLASIS, P., FISH, S. K., GASPAR, M. D., and FISH, P. R. Some references for the discussion of complexity among the sambaqui moundbuilders from the southern shores of Brazil. *Revista de Arqueologia Americana*, 15, 75-105, 1998.
- DeBLASIS, P.; KNEIP, A.; SCHEEL-YBERT, R.; GIANNINI, P.C. and GASPAR, M. D. Sambaquis e paisagem: dinâmica natural e arqueologia regional no litoral sul do Brasil. *Arqueología Sudamericana/Arqueologia Sul-Americana*, v. 3, n. 1, p. 29-61, 2007.

- DeBLASIS, P., FARIAS, D.S. and KNEIP, A. Velhas tradições e gente nova no pedaço: perspectivas longevas de arquitetura funerária na paisagem do litoral sul catarinense. *Revista do Museu de Arqueologia e Etnologia*, São Paulo, 24, 109-136, 2014.
- DeMASI, M. A. *Prehistoric Hunter-Gatherer Mobility on the Southern Brazilian Coast: Santa Catarina Island*. PhD Thesis, Stanford University, Palo Alto. 1999.
- DeMASI, M. A. *Projeto de Salvamento Arqueológico Usina Hidrelétrica de Campos Novos: Relatório Final*. Florianópolis, Brazil. 2005.
- DeMASI, M. A. Análise de isotopos estáveis de  $^{13/12}\text{C}$  e  $^{15/14}\text{N}$  em resíduos de incrustações carbonizadas de fundo de recipientes cerâmicos das Terras Altas do sul do Brasil. *Anais do XIV Congresso da SAB*, Florianópolis, Brazil, 2007.
- DeMASI, M. A. Centros cerimoniais do planalto meridional: uma análise intrasítio. *Revista de Arqueologia SAB*, v. 22, p. 99-113, 2009.
- DeSOUZA, J. G. and COPÉ, S. Novas perspectivas sobre a arquitetura ritual do planalto meridional brasileiro: pesquisas recentes em Pinhal da Serra, RS. *Revista de Arqueologia SAB*, v. 23, p. 104-117, 2011.
- DeSOUZA, J. G., CORTELETTI, R., ROBINSON, M., and IRIARTE, J. The genesis of monuments: Resisting outsiders in the contested landscapes of southern Brazil. *Journal of Anthropological Archaeology*, 41, 196-212, 2016.
- DURÁN, A. and BRACCO, R. *Arqueología de las Tierras Bajas*. Montevideo: Comisión Nacional de Arqueología, Ministerio de Educación y Cultura, 2000.
- FAO. Food and Fruit-bearing Forest Species: Examples from Latin America. *FAO Forestry Paper*. v. 44. n. 3. Rome: FAO 1986.
- FISH, P. R., FISH, S. K., DeBLASIS, P. and GASPAS, M.D. Monumental Shell Mounds as Persistent Places in Southern Coastal Brazil. In Thompson, Victor D. and James C. Waggoner Jr. (eds.) *The Archaeology and Historical Ecology of Small Scale Economies*, Gainesville, Univ. Press of Florida, 2013, p. 120-140.
- GASPAS, M. D. Considerations of the sambaquis of the Brazilian coast. *Antiquity*, 72, 592-615, 1998.
- GASPAS, M. D. *Sambaquis. Arqueologia do Litoral*. Rio de Janeiro: Jorge Zahar Editora, 2000.
- GASPAS, M., DEBLASIS, P., FISH, S., and FISH, P. Sambaqui (shell mound) societies of coastal Brazil. In: (Ed.). *The Handbook of South American Archaeology*: Springer, 2008.
- GASPAS, M.D., KLÖKLER, D. and DeBLASIS, P. Were *Sambaqui* People Buried in the Trash? Archaeology, Physical Anthropology, and the Evolution of the Interpretation of Brazilian Shell Mounds. In: ROKSANDIC, M., MENDONÇA DE SOUZA, S., EGGERS, S., BURCHELL, M. and KLÖKLER, D. (eds.) *The Cultural Dynamics of Shell-Matrix Sites*, Albuquerque, University of New Mexico Press, 2014, p. 91-100.
- GIANNINI, P. C. F. et al. Interações entre evolução sedimentar e ocupação humana pré-histórica na costa centro-sul de Santa Catarina, Brasil. *Boletim do Museu Paraense Emílio Goeldi Ciências Humanas*, v. 5, n. 1, p. 105-128, 2010.

- GIANOTTI, C. *Desarrollo Metodológico y Aplicación de Nuevas Tecnologías para la Gestión Integral del Patrimonio Arqueológico en Uruguay*. Galicia: Laboratorio de Arqueología de Paisaxe, 2005.
- HUECK, K. Distribuição e habitat natural do Pinheiro do Paraná (*Araucaria angustifolia*). Boletim da Faculdade de Filosofia e Ciências. Botânica. Universidade de São Paulo, n. 10, p. 1-14, 1953.
- IBGE - *Geografia do Brasil: Região Sul*. Fundação Instituto Brasileiro de Geografia e Estatística, Diretoria de Geociências. Rio de Janeiro: IBGE, 1990.
- IRIARTE, J. *Mid-Holocene emergent complexity and landscape transformation: the social construction of early Formative communities in Uruguay, La Plata Basin*. PhD Thesis. Anthropology, University of Kentucky, Lexington, 2003.
- IRIARTE, J. Landscape transformation, mounded villages and adopted cultigens: the rise of early Formative communities in south-eastern Uruguay. *World Archaeology*, v. 38, n. 4, p. 644-663, 2006a.
- IRIARTE, J. Vegetation and climate change since 14,810 C-14 yr BP in southeastern Uruguay and implications for the rise of early Formative societies. *Quaternary Research*, v. 65, n. 1, p. 20-32, 2006b.
- IRIARTE, J. Emerging food-production systems in the La Plata Basin: the Los Ajos site. In: DENHAM, T. P.; IRIARTE, J.; and VRYDAGHS, L. (Ed.). *Rethinking agriculture: archaeological and ethnoarchaeological perspectives*. Walnut Creek, CA: Left Coast, 2007, p.165-186.
- IRIARTE, J. "Down under the marshes": Investigating settlement patterns of the Early Formative mound-building cultures of south-eastern Uruguay through historic aerial photography. In: HANSON, W. S. and OLTEAN, I. A. (Ed.). *Archaeology from Historical Aerial and Satellite Archives*. Springer, 2013, p.243-260.
- IRIARTE, J. and BEHLING, H. The expansion of Araucaria Forest in the southern Brazilian highlands during the last 4000 years and its implications of the Taquara/Itararé Tradition. *Environmental Archaeology*, Vol 12, nº 2: 115-127, 2007.
- IRIARTE, J., HOLST, I., MAROZZI, O., LISTOTAD, C., ALONSO, E. and RINDERKNECHT, A., et al. Comentario Sobre "Montículos de la Cuenca de la Laguna Merín: Tiempo, Espacio, y Sociedad". *Latin American Antiquity*, p. 317-324, 2008a.
- IRIARTE, J.; GILLAM, J. C. and MAROZZI, O. Monumental burials and memorial feasting: an example from the southern Brazilian highlands. *Antiquity*, v. 82, n. 318, p. 947-961, 2008b.
- IRIARTE, J., HOLST, I., LÓPEZ MAZZ, J. M., and CABRERA, L. Subtropical wetland adaptations in Uruguay during the mid-Holocene: an archaeobotanical perspective. In: PURDY, B. (Ed.). *Enduring Records: The Environmental and Cultural Heritage of Wetlands*. Oxford: Oxbow Books, 2001, p.61-70.
- IRIARTE, J.; HOLST, I.; MAROZZI, O.; LISTOPAD, C.; ALONSO, E.; REINDERKNECHT, A. and MONTAÑA, J. Evidence for cultivar adoption and emerging complexity during the mid-Holocene in the La Plata basin. *Nature*, v. 432, n. 7017, p. 614-617, 2004.

- IRIARTE, J.; MAROZZI, O. and GILLAM, J. Monumentos funerarios y festejos rituales: complejos de recintos y montículos Taquara/Itararé en El-Dorado, Misiones (Argentina). *Arqueología Iberoamericana*, v. 6, p. 25-38, 2010.
- IRIARTE, J.; COPÉ, S.M.; FRADLEY, M.; LOCKHART, J. and GILLAM, C. Sacred landscapes of the southern Brazilian highlands: Understanding southern proto-Jê mound and enclosure complexes. *Journal of Anthropological Archaeology*, v. 32, n. 1, p. 74-96, 2013.
- IRIONDO, M. H. and GARCIA, N. O. Climatic variations in the Argentine plains during the last 18,000 years. *Palaeogeography, Palaeoclimatology, Palaeoecology*, v. 101, n. 3–4, p. 209-220, 1993.
- JACOBSON JR, G. L. and BRADSHAW, R. H. W. The selection of sites for paleovegetational studies. *Quaternary Research*, v. 16, n. 1, p. 80-96, 1981.
- JOLKESKY, M. P. D. V. *Reconstrução fonológica e lexical do Proto-Jê Meridional*. Master Dissertation. Universidade Estadual de Campinas, Campinas. 2010.
- KERN, A.; SOUZA, J. A. and SEFFNER, F. Arqueologia de salvamento e a ocupação pré-histórica do vale do Rio Pelotas. (Municípios de Bom Jesus e Vacaria). *Veritas*, v.35, p. 99-127, 1989.
- KLÖKLER, D. *Food for body and soul: mortuary ritual in shellmounds (Laguna-Brazil)*. PhD Thesis, University of Arizona, 2008.
- KNEIP, A. *O povo da lagoa: uso do SIG para modelamento e simulação na area arqueológica do Camacho*. PhD Thesis, University of São Paulo, 2004.
- LEDRU, M. P.; SALGADO-LABOURIAU, M. L. and LORSCHREITER, M. L. Vegetation dynamics in southern and central Brazil during the last 10,000 yr BP. *Review of Palaeobotany and Palynology*, v. 99, n. 2, p. 131-142, 1998.
- LIMA, T. A. Em busca dos frutos do mar: os pescadores-coletores do litoral centro-sul do Brasil. *Revista do Museu de Arqueologia e Etnologia*, 44, 270-327, 2000.
- LIMA, T. A. and MAZZ, J. L. La emergencia de complejidad entre los cazadores recolectores de la costa atlantica meridional sudamericana. *Revista de Arqueologia Americana*, 17/18/19, 129-175, 1999.
- MABILDE, A. O índio Kaingang do Rio Grande do Sul no final do século XIX. *Documentos*, v. 2, p. 141-172, 1988.
- MARTÍNEZ, S. and ROJAS, A. Relative sea level during the Holocene in Uruguay. *Palaeogeography, Palaeoclimatology, Palaeoecology*, v. 374, p. 123-131, 2013.
- MAYLE, F. E. and IRIARTE, J. Integrated palaeoecology and archaeology – a powerful approach for understanding pre-Columbian Amazonia. *Journal of Archaeological Science*, v. 51, n. 0, p. 54-64, 2014.
- MAYLE, F. E. and POWER, M. J. Impact of a drier Early–Mid-Holocene climate upon Amazonian forests. *Philosophical Transactions of the Royal Society of London: Biological Sciences*, v. 363, p. 1829-1838, 2008.



- MAZZ, J. M. L. Las estructuras tumulares (cerritos) del Litoral Atlántico uruguayo. *Latin American Antiquity*, p. 231-255, 2001.
- MAZZ, J. M. L.; DABEZIES, J. M., and CAPDEPONT, I. La gestión de recursos vegetales en las poblaciones prehistóricas de las tierras bajas del sureste del Uruguay: un abordaje multidisciplinar. *Latin American Antiquity*, v. 25, n. 3, p. 256-277, 2014.
- MENGHIN, O. F. El poblamiento prehistorico de Misiones. *Anales deArqueología y Etnología*, Mendoza, v. XII, p. 19-40, 1957.
- MÉTRAUX, A. The Caingang. In: STEWARD, J. H. (Ed.). *Handbook of South American Indians*. Washington, D.C.: Smithsonian Institution, v.1, 1946, p.445-477.
- MILHEIRA, R. G. and DeBLASIS, P. O território Guarani no litoral sul catarinense: ocupação e abandono no limiar do pe-ríodo colonial. *Revista de Arqueologia Americana*. Mexico, Instituto Panamericano de Historia y Geografía, v.29: 147-182, 2011.
- MILLER, E. T. Pesquisas arqueológicas efetuadas no nordeste do Rio Grande do Sul. In: (Ed.). *Publicações Avulsas* No. 6. Belém: Museu Paraense Emílio Goeldi, p.15-38, 1967.
- MILLER, E. T. Pesquisas arqueológicas efectuadas no Planalto Meridional, Rio Grande do Sul (rios Uruguai, Pelotas, e das Antas). In: (Ed.). *Publicações Avulsas* No. 15. Belém: Museu Paraense Emílio Goeldi, p.37-60, 1971.
- NOELLI, F. A ocupação humana na região sul do Brasil: arqueologia, debates e perspectivas. *Revista USP*, v. 44, p. 218-269, 2000.
- PESTANA, M. *A Tradição Tupiguarani na Porção Central da Planície Costeira do Rio Grande do Sul, Brasil*. Master Dissertation. Universidade do Vale do Rio dos Sinos, São Leopoldo, 2007.
- POLITIS, G., BONOMO, M., CASTIÑEIRA, C., and BLASI, A. Archaeology of the Upper Delta of the Paraná River (Argentina): mound construction and anthropic landscapes in the Los Tres Cerros locality. *Quaternary International*, v. 245, n. 1, p. 74-88, 2011.
- PROBIDES, P. *Plan Director: Reserva de Biosfera Bañados del Este*. Rocha, Uruguay. Rocha, Uruguay: PROBIDES, 2000.
- PROUS, A. *Arqueologia Brasileira*. Brasília: Editora da UNB, 1992.
- PUERTO, L. D. et al. Assessing links between late Holocene climate change and paleolimnological development of Peña Lagoon using opal phytoliths, physical, and geochemical proxies. *Quaternary International*, v. 287, n. 0, p. 89-100, 2013.
- RIBEIRO, P. A. A Tradição Taquara e as casas subterrâneas no sul do Brasil. *Revista de Arqueologia Americana*, v. 17/18/19, p. 9-49, 1999/2000.
- RIBEIRO, P. A. and RIBEIRO, C. T. Levantamentos arqueológicos no Municipio de Esmeralda, Rio Grande do Sul, Brasil. *Revista do CEPA*, Santa Cruz do Sul, v. 14, p. 49-105, 1985.

- RODRIGUEZ, J. Human occupation of the eastern La Plata Basin and the adjacent littoral region during the mid-Holocene. *Quaternary International*, v. 132, n. 1, p. 23-36, 2005.
- ROGGE, J. H. and SCHMITZ, P. I. Projeto Arroio do Sal: A Ocupação Indígena Pré-Histórica no Litoral Norte do RS. *Pesquisas, Antropologia*, 68, 167-225, 2010.
- SALDANHA, J. D. Paisagens e sepultamentos nas terras altas do sul do Brasil. *Revista de Arqueologia SAB*, v. 21, p. 85-95, 2008.
- SALDANHA, J. D. *Paisagem, lugares e cultura material: uma arqueologia espacial nas terras altas do sul do Brasil*. Master Dissertation. PUCRS, Porto Alegre, 2005.
- SANDWEISS, D. H.; MAASCH, K. A. and ANDERSON, D. G. Transitions in the mid-Holocene. *Science*, v. 283, n. 5401, p. 499-500, 1999.
- SCHEEL-YBERT, R. et al. Novas perspectivas na reconstituição do modo de vida dos sambaquieiros: uma abordagem multidisciplinar. *Revista de Arqueologia SAB*, v.16, n.1, 2006.
- SCHMITZ, P. I. Arqueologia do planalto sul-brasileiro. *Revista de Arqueología Americana*, v. 17/18/19, p. 51-74, 1999/2000.
- SCHMITZ, P. I. Ambientes Holocênicos e surgimento de sistemas culturais. *Revista de Arqueologia SAB*, v. 14/15, p. 87-96, 2001/2002.
- SCHMITZ, P. I. *As Casas Subterrâneas de São José do Cerrito*. Instituto Anchietano de Pesquisas, São Leopoldo, 2014.
- SCHMITZ, P. I., ARNT, F. V., BEBER, M. V., ROSA, A., and FARIAS, D. S. Casas subterrâneas no planalto de Santa Catarina: São José do Cerrito. *Pesquisas, Antropologia*, Instituto Anchietano de Pesquisas, São Leopoldo, v. 68, p. 7-78, 2010.
- SCHMITZ, P. I.; NAUE, G. and BECKER, I. Os aterros dos campos do sul: a tradição Vieiria. In: KERN, A. (Ed.). *Arqueologia Pré-histórica do Rio Grande do Sul*. Porto Alegre: Mercado Aberto, 1991, p.221-251.
- SCHMITZ, P. I., ROGGE, J. H., ROSA, A., BEBER, M. V., MAUHS, J., and ARNT, F. V. Casas subterrâneas nas terras altas do sul do Brasil. *Pesquisas, Antropologia*, Instituto Anchietano de Pesquisas, São Leopoldo, 58, p.11-105, 2002.
- SCHMITZ, P. I., ROGGE, J. H., NOVASCO, R. V., MERGEN, N. M., and FERRASO, S. Boa Parada: um lugar de casas subterrâneas, aterros-plataforma e danceiro. *Pesquisas, Antropologia*, Instituto Anchietano de Pesquisas, São Leopoldo, n. 70, p.133-195, 2013a.
- SCHMITZ, P. I., ROGGE, J. H., NOVASCO, R. V., MERGEN, N. M., and FERRASO, S. Rincão dos Albinos: um grande sítio Jê meridional. *Pesquisas, Antropologia*, Instituto Anchietano de Pesquisas, São Leopoldo, n. 70, p.65-131, 2013b.
- SILVA, S.B. *Etnoarqueologia dos grafismos Kaingang*. PhD Thesis. Universidade de São Paulo, São Paulo. 2001.

- SIMÕES, M. F. and CORREA, C. G. Pesquisas arqueológicas na região do Salgado (Pará) - a fase Areão do litoral de Mariparim. *Boletim do Museu Paraense Emílio Goeldi Ciências Humanas*, 48, 1-30, 1971.
- SUGITA, S. A Model of Pollen Source Area for an Entire Lake Surface. *Quaternary Research*, v. 39, n. 2, p. 239-244, 1993.
- TWISS, P. C. Predicted world distribution of C3 and C4 grass phytoliths. In: RAPP JR., G. and MULHOLLAND, S. C. (Ed.). *Phytolith Systematics. Emerging Issues*. Philadelphia: University of Pennsylvania, (Advances in Archaeology and Museum Science), p.113-128, 1992.
- VILLAGRAN, X. S.; GIANNINI, P. C. F. and DeBLASIS, P. Archaeofacies analysis: Using depositional attributes to identify anthropic processes of deposition in a monumental shell mound of Santa Catarina State, southern Brazil. *Geoarchaeology*, v. 24, n. 3, p. 311-335, 2009.
- VILLAGRAN, X. and GIANOTTI, C. Earthen mound formation in the Uruguayan lowlands (South America): micromorphological analyses of the Pago Lindo archaeological complex. *Journal of Archaeological Science*, v. 40, n. 2, p. 1093-1107, 2013.
- WACHNITZ, G. A. *Prehistoria Altoparanaense Preguarani*. Argentina: Imprenta Seyfried, 1984.
- WESOLOWSKI, V.; MENDONÇA DE SOUZA, S.M.F.; KARL REINHARD, K. and CECCANTINI, G. Grânulos de amido e fitólitos em cálculos dentários humanos: contribuição ao estudo do modo de vida e subsistência de grupos sambaquianos do litoral sul do Brasil. *Revista do Museu de Arqueologia e Etnologia*, São Paulo, 17: 191-210, 2007.
- WESOLOWSKI, V.; MENDONÇA DE SOUZA, S.M.F.; KARL REINHARD, K. and CECCANTINI, G. Evaluating microfossil content of dental calculus from Brazilian sambaquis. *Journal of Archaeological Science* 37(6):1326-1338, 2010.

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