Cadernos do Lepaarq

OF FORESTS AND GARDENS: LANDSCAPE, ENVIRONMENT, AND CULTURAL CHOICES IN AMAZONIA, SOUTHEASTERN AND SOUTHERN BRAZIL FROM C. 3000 TO 300 CAL YRS BP

A FLORESTA E O QUINTAL: PAISAGEM, AMBIENTE E ESCOLHAS CULTURAIS NA AMAZONIA, SUDESTE E SUL DO BRASIL ENTRE C. 3000 E 300 ANOS CAL BP

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Of forests and gardens: landscape, environment, and cultural choices in Amazonia, Southeastern and Southern Brazil from c. 3000 to 300 cal yrs BP

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Abstract: Brazilian rainforests have long been considered pristine environments, ecologically representative of primary forest. More recently, important discussions arised especially out of historical ecology studies recognise that human populations significantly interfered in the landscape. Direct archaeological evidence can be provided by anthracological analyses. Examples driven from sites of different pottery producing cultural traditions in the Brazilian territory are given. Results from Southeastern and Southern Brazil, as well as from Amazonia, demonstrate that human occupation promoted forest disturbance and created anthropogenic environments. Each of the different studied groups has transformed the forest landscape by creating areas of secondary vegetation and likely concentrating useful species. The secondary vegetation domesticated spaces surrounding the settlements might be preferred for firewood gathering due to their proximity, structure and/or social significance. We conclude interpreting the data according to the premise that reconstructing landscape in archaeological sites implies overcoming merely economistic or naturalistic interpretations as well as understanding the underlying cultural determinants to the data, while still not neglecting their ecological significance.

Keywords: Landscape, Historical Ecology, Anthracology, Pottery-makers, Brazil, Amazonia.

Resumo: As florestas ombrófilas do Brasil foram durante muito tempo consideradas como ambientes intocados pela ação humana e ecologicamente representativos de florestas primárias. Mais recentemente, importantes discussões, surgidas especialmente no quadro da ecologia histórica, passaram a reconhecer que populações humanas interferiram significativamente na paisagem, mas não existiam até o momento evidências arqueológicas diretas. Análises antracológicas em sítios de diferentes tradições culturais que ocuparam o território brasileiro vêm oferecendo tais evidências. Exemplos obtidos em sítios ceramistas do Sudeste e do Sul do país e na Amazônia demonstram que a ocupação humana alterou a vegetação local criando ambientes antropogênicos. Os diferentes grupos estudados transformaram a paisagem com a criação de áreas de vegetação secundária e uma possível concentração de espécies úteis. Devido à sua proximidade, estrutura e/ou significado social, os espaços de vegetação secundária domesticada no entorno dos assentamentos eram possivelmente preferidos para a coleta de lenha. Conclui-se interpretando os dados de acordo com a premissa de que estudar paisagem em sítios arqueológicos implica em, sem negligenciar os significantes ecológicos, ultrapassar interpretações meramente economicistas ou naturalistas e perceber os determinantes culturais subjacentes aos dados.

Palavras-chave: Paisagem, Ecologia Histórica, Antracologia, Ceramistas, Brasil, Amazonia.

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INTRODUCTION

Brazilian ombrophilous forests have long been considered pristine and untouched environments, ecologically representative of primary forests. In the last decades, important discussions have arisen, especially in the context of historical ecology, pointing to the fact that human populations largely interfered in the landscape (e.g. POSEY 1985; BALÉE 1989, 1994; DENEVAN 1992; FAIRHEAD and LEACH 1995; POLITIS 1997, 2001; RIVAL 1998; BALÉE and ERICKSON 2006; TOLEDO and MOLINA 2007; OLIVER 2008; CLEMENT and JUNQUEIRA 2010).

Clement and Junqueira (2010) suggest that the first anthropogenic environments in Amazonia were created from the beginning of human occupation in the region. Particularly favourable spots combining water, game, and plants availability might had been initially briefly occupied with the aim of collecting seasonal (fruits, roots, fish, game) or perennial (fibers, wood, lithics) resources. Concentrations of useful species might had grown thereafter in each camping area by means of seeds discharge. In time, such anthropogenic ecosystems would become more attractive and allow longer dwelling periods. Dumping areas (CLEMENT and JUNQUEIRA 2010) and paths (PIPERNO and PEARSALL 1998) would also favor the establishment of new local and introduced useful secondary species as a result of soil enrichment due to organic material deposition and higher light availability.

Ethnographical studies on the Nukak, for instance, foragers from the Colombian Amazon, demonstrate the creation of cultivated islands into the forest, which contained palm trees and tubers from horticultural activities that are believed to date back to 9000 years BP (POLITIS 1997, 2001; OLIVER 2008). These plants management increased the ecological diversity in such environments. The Ka'apor, native horticulturalists from Eastern Amazon, farm and handle the environment around them. They distinguish vegetation types according to species composition and their uses, including game attraction (BALÉE 1989, 1994). The Huaorani, traditional foragers from Equatorian Amazon, are reported to impose strong territorial control over "ancestral groves", considered a living reserve of planting seeds (RIVAL 1998). One of the most frequent species in these areas is the peach palm (*Bactris gasipaes*), which assumed such importance for Amazonian groups that it became the only fully domesticated palm in the region (RIVAL 1998; CLEMENT 1989).

Evidence of anthropogenic forests is often related to the occurrence of palm trees, and some authors sustain that the strategy of dispersion of many palms might be associated with past human activities (BALÉE 1989; BALÉE and ERICKSON 2006). However, the concentration of several tree species may attest human manipulation. For instance, forests of Brazil nuts (*Bertholletia excelsa*) in eastern Amazon, in the same way that the palm species *Elaeis oleifera*, are frequently correlated with anthropogenic disturbance, appearing over Amazonian dark earths[3] associated with archaeological remains (BALÉE 1989).

High concentrations of useful and domesticated plants were identified on secondary forests upon anthropogenic soils in Central Amazon (JUNQUEIRA et al. 2011). Eleven "ethnospecies" were recognised as anthropogenic soil indicators, among which five palms. The authors argue that intimate and long-lasting interactions between humans and dark earths have favored the maintenance of secondary forests in these domesticated landscapes.

In spite of the accumulated evidence of human construction of the landscape, driven from historical ecology and ethnographical approaches, direct archaeological evidence remains scarce. Such evidence used to be considered difficult to acquire, considering the fragility of vegetation proxies among archaeological remains. Palynology, the most traditional tool for palaeoecological reconstruction, may provide many interesting results (e.g. BUSH and COLINVAUX 1988; IRIARTE and BEHLING 2007), although mostly from indirect evidence, since pollen grains and spores are poorly preserved in archaeological sediments. Important evidence may also be driven from phytolith analysis, in spite of its lower taxonomic definition. Phytoliths are very well preserved in archaeological sites, however, most landscape studies heretofore were performed on off-site lake or soil sediments (e.g. PIPERNO et al. 1991; PIPERNO and JONES 2003; MCMICHAEL et al. 2012; MAYLE and IRIARTE 2014).

Anthracology, in many ways complimentary to the abovementioned methods, is particularly appropriate for this purpose by the very nature of its object of study, as charcoal fragments are almost ubiquitous in archaeological sediments. The analysis of archaeological charcoal is now largely recognised as a reliable tool for palaeoecological and landscape reconstruction (VERNET 1977, 1992; CHABAL 1997; SCHEEL-YBERT 2000; THIÉBAULT 2002; FIORENTINO and MAGRI 2008; BADAL et al. 2012; DAMBLON et al. 2013). It also provides diverse palaeoethnobotanical data, especially related to wood use in domestic and ritual contexts (e.g. BEAUCLAIR et al. 2009; CARRIÓN et al. 2012; DOTTE-SAROUT et al. 2014; DUSSOL et al. 2016), but also to other aspects such as site formation processes (SCHEEL-YBERT et al. 2009; BIANCHINI et al. 2011) and indicators of people's mobility in the landscape (BYRNE et al. 2013).

Although its use to reconstruct the vegetation surrounding a site, and therefore infer anthropogenic disturbance, is still frequently criticised on the assumption that archaeological charcoal would always be biased by human selection, this matter has already been extensively discussed in specialised literature (e.g. CHABAL 1997; SCHEEL-YBERT 2000, 2004a; FIGUEIRAL and MOSBRUGGER 2000; THÉRY-PARISOT et al. 2010). The reliability of palaeoecological reconstructions from archaeological charcoal is

[3] Anthropogenic dark earths (*"terra preta de índio"* or TPI) are widespread in the uplands (*terra firme*) of Amazonia, occurring in large patches up to several hundred hectares. The blacker form (*terra preta*) is interpreted as derived from village middens consisting of ash and charcoal from kitchen fires, cultural debris, faeces, human and animal bone, and house/garden waste. The lighter, dark brown form (*terra mulata*) is considered an outcome of spatially intensive cultivation activities involving organic amendments and low-temperature near-surface fires (DENEVAN 2004; ARROYO-KALIN 2010).

demonstrated both in temperate and tropical environments by (1) the high taxonomic richness of charcoal samples; (2) good agreement between different anthracological analyses and between those and other proxies' results; and (3) good statistical correlation between anthracological spectra and extant vegetation types (CHABAL 1997; SCHEEL-YBERT 2000, 2004a). This adequate representation of the local vegetation is ensured by (1) the low selectivity of domestic firewood gathering (ASCH et al. 1972; VERNET 1990; CHABAL 1992; SCHEEL-YBERT 2000), and (2) the vast variety of wood choices likely associated with each function of fire in a human settlement (heating, cooking, lighting, drying, smoking, transforming raw materials, keeping animals away, taking part in ceremonies or ritual practices, etc.) (THÉRY-PARISOT et al. 2010). Therefore, given a long duration of wood collection activities in a settlement, it is possible that all the species in the different vegetation types around it will have, sooner or later, a chance to be collected, charred, and hence preserved as charcoal.

In the last decades, the development of anthracological analyses in sites of several Brazilian regions provided important evidence on the landscape occupied by human populations in the past (e.g. SCHEEL-YBERT 2000, 2001; SCHEEL-YBERT and SOLARI 2005; SCHEEL-YBERT and DIAS 2007; BEAUCLAIR et al. 2009; SCHEEL-YBERT et al. 2009; BIANCHINI et al. 2011; BIANCHINI and SCHEEL-YBERT, 2012; CAROMANO et al. 2013; SCHEEL-YBERT et al. 2014a). In this paper examples will be provided regarding agriculturalist/horticulturalist pottery makers who inhabited different parts of the country from up to 3000 years before the present until around 1400-1650 AD, at the time of arrival of the first Europeans. The results demonstrate that these groups interacted with the natural vegetation and transformed the landscape in many ways, particularly by creating areas of secondary vegetation inside the forest.

In presenting these sets of data we aimed to put in evidence a pattern of environmental/landscape settings related to ancient groups of different cultural affiliations who occupied the Brazilian territory. Additionally, we aimed to attract attention to the potential of anthracology in paleoecological reconstruction, as well as on the gathering of data of cultural significance such as landscape, wood use, economic practices, ritual, and social evidence.

THE SITES

The Morro Grande Tupiguarani settlement (Southeastern Brazil)

The Morro Grande site, situated in the southeastern coastal plain of Rio de Janeiro State (Fig. 1), is attributed to proto-Tupinambá agriculturalist and pottery producing populations (BUARQUE 2009, 2010). It lies in an urban area, nowadays completely deforested, in the Atlantic rainforest phytogeographical domain. The climate, Aw in the Köppen system, is tropical; annual precipitation is 993 mm, with rainy summers and drier winters; mean annual temperature is 23 °C.

Morro Grande is currently one of the best studied Tupiguarani sites in Southeastern Brazil, presenting the oldest known dates for this region and standing out for its long occupation. Four periods of occupation were identified, dated at: (1) 2920±70 yrs BP (3220-2840 cal yrs BP); (2) 2600±160 yrs BP (3000-2150 cal yrs BP); (3) 1740±90 yrs BP (1820-1390 cal yrs BP); (4) 510±160 yrs BP (750-0 cal yrs BP) to 315±50 (415-215 yrs BP TL). The latter is possibly related to a reoccupation of the area by people of Guarani affiliation, for it is associated with an urn of quite different cultural characteristics (BUARQUE 2009; SCHEEL-YBERT et al. 2014a).

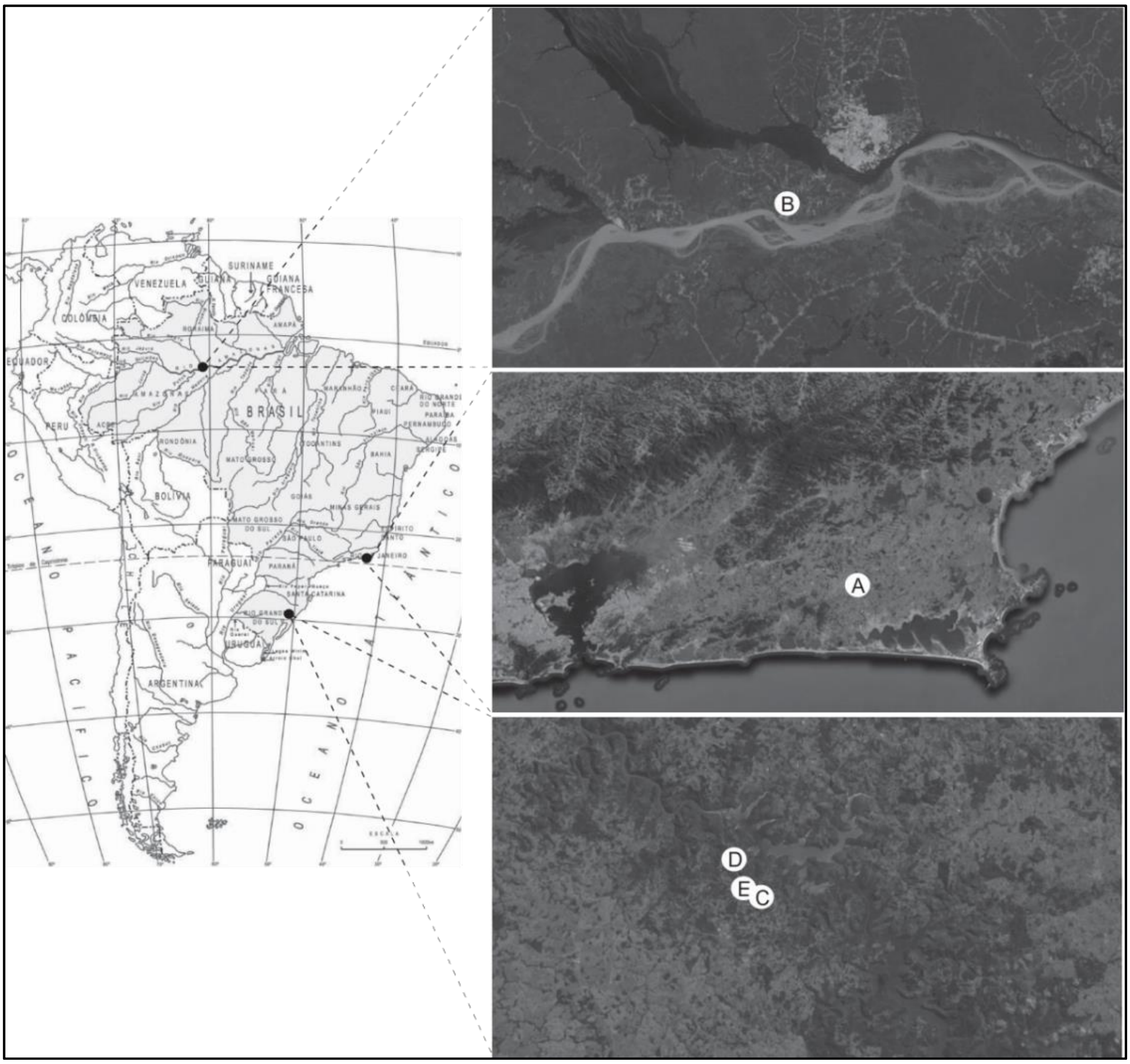

Figure 1: Location of the studied areas. (A) Morro Grande site, Araruama municipality, Rio de Janeiro State; (B) Hatahara site, Iranduba municipality, Amazonas State; (C-E) Southern Proto-Je sites, Pinhal da Serra municipality, Rio Grande do Sul State, (C) Ari-I, (D) Leopoldo-V and Leopoldo-VII, (E) Pedreira (source: Google earth, images date 04/09/2013 (A, B), 09/10/2013 (C-E); accessed 29/01/2015). The map of South America (adapted from DUARTE 2010) shows political divisions and main rivers.

The archaeological area comprises c. 9 ha, presenting many archaeological features and well preserved pottery (BUARQUE 2010). Five archaeological layers were identified in different loci. Each archaeological locus comprises a funerary area, with the presence of a funerary urn surrounded by painted vessels (the latter probably used for food offerings), and generally a domestic area. In the funerary area pottery pieces presented painted decoration, frequently with elaborated patterns (e.g. skeletal, visceral) that suggest they were made specially for the mortuary ritual (BUARQUE 2010). Farther from the funerary urn and spatially isolated from the funerary area, features in domestic context are associated with fragments of utilitarian, non-decorated or plastic decorated potsherds (for more information, SCHEEL-YBERT et al. 2014a).

The analysis presented here was performed upon samples from Locus 2, the more extensively excavated, also with the most extensive sampling of dispersed charcoal (SCHEEL-YBERT et al. 2014a). The three earlier periods of site occupation are represented in this locus, therefore dated between 3220-2840 and 1820-1390 cal yrs BP.

The Hatahara multicomponencial site (Central Amazon)

The Hatahara site (AM-IR-13), located on a high terrace next to a small lowland (*várzea*) area on the left bank of the Solimões River, Amazonas State (Fig. 1), is considered an example of establishment of sedentism related to food production (e.g. HECKENBERGER and NEVES 2009; ARROYO-KALIN 2010). It is a very well-studied site on which multiple research approaches were applied, such as archaeometry (REBELLATO 2007; NUNES 2009), soil analysis (MOREIRA 2007; BIRK et al. 2011; MADARI et al. 2011; SCHMIDT et al. 2014), geoarchaeology (ARROYO-KALIN 2009, 2010), bioanthropology (PY-DANIEL 2009), archaeobotany (BOZARTH et al. 2009; CASCON 2010; CAROMANO 2010; SHOCK et al. 2014), besides site formation, settlement pattern, and artifacts analyses (LIMA 2008; LIMA and NEVES 2011; MACHADO 2005; REBELLATO et al. 2009; NEVES 2011; TAMANAHA 2012) and others.

Hatahara site is located in an urbanised and deforested area, in the Amazon phytogeographical domain. The main phytophisiognomies are dense ombrophilous forests (*terra firme* forests) and alluvial dense ombrophilous forests (*várzea* forests), both presenting high species diversity (VICENTINI 2001). The climate, Ami in the Köppen system, is tropical hot and rainy with a small and innefective dry season; annual precipitation is 2500 mm; mean annual temperature is 27 °C (SUDAM 1984).

This site attains 16 ha of area, combining a privileged access to a large body of water to the vicinity of a *terra firme* rain forest (MACHADO 2005). It features extensive layers of Amazonian dark earths, which formation was probably initially associated with Manacapuru phase and latter intensified during the Paredão phase. It also presents earthworks through mound construction and high density of pottery, polished stone artifacts, concentrations of funeral urns, and direct burials. Fourteen artificial mounds built with TPI and potsherds are distributed in four groups, each one presenting a roughly semicircular arrangement (MACHADO 2005; PY-DANIEL 2009). It is suggested that these mounds were dwelling and burial places (MACHADO 2005; MORAES 2007).

Four different ceramic phases with different spatial distribution were identified in this site (MACHADO 2005; NEVES and PETERSEN 2006; REBELLATO 2007). The Açutuba phase, found in deeper deposits, is dated between c. 2250 and 1600 ysr BP (LIMA et al. 2006) and seems to have a wide spatial distribution (REBELATTO 2007; LIMA 2008). The Manacapuru phase, dated between c. 1550 and 1050 yrs BP, was identified in different areas of the site through potsherds and funerary urns (LIMA 2008). The Paredão phase, dated between c. 1250 and 700 yrs BP, presents the largest spatial distribution and pottery density and is associated with higher population densities (CAROMANO 2010), formation of deep layers of TPI, and construction of artificial mounds (MORAES 2007; REBELLATO 2007). The Guarita phase, dated between c. 1050 and 400 yrs BP, is found closer to the surface. The artifacts associated with this phase are distributed along a linear pattern that follows the river course, therefore corroborating chroniclers' reports of numerous linear villages along the Amazon river bed (REBELLATO 2007).

The anthracological analysis here presented concerns charcoal samples collected from an excavation square of 1x1 m presenting three archaeological layers, besides an additional surficial layer highly disturbed and therefore disregarded (CAROMANO 2010).

Layer-III (3-30 cm) is characterised by the presence of *terra preta* and the highest concentrations of cultural material, especially pottery. This layer is attributed to the Paredão phase and indirectly dated of c. 1250-700 yrs BP. Layer-II (30-60 cm) presents *terra mulata* and lower pottery density. Layer-I (60-120 cm), composed of a clayey yellow latossol, presented very little cultural material and was initially not entirely considered an archaeological layer. However, the large quantity and high diversity of charcoal identified, associated with the presence of seeds, palm endocarps, tubers, and even a cassava tuberous root, allowed Caromano (2010) to demonstrate that it assuredly represented a cultural layer, even if it is not yet clear whether it could represent a garden or a field rather than a dwelling space. As the two first layers were not dated, not even relatively, it is presently impossible to know their chronology. Nevertheless, one can assume they might be related to the Açutuba and/or to the Manacapuru phases, and therefore estimatively dated from c. 2250/1550 to 1000 yrs BP.

The Southern Proto-Je sites (Southern Brazil)

Four archaeological sites associated with the Southern Proto-Je populations in northeastern Rio Grande do Sul State were studied (Fig. 1). Sites are distributed along the left bank of Pelotas River, in a region with relief and vegetation characteristics of the Brazilian *Araucaria* Plateau. The altitude ranges between 500 and 1000 m above sea level. The vegetation is characterised by the occurrence of deciduous forests closest to the river and of mixed rain forests and *Araucaria* forests interspersed by grasslands in higher altitude areas further away. The climate is temperate hot, Cfb in the Köppen system, without dry season; the annual precipitation is 1752 mm; mean annual temperature is 16° C, reaching under zero temperatures in winter (IBGE 2010).

This region's occupation by Southern Proto-Je groups was dated between c. 1200-300 yrs BP. The archaeological record consists of ensembles of pithouses, funerary monuments, ceremonial centers, and cultivation areas assigned to a farming society presenting well-defined social and political structures. Their material culture consists of a pottery industry described as utilitarian, and a lithic industry characterised by polished and flaked artifacts (for more information see AZEVEDO and SCHEEL-YBERT, this volume).

In this context, three dwelling sites – two of them composed of pithouses (Ari-I and Leopoldo-V) and one litho-ceramic (Pedreira) – and a ceremonial site consisting of an earth mound (Leopoldo-VII) were studied (AZEVEDO 2014; AZEVEDO and SCHEEL-YBERT, this volume). These sites were dated from 1200±40 to 350±40 yrs BP (SOUZA 2012), therefore representing all the occupation period known to the region.

The Ari-I site (RS-PE-41), dated at 1200±40 yrs BP (1178-964 cal yrs BP), is a dwelling space composed of 10 pithouses, six earth mounds, surface concentrations of lithics and potsherds, and earthworks limiting the structures (AZEVEDO 2014). The sample analysed here consists in dispersed charcoal fragments evidenced throughout the occupation layer of an excavated pithouse.

The Leopoldo-V site (RS-PE-11), dated at 1140±40 yrs BP (1066-930 cal yrs BP), consists of 8 pithouses also considered a domestic area, linearly distributed on top of a hill and limited by earthworks (COPÉ et al. 2002; SALDANHA 2005). A sample coming from a hearth excavated in the center of a pithouse floor was analysed.

The Pedreira site (RS-PE-12), dated at 460±40 yrs BP (535-328 cal yrs BP), consists of a large circular patch of darkened soil containing dispersed lithics and pottery. It is interpreted as the floor of a semi-circular hut (COPÉ et al. 2002; SALDANHA 2005). Charcoal samples from a hearth of concave base, probably located in the hut entrance, were studied.

The Leopoldo-VII site (RS-PE-21), dated at 350±40 yrs BP (486-300 cal yrs BP), is a ceremonial site located at a high area in the same settlement system as Leopoldo-V. It comprises at least two mound structures of 15 and 20 m in diameter each, both containing central mounds associated with dispersed lithics and pottery (COPE et al. 2002; SALDANHA 2005). A funeral pyre excavated from this site provided the charcoal samples analysed.

MATERIAL AND METHODS

Archaeological excavations in all sites were performed according to traditional methods. Morro Grande and the Southern Proto-Je sites were extensively excavated in natural layers. At Morro Grande, all the sediments removed from an extensive open-area excavation in Locus 2 were dry- or water-sieved and the charcoal pieces were collected with supple tongs (SCHEEL-YBERT et al. 2014a), while in Southern Proto-Je sites charcoal was collected alongside with other archaeological materials only when its presence was identified in the sediments during the excavation (AZEVEDO 2014). In the Hatahara site, one test pit of 1 m^2 was excavated in 10 cm-artificial layers; all sediments removed were water-sieved in the field and later flotated in the lab; charcoal pieces were collected from both light and heavy fractions (CAROMANO 2010). All sieving and flotation were performed with 4-mm meshes. A synthesis of sites characteristics and archaeological methods is presented in Table 1.

Charcoal identification was performed under reflected light brightfield/darkfield microscopes, observing wood anatomical features along fresh hand-broken surfaces. Systematic determinations were helped by a computerised key for wood determination associated with a database of anatomical characters for Brazilian species (SCHEEL-YBERT 2012; SCHEEL-YBERT et al. 2014b), as well as by comparison with the reference collection of modern carbonised wood from the *Laboratório de Arqueobotânica e Paisagem do Museu Nacional*, UFRJ (SCHEEL-YBERT 2016) (both containing over 1200 species/2300 specimens of different Brazilian vegetation types) and with the specialised literature. All results are presented in count of charcoal pieces, according to methodological premises standard in anthracology and already previously justified (CHABAL 1997; SCHEEL-YBERT 2000, 2004b).

Each sample consisted of a minimum of 200 (Morro Grande and Hatahara sites) or 300 (Southern Proto-Je sites) charcoal pieces, except for samples with fewer pieces, in which case all available charcoal was analysed. Only charcoal pieces above 4 mm were analysed, since smaller fragments generally lack a set of anatomical diagnostic features large enough for determination.

Charcoal diagrams were plotted using program C2 Data Analysis (JUGGINS 2007) (Morro Grande and Hatahara sites) or Excel (Southern Proto-Je sites). Diagrams were constructed with the relative frequencies of the different taxa calculated on the basis of the number of identified fragments, indeterminate pieces included (Ni). The total number of fragments analysed (Nt) comprises the Ni plus non-identifiable pieces (e.g. knots, bark, poorly-preserved fragments) (SCHEEL-YBERT 2004b).

Statistical analyses and ecological measures (especially the Shannon diversity index[4]) were calculated using the computing environment R (R Development Core Team 2007).

An estimate of the successional stages represented in each anthracological assemblage was obtained by attributing the identified taxa to ecological groups (pioneer, early secondary, late secondary, or climax), according to various authors who used this approach in phytosociological surveys from the phytogeographical area of each site. Most archaeological taxa being determinated at genus level, the ecological groups of the most frequent species in each region were considered.

The floristic composition, physiognomy, and structure of plant communities change over time according to processes of ecological succession. The characteristics of different plant species in a given plant community are related to these processes, and it is therefore possible to recognise successional stages through the plants that occur in each community. Pioneer plants, heliophilous and resistant to drought, grow

[4] The Shannon diversity index is frequently used in plant ecology to describe different plant communities by taking into account species richness and uniformity in distribution. The higher the index, the greater the plant diversity, i.e., the higher the number of species (richness) and the more evenly they are distributed (equitability), the greater the plant diversity.

in areas devastated either by natural or by anthropogenic agents, and are the first to develop on the exposed soil. They are therefore the first to colonise a deforested land after disturbance, shortly followed by early secondaries. Secondary plants are those that prevail in the initial and intermediate stages of forest development or recovery. Late secondary plants would be the last to appear before the final stage of forest development: the climax community, a ‘mature’ and relatively stable forest (or plant community) in equilibrium with the physical environment (BUDOWSKI 1965).

One must keep in mind that the classification of plant species in ecological stages is not straightforward. Several different classification schemes have already been proposed (cf. LONGHI et al. 2006). More recently, the very concept of “climax” came to be questioned, as it implies the existence of supposed “untouched” vegetation. In spite of that, this approach can provide useful means of describing the plant environment and understanding the vegetation.

Table 1: Synthesis of site characteristics, archaeological methods, and anthracological samples analysed in this paper for each site (only conventional dates given here).

site	location / current phytogeography	site occupation/ studies layers	studied sample	archaeological context	associated date	excavation method	charcoal recovery	sample size
Morro Grande	Southeastern Brazil (RJ) – Atlantic rainforest	4 occupation periods (3 studied)	dispersed charcoal	Domestic	2920±70 to 1740±90 BP	extensive excavation in natural layers	dry- or water-sieving in the field	Ni=549 Nt=642 Nsp=51
			*plus concentrated samples and funerary context non detailed here					
Hatahara	Central Amazon (AM) – Amazon rainforest (*terra firme / várzea*)	4 occupation periods (3 studied)	dispersed charcoal	domestic or garden/field	probably c. 2250/1550? to 700 BP	1m² test pits, 10cm-artificial layers	water-sieving in the field + lab flotation	Ni=585 Nt=659 Nsp=58
Ari-I	Southern Brazil (RS) – Mixed rain forest, Deciduous Araucaria forest, Grasslands	1 occupation period each site	dispersed charcoal	domestic (pithouse)	1200±40 BP	extensive excavation in natural layers	hand-picked in the field	Ni=300 Nt=340 Nsp=8
Leopoldo-V			Hearth	domestic (pithouse)	1140±40 BP			Ni=263 Nt =287 Nsp=9
Pedreira			Hearth	domestic (lithoceramic)	460±40 BP			Ni=300 Nt=312 Nsp=4
Leopoldo-VII			funeral pyre	ceremonial	350±40 BP			Ni=264 Nt=300 Nsp=9

RESULTS

Morro Grande Site

Charcoal samples from different contexts in three loci of the Morro Grande site were analysed; the complete results were already published (BEAUCLAIR et al. 2009; SCHEEL-YBERT et al. 2014a). From almost 4,000 charcoal pieces identified, 1,112 fragments related to dispersed charcoal from domestic contexts of Locus 2 were used for palaeoecological interpretation, but only the results of a part of the locus with exclusively domestic evidence (5 squares out of 17, which provided 642 charcoal fragments) will be more detailedly presented here.

From these, 51 taxa in 26 families were identified, along with 20 indeterminate (Fig. 2). Taxonomic composition and frequencies in the three analysed levels demonstrate the permanence of the Brazilian Atlantic rainforest in the region between 3,220-2,840 cal yrs BP and 1,820-1,390 cal yrs BP. Taxonomic richness increases, along with sample size, from earlier to later archaeological levels (20 taxa in 114 charcoal pieces in level 1; 27 taxa in 223 fragments in level 2; and 35 taxa in 305 fragments in level 3). Shannon diversity indices (H') are relatively low (2.7-2.1-2.6, respectively). There is a high proportion of taxa of early successional stages in all archaeological levels, although taxa of late ecological successional stages are also recorded (Fig. 2). An increase in the proportion of early successional taxa in the third archaeological level (L2-l.3, 1820-1390 cal yrs BP) points to a possible opening of the local vegetation after c. 2,000 yrs BP.

A positive linear correlation (0,7361) was verified between species richness and number of charcoal pieces analysed in funerary and domestic hearths, confirming that taxonomic diversity increases in larger samples (BEAUCLAIR et al. 2009). Larger samples obviously increase representativeness. However, all available fragments were analysed.

Hatahara Site

In this site, the analysis of 659 charcoal pieces from one test-pit revealed 585 woody dicotyledons and two monocotyledons (palms); 58 dicotyledon taxa were distributed in 36 families and 49 genera, along with nine indeterminates (CAROMANO 2010) (Fig. 3).

All taxa are characteristic of the Amazon Forest; taxa characteristic both of the *terra firme* and of the *várzea* forest occur, indicating a forested environment between c. 2250/1550 and 700 yrs BP. However, as no direct date was obtained from the studied locus, this is an approximate chronology.

Taxonomic richness increases, along with sample size, from earlier to later archaeological levels (36 taxa in 148 charcoal pieces in level 1; 48 taxa in 221 fragments in level 2; and 58 taxa in 290 fragments in level 3). Shannon diversity indices of 3.28, 3.42, and 3.67 H', respectively, are consistent with the expected for Central Amazon (varying from 3 to 5, according to MARTINS 1993). There is a high proportion of taxa of early successional stages on all archaeological levels; taxa of late ecological successional stages were scarce; some possibly cultivated taxa are present (Fig. 3).

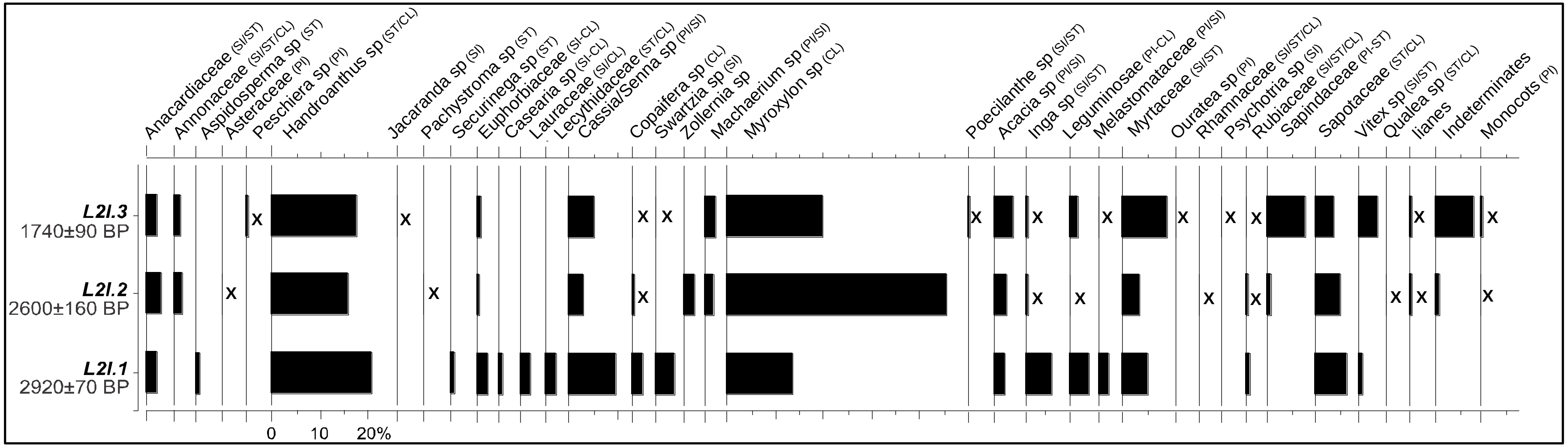

Figure 2: Morro Grande anthracological diagram (adapted from SCHEEL-YBERT et al. 2014a) – Ni (Number of identified wood charcoal pieces): L2l.1=282, L2l.2=197, L2l.3=70; Nt (Total number of analysed charcoal pieces): L2l.1=305, L2l.2=223, L2l.3=114; Nsp (Number of species in each sample): L2l.1=35, L2l.2=27, L2l.3=20; H' (Shannon diversity index): L2l.1=2.6, L2l.2=2.1; L2l3=2.7 – Codes after the taxonomic names stand for their classification in ecological groups (see legend Fig. 5). Crosses indicate presence of rarer taxa (< 2%).

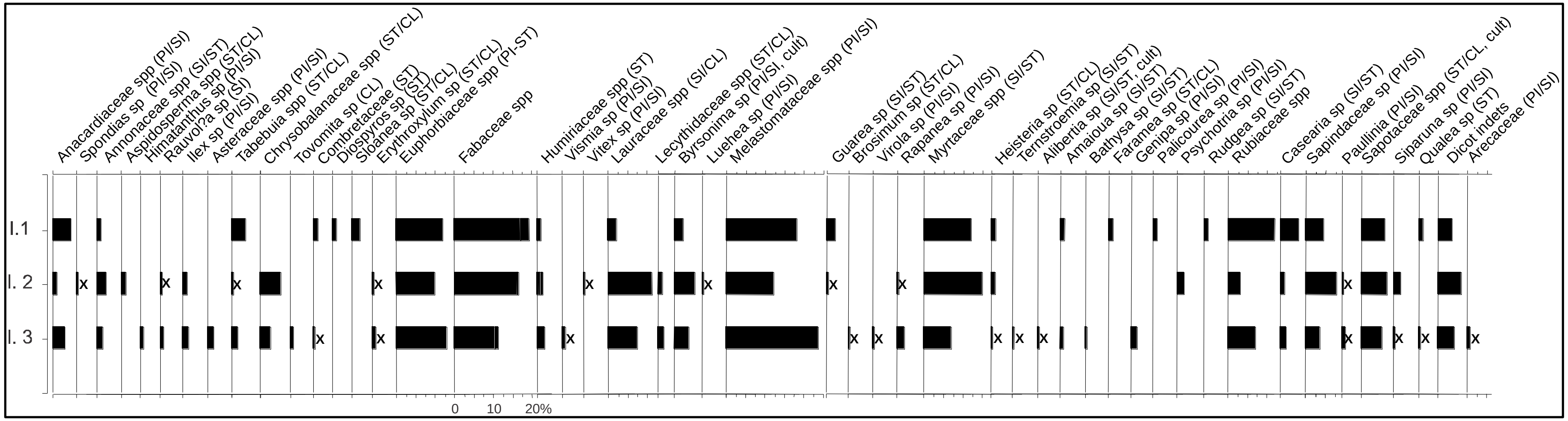

Figure 3: Hatahara anthracological diagram – layer.1: Ni=129, Nt=148, Nsp=26, H': l.1=3.28; layer.2: Ni=200, Nt=221, Nsp=35, H': l.1=3.67; layer.3: Ni=256, Nt=290, Nsp=42, H': l.1=3.43 – Estimated dates between c. 2250/1550 and 700 yrs BP.

Southern Proto-Je

All charcoal pieces collected in each of the four studied sites were analysed, consisting of a total of 1,239 fragments (AZEVEDO 2014; AZEVEDO and SCHEEL-YBERT, this volume).

Twenty-three taxa were identified, comprising 12 families, 12 genera, and four types of indeterminate angiosperms, including one liana (Fig. 4). All taxa are characteristic of the Brazilian Atlantic rainforest biome and occur in the mixed rain forest (*Araucaria* Forest), demonstrating the permanence of this vegetation type during all the studied period, around c. 1178-930 cal yrs BP (sites Ari-I and Leopoldo-V).and later around c. 535-300 cal yrs BP (sites Pedreira and Leopoldo-VII). A very low diversity was observed in all studied sites, including, conversely to the expected, the dispersed charcoal sample from Ari-I (8 taxa in 340 charcoal pieces in Ari-I; 9 taxa in 287 pieces in Leopoldo-V; 4 taxa in 312 pieces in Pedreira; 9 taxa in 300 pieces in Leopoldo-VII) (Fig. 4).

The high proportions of *Inga* sp in all studied sites possibly point to a fuelwood preference. This taxon was largely predominant in samples Ari-I, Pedreira, and Leopoldo-VII (43, 62, and 52%, respectively), while also well represented in Leopoldo-V (17%) (AZEVEDO 2014; AZEVEDO and SCHEEL-YBERT, this volume).

High proportions of taxa of early successional stages were recorded in all samples.

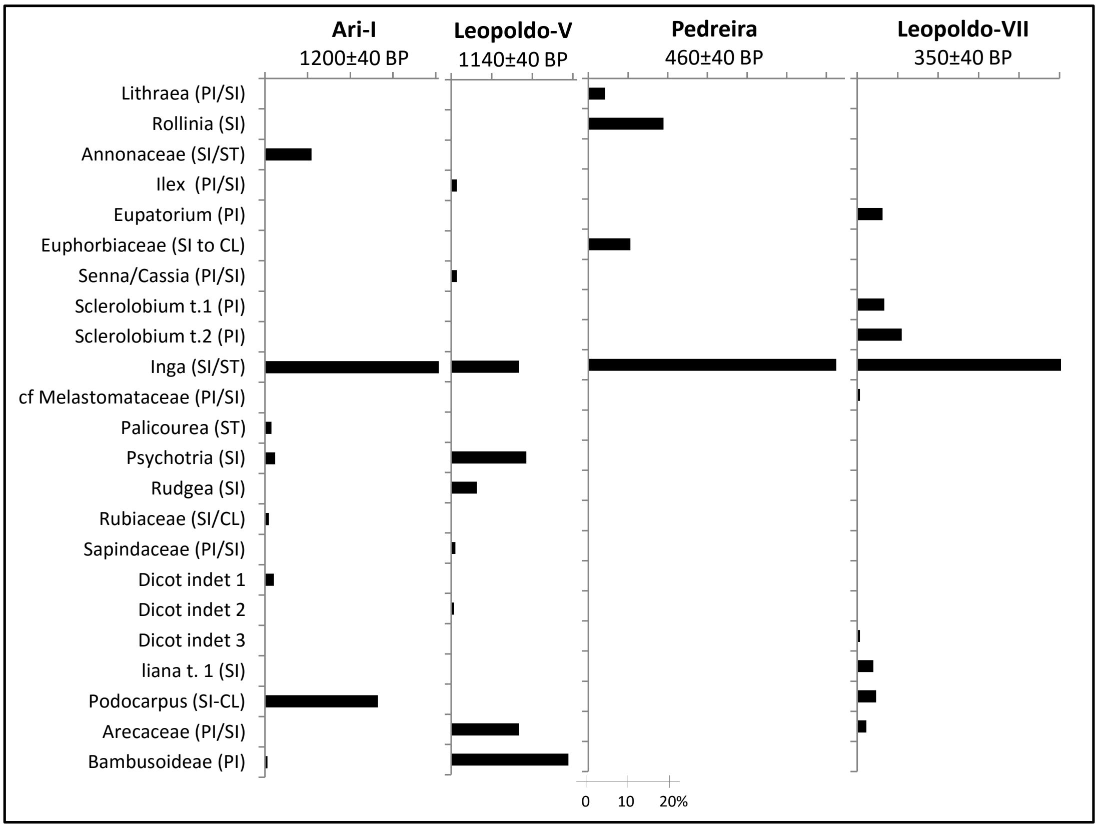

Figure 4: Southern Proto-Je sites anthracological diagrams – Ari-I: Ni=300, Nt=340, Nsp=8; Leopoldo-V: Ni=263, Nt =287, Nsp=9; Pedreira: Ni=300, Nt=312, Nsp=4; Leopoldo-VII: Ni=264, Nt=300, Nsp=9 – Codes after the taxonomic names stand for their classification in ecological groups (see legend Fig. 5).

DISCUSSION

Environment

Anthracological results for all studied sites demonstrated the existence of forested environments around the settlements, in accordance with what would be expected in each phytogeographical area. The assemblages of taxa identified point to the occurrence of the Atlantic Forest in the Southeastern region between c. 3000 and 1500 cal yrs BP (Fig. 2); of *terra firme* and *várzea* forests in the Northern Central Amazon from c. 2250/1550(?) to 700 yrs BP (Fig. 3); and of Atlantic Forest and *Araucaria* forest in the Southern part of the country from c. 1180 to 300 cal yrs BP (Fig. 4).

Very high taxonomic richness was verified in Central Amazon and in Southeastern Brazil, even if diversity indices were relatively low in the latter, pointing in both cases to a good representation of the landscape and to long lasting occupations (Figs. 2-3).

The very low diversity from Southern sites is most probably explained by a bias of archaeological sampling, which was asystematic, although cultural practices of cleaning or sweeping the dwelling area before each new fire and/or cultural choice of specific taxa might also be implied (cf. AZEVEDO 2014; AZEVEDO and SCHEEL-YBERT, this volume). However, the identification of key taxa characteristic of the vegetation typical to this area in all samples (e.g. *Podocarpus*, *Ilex*) allow a qualitatively reliable landscape reconstruction (Fig. 4).

In Central Amazon, the more prevalent families, either in number of taxa or in number of individuals, were Melastomataceae, Fabaceae, Myrtaceae, Rubiaceae, Euphorbiaceae, and Sapotaceae, which together accounted for more than 50% of the identified charcoal pieces (Fig. 3). Those families still figure among the more important plants recorded in phytosociological studies in Central Amazon (e.g. HOPKINS 2005; OLIVEIRA and AMARAL 2005). The high prevalence of Melastomataceae in this record clearly evokes the secondary forests ("*capoeiras*") currently so common in the Central Amazon near Manaus, where plants of this family are conspicuous and compose a great part of the understory (personal observation of the first author; also Junqueira, pers. comm.).

In the Southeastern, Fabaceae, Bignoniaceae, Myrtaceae, Sapotaceae, and Euphorbiaceae are the most important families, both in number of species and of individuals (Fig. 2), paralleling what is presently found in low altitude Atlantic forest facies (e.g. VAZ 1992; OLIVEIRA-FILHO and FONTES 2000). In this site, high frequencies of *Myroxylon* and *Handroanthus* are remarkable. High frequencies of *Handroanthus* can be consistent with an environmental natural condition, as species of this genus are frequently important elements of the dense ombrophilous forest. *Myroxylon*, however, is a very rare plant, unlikely to ever have been predominant in the Atlantic Forest phytosociology. Given their properties, it is unlikely that any of these taxa was selected merely for firewood, for both plants are characterised by producing highly valuable wood and important medicine. Besides, they are characteristically late secondary or climactic species, which should be searched farther from the settlement. The prevalence of these taxa might therefore be explained by a particular exploitation of their wood. If so, the wood waste remaining from these activities was probably set to fire, raising their frequencies in the anthracological spectrum (SCHEEL-YBERT et al. 2014a).

In the South, Fabaceae was clearly the best represented family, both in number of taxa and of individuals, followed by Rubiaceae, Podocarpaceae, and Annonaceae (Fig. 4). However, in this case, the results cannot be taken as representative of the phytosociological importance of these families in the vegetation, because of the low diversity of the samples.

No significant palaeoenvironmental variation was recorded in any of the sites during the studied periods, except for a possible opening of the local vegetation after c. 2,000 yrs BP in the Morro Grande site, as demonstrated by an increase in the frequency of pioneer and early secondary plants (Fig. 5).

All sites bear in common a high proportion of taxa of early successional stages, attesting the existence of secondary vegetation around the settlements (Fig. 5).

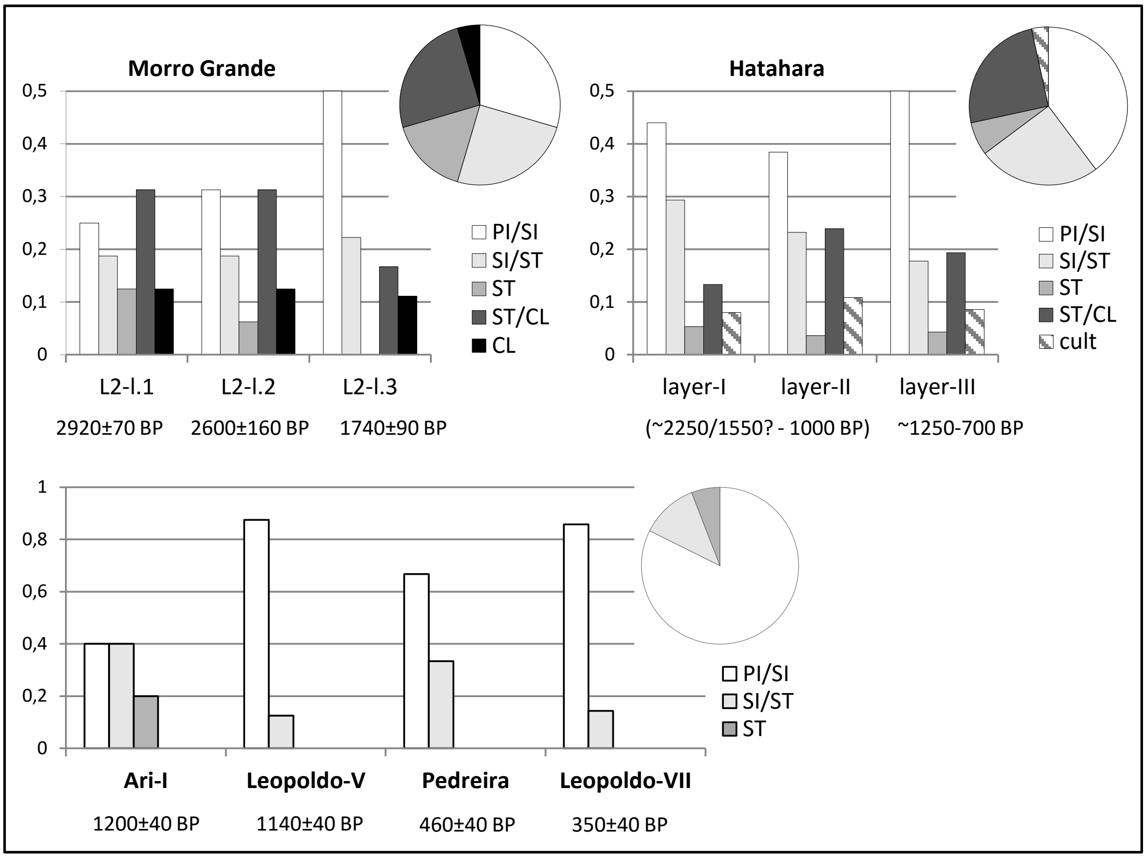

Figure 5: Histograms showing the distribution of taxa in ecological groups for all sites in frequency of the number of taxa at each archaeological level. Pie charts represent the distribution of ecological groups in all analysed samples (dispersed and/or concentrated charcoal in Morro Grande and the Southern Proto-Je sites, only dispersed charcoal in Hatahara) (PI- pioneer; SI- early secondary; ST- late secondary; CL-climax; cult- cultivated).

Besides the taxonomic evidence, wood anatomy aspects also point to early successional stages taxa. Indeed, it is well known that ecological factors affect wood anatomy. On the one hand, there is a genetic component that distinguishes the wood anatomy of trees occurring under certain environmental conditions; on the other hand, individuals of the same species growing under different ecological conditions will respond producing slightly different wood anatomical features (FISHER et al. 2007). It is therefore possible to drive climatic and vegetational inferences from wood anatomy, as certain wood anatomy features tend to be more common under particular ecological conditions (e.g. CARLQUIST 1977, 2001; CARLQUIST and HOEKMAN 1985; WIEMANN et al. 1998; ALVES and ANGYALOSSY 2000).

Vessels which are narrow and numerous, frequently grouped, and the presence of well-marked growth rings are associated with xeromorphy and are expected in seasonal climate (dry or cold). On the contrary, vessels that are wide and rarer, frequently solitary, and the absence of growth rings indicate mesomorphy and are associated with humid environments (CARLQUIST 1977; CARLQUIST and HOEKMAN 1985). In the equatorial Amazon, and to a lesser degree in tropical Atlantic rainforests, trees presenting large and unfrequent vessels are expected.

It was therefore quite surprising that most of the anatomical types identified in Hatahara site presented rather small and frequent vessels, frequently grouped, conversely to what was to be expected in such environment (cf. ALVES and ANGYALOSSY 2000) – the same pattern apply to the Morro Grande site, where it was less unexpected (Figs. 6-7). Growth rings are rare in both sites, for there is no climatic seasonality, but it is clear that these trees experienced a certain level of water restriction. This could be explained if they were not growing inside the very humid environments of a rainforest, but rather in quite open spaces characteristic of anthropogenic secondary vegetation, and thus submitted to higher insolation and a lesser hydric availability.

These results point to the fact that human occupation, as might be expected, promoted forest disturbance and created anthropogenic environments. The substantial earthworks and the extended villages characteristic of the Central Amazon and Southern Proto-Je occupations, as well as the anthropogenic dark earths in the former, and the complex settlement system in the latter, have already led several researchers to highlight the importance of past populations in the landscape construction at these regions (e.g. COPÉ and SALDANHA 2002; MACHADO 2005; SALDANHA 2005; COPÉ 2006a, 2006b; NEVES and PETERSEN 2006; REBELLATO et al. 2009; SCHMIDT et al. 2014). However, the importance of human influence on the vegetation has seldom been demonstrated, exception made to the possible management of *Araucaria* pine, with important outcomes to the Southern landscape (COPÉ 2006a; BITENCOURT and KRAUSPENHAR 2006; IRIARTE and BEHLING 2007).

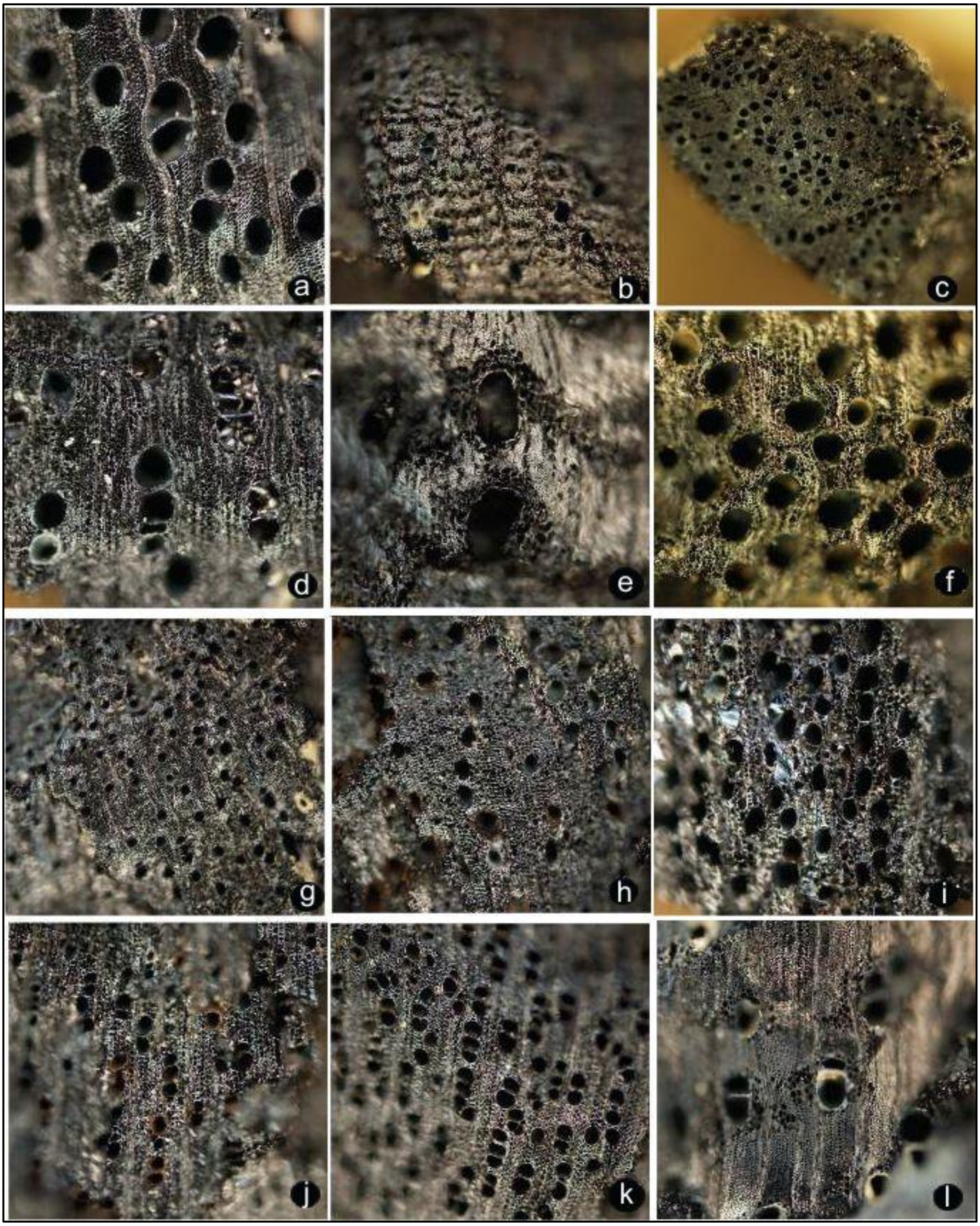

Figure 6: Transversal plans of some of the taxa identified in Hatahara site at reflected light microscopy. a. Anacardiaceae; b. Annonaceae; c. Apocynaceae (*Aspidosperma* sp); d. Euphorbiaceae; e. Fabaceae; f. Humiriaceae; g. Melastomataceae; h. Myrtaceae; i. Pentaphylacaceae; j. Rubiaceae (*Psychotria* sp); k. Salicaceae (*Casearia* sp); l. Vochysiaceae (*Qualea* sp). All pictures taken at 100x increment.

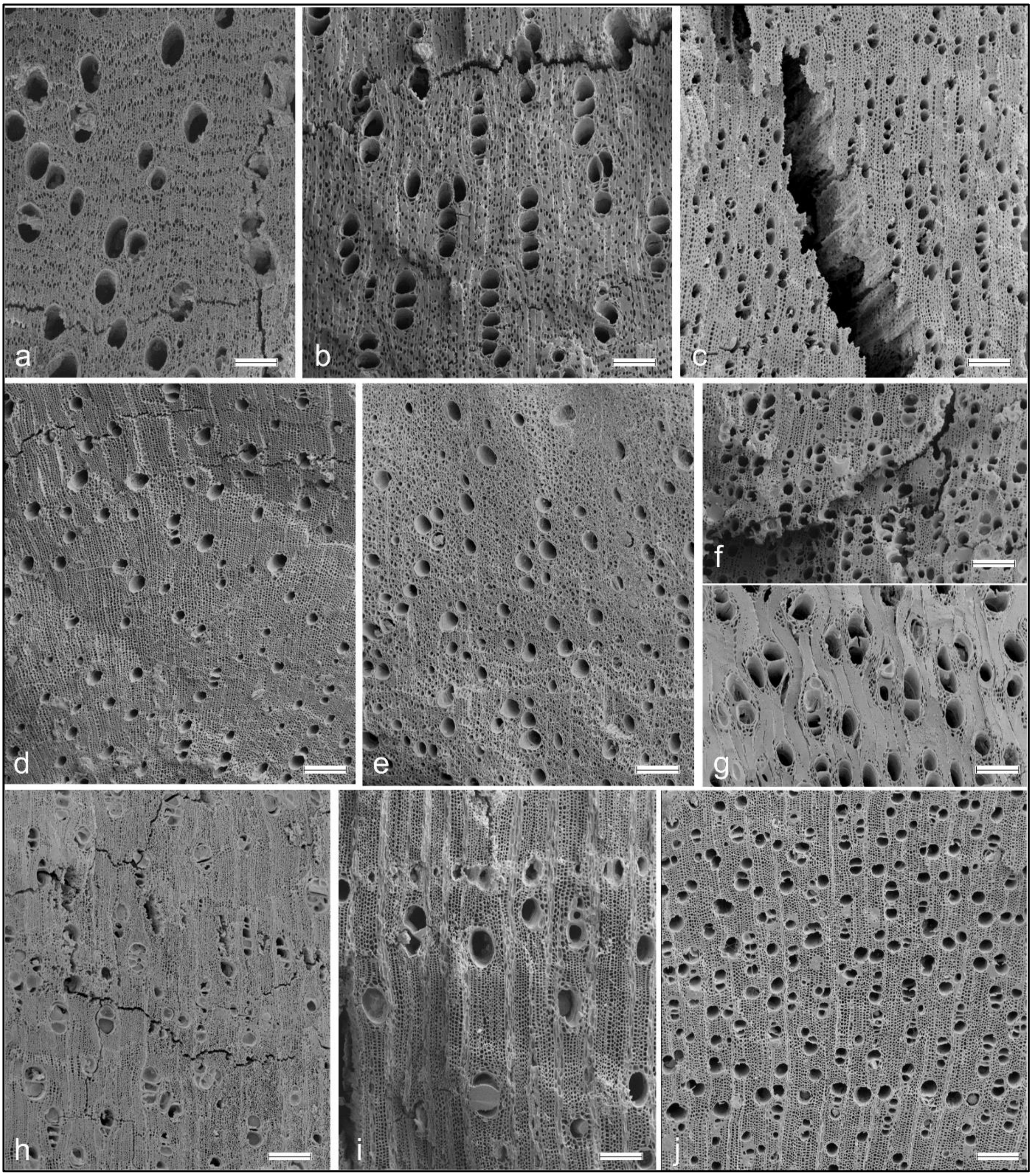

Figure 7: Transversal plans of some of the taxa identified in the Morro Grande site at scanning electron microscopy. a. Chrysobalanaceae; b. Sapotaceae; c. Rubiaceae (*Psychotria* sp); d. Fabaceae (*Machaerium* sp); e. Myrtaceae; f. Bignoniaceae (*Handroanthus* sp); g. Fabaceae (*Myroxylon* sp); h. Fabaceae (*Bauhinia* sp); i. Fabaceae (*Copaifera* sp); j. Anacardiaceae. bars = 200 μm (adapted from SCHEEL-YBERT et al. 2014a).

Plants use

The plant diversity represented in charcoal samples from the Morro Grande and Hatahara sites undoubtedly demonstrates that, at least for most usages, the gathering of firewood for domestic firewood was not selective. For both these sites, collection of the necromass (dead wood), carried out in spaces of secondary anthropogenic vegetation surrounding the settlements, but possibly also in fallows or swiddens, is suggested.

Some particular species might be preferred for specific firewood uses, as it seems to be the case in Southern Proto-Je sites, where *Inga* was possibly selected for its burning qualities and/or symbolic value. Even if the possibility of some fuelwood preference is not opposed to the gathering of deadwood or tree felling (the latter associated with swidden cultivation?) for a more general use as firewood, the very small and probably biased samples from these sites do not allow for any more solid inferences.

Plants possibly bearing edible fruits, valuable wood and/or medicinal parts are very common in the anthracological records of all studied sites (Table 2); other potentially useful taxa, such as hallucinogenic or ritualistic plants, were also recorded, especially in Hatahara site.

Table 2: Potentially useful taxa recorded in Morro Grande, Hatahara, and in the Southern Proto-Je sites studied.

Taxon	Use	Morro Grande	Hatahara	Proto-Je
Anacardiaceae	edible fruits	X	X	X
Spondias (cajá)	edible fruits		X	
Annonaceae	edible fruits	X	X	X
Aspidosperma sp	valuable wood, medicine	X	X	
Ilex sp	beverage, medicine			X
Eupatorium sp	medicine			X
Handroanthus sp	valuable wood, medicine	X	X	
Chrysobalanaceae	edible fruits, *cariapé*	X	X	
Diospyros sp	edible fruits		X	
Lecythidaceae	edible fruits	X	X	
Copaifera sp	valuable wood, medicine	X		
Inga sp	edible fruits	X		X
Myroxylon sp	valuable wood, medicine	X		
Melastomataceae	edible fruits, medicine	X	X	
Byrsonima sp	edible fruits	X	X	
Vantanea sp	edible fruits		X	
Virola sp	hallucinogenic		X	
Myrtaceae	edible fruits	X	X	
Rubiaceae	edible fruits	X	X	X
Genipa sp	edible fruits, black dye		X	
Psychotria sp	medicine / ritualistic	X	X	X
Sapotaceae	edible fruits	X		
Siparuna sp	medicine / ritualistic		X	
Arecaceae (palms)	edible fruits		X	X
Podocarpus	medicine			X

Useful plants, presumably, only happen to be used as firewood when fallen dead branches are collected, as in the case of dead wood gathering. However, this might also happen when the wood wastes of a particular exploitation activity of the trees (e.g. for wood, medicine, dye, or any other reason) are set to fire, as it was proposed by Scheel-Ybert et al. (2014a) to explain the high usage frequencies of *Myroxylon*, *Handroanthus*, and *Copaifera* species (the latter in concentrated charcoal) in the charcoal remains of Morro Grande.

On the one side, the presence of these plants can be interpreted as validating the hypothesis of good representation of the plant environment in the anthracological record, along with the lack of selectivity in firewood gathering. On the other side, the importance of secondary and useful plants around the settlements might be an evidence of the domestication of the landscape, as it will be discussed latter.

Landscape

The concept of "landscape" means much more than merely the topographical and environmental contexts around a settlement (THOMAS 2001; BENDER 2006). It may be defined as the space where human activities are carried out, through which individuals recognize themselves and acknowledge their world within culturally established rules and meanings (HODDER and HUTSON 2003). Hirsh (1995) argues that while the landscape effectively provides a context for human life, it necessarily integrates a relationship between lived realities and potential for other ways of being, which are metaphysical, imagined, or idealised.

Recent approaches to human interaction with the environment frequently privileges the social, emphasising the perception, experience, and symbolic attributes of the landscape, at expense of the natural. McGlade (1995) argues that the debate opposing the landscape perceived as a hermeneutic entity and the landscape as a physical fact is an oversimplification of facts. In reality, social practices occur whithin the natural world and share with it a reciprocal dynamic – the social informs the natural and the natural informs the social. The challenge of working with landscape is to take into account both the natural and the social aspects of the question (THOMAS 2001). In considering the human-environment binomial as inseparable, the concept of landscape therefore rejects any kind of binary relation between man and nature (INGOLD 1993).

Following these premises, and since the mythological system is closely linked to the environment, focusing as it does on the flora and fauna associated with particular places, one might therefore expect a close correspondence between nature and culture, and a logic to the distribution of ancestral beings that accords with the distribution of natural species (MORPHY 1995).

Recent studies aimed at providing a better understanding of landscapes as perceived through anthracological research supply interesting examples. Dotte-Sarout (2010), in an ethnobotanical survey related to the Kanak from New Caledonia, southwestern Pacific, identified four contiguous partitions of the territory, each associated with different ways of managing wood resources and occupation by traditional populations. The domestic space, containing dwelling, gardens, and horticultural areas, is reserved to social and ritual activities; previously cleared, it is replanted with trees strictly distributed according to food or symbolic functions. A borderland assembles useful and symbolic woody plants between the domestic space and the forest; it consists on secondary formations seemingly natural, but where all plants serve a functional role (symbolic, food, raw materials, medicinal, etc). The humid forest is uncultivated, still not a wild space, for it is used, managed, and exploited; this area is perceived as the dwelling of the ancestors' spirits. Finally, the 'deep forest' – associated with higher altitude dense wet rainforests – is considered dangerous, avoided, and out of the social world.

Picornell et al. (2011), in an ethnographical study of the Fang, a slash-and-burn society from Equatorial Guinea, also described a topocentric organization of the world in which the village occupies the center of social space. A network of paths connects the village with other areas of daily activities, such as orchards (cultivation) and rivers (fishing). The forest, further away, is perceived as a space inhabited by the spirits of plants, animals, and the ancestors, which are seen as an integral part of the social life of the village; roads, pathways, orchards, and fallow land are a frontier zone between the center of social life and the forest.

Reconstructing landscapes from archaeological remains is therefore passing beyond the merely economicist and/or naturalistic interpretations to perceiving the underlying cultural determinants that pervade the data, while still not missing their ecological significants. It is clear that the surroundings of the settlements, possibly including not only the dwelling places but also paths interconnecting them with gardens, orchards, cultivation fields, rivers, and exploited forests, were spaces of domesticated secondary vegetation in all studied contexts. Scheel-Ybert et al. (2014a) have proposed that these anthropogenic areas, for their characteristics of proximity, structure, and/or social significance, were probably preferred for the firewood collection in the Morro Grande site (SE Brazil), as both the rather low diversity of charcoal samples and the high proportion of taxa of early successional stages suggested a restricted site catchment area for firewood. In view of the data presented here, it is possible to extend this proposition also to the other studied sites, both in Northern (Hatahara site) and in Southern Brazil (Southern Proto-Je sites). It is not possible to reconstruct the beliefs, ideologies, and particular precepts orienting each of these populations' choices – which anyway are certainly different in each case –, but it is clear that the gathering of firewood took place in areas of anthropogenic secondary vegetation around the villages, the paths, or in fallows/swiddens, and not in the mature forest.

Ethnographic analogy must be taken with extreme caution in any context, and most especially for interpreting Brazilian prehistory. Indigenous lifeways have changed significantly after the colonization, due to the establishment of new and different demographic, geographic, economic, and sociopolitical contexts (Roosevelt, 1989). Besides, ethnological data on firewood use and on the reports of indigenous populations with plant communities are extremely scarce.

Most studies available concern Amazonia. Settlements surrounded by garden plots, with the uninhabited forest further away are reported for different indigenous cultural groups – such as the Ka'apor (Tupi-Guarani) from Eastern Amazon (BALÉE and GÉLY 1989; BALÉE 1994), the Kuikuro (Arawak) from the Upper Xingu (HECKENBERGER 2005), the Barafiri (Yanomami) from Venezuela and Brazil (SMOLE 1989), and the Achuar (Jivaro) from Equator (DESCOLA 1986, 1993), among others.

In all cases, the forest outside the dwelling space, although uninhabited, is not unfrequented. It is a collecting and hunting space, but it is also a strongly manipulated environment. Human manipulation of resources – by relocating, protecting, planting, transplanting, semidomesticating, domesticating, and using plants – is considered to be a central cultural factor in Amazonian adaptations (BALÉE 1989). Indigenous Amazonian people therefore have, and have had, an important impact on rain forest structure and composition, as they alter the course of natural succession by favouring the distribution of plant species used for food, medicine, construction, manufacture, and firewood, through processes that Irvine (1989) called "succession management" and Erickson (2006) called "domestication of landscape".

One example of spatial organization is provided by xinguan Kuikuro settlements – whose economy is essentially based on manioc cultivation and fishing. Villages follow a circular layout with rings of houses and domestic activity areas around a central plaza. Radial paths lead out from the plaza to river ports, bathing areas, lakes, fields, other villages, etc. Trash middens and home gardens extend out from the backyard. Short-fallow swidden cultivation is practiced on the edge of the village (CARNEIRO 1978; HECKENBERGER 2005; SCHMIDT 2009). The ensemble of gardens, groves, baths, paths and other places around the village consists of a largely anthropogenic area, intermediate between the village itself and the "deep forest", place of spirits and ancestors. The latter is not really a "natural" world, but one where there are campsites, special procurement areas, crossroads, and marks of previous land uses (HECKENBERGER 2005) – that is to say, a largely cultural landscape.

For the Kuikuro, firewood is provided essentially by swiddens, which are preferably made in areas of different stages of secondary succession and may supply the settlements for several months (CARNEIRO 1978, 1986).

The Chácobo, a Panoan group from Bolivian Amazonia, collect firewood mostly in secondary forests surrounding the settlement, but also in abandoned pastures. For them, any tree species can be used as firewood, however, they recognise certain species as possessing burning qualities that make them superior for certain specific applications (BOOM 1989).

These examples provide a possible frame in which to interpret the results from the prehistoric sites studied here. Anthracological data from all of them provide evidence for practices of succession management and creation of areas of secondary anthropogenic environments around the settlements since the earliest occupations, meaning from c. 3000 to 1500 yrs BP in Southeastern Brazil (here probably increased after c. 2000 yrs BP), at c. 2250/1550(?)-700 yrs BP in Central Amazon, and from c. 1180 to 300 yrs BP in the Southern sites (Figs. 2-5). The very establishment of the settlements possibly created spaces of domesticated secondary vegetation, but these results might also point to longer-term practices of environmental manipulation in a landscape people had been visiting and slowly transforming even before the installation of each one of these settlements.

These results support the studies based upon historical ecology approaches that have been discussing anthropogenic forests and human influence on the environment (e.g. POSEY 1985; DENEVAN 1992; FAIRHEAD and LEACH 1995; TOLEDO and MOLINA 2007), many of them focusing on Amazonia (BALÉE 1989, 1994; BALÉE and ERICKSON 2006; POLITIS 1997, 2001; RIVAL 1998; OLIVER 2008; CLEMENT and JUNQUEIRA 2010). These authors agree that much, if not all of the biosphere has already been affected by human activity, which does not necessarily lead to degradation and extinction of species (BALÉE 1998). As long as we consider traditional societies and land use at non-industrial scales, human disturbance, local deforestation, and creation of secondary environments do not result in irreversible damage to local biodiversity, due to the resilience of natural ecosystems and their ability of regeneration. Conversely, human activities may actually increase natural biodiversity by forest management, planting, and/or encouraging the growth of an assemblage of useful plants in certain forest spots (BALÉE 1994; RIVAL 1998; POLITIS 2001; OLIVER 2008).

CONCLUSION

Discussing archaeological landscapes does not pertain, according to Ingold (1993), to 'land', 'nature', or 'space', neither does it to 'cultural images' or 'pictorial ways of representing or symbolising surroundings'. Landscape is the world as it is known to those who dwell therein, who inhabit its places and journey along its paths. The distinction between landscape and environment is not easy to establish. We agree with Ingold (1993) in believing that the environment is no more 'nature' than is the landscape a 'symbolic construct'. These concepts are in reality intimately connected, and in reconstructing archaeological environments one must necessarily take into account the cultural choices embodied in them.

The data presented here were obtained from sites of different cultural affiliations, different geographical settings, and different temporalities, yet, they bear in common similar indicators of human influence in the landscape. Creating secondary environments is inherent to the establishment of human populations. However, the ways people perceive the environment around them may vary, and that might only become clear by taking into account a large set of archaeological indicators.

Besides demonstrating that the plant environment around the settlements was modified through human action, the results presented here also highlight cultural choices concerning the gathering and the catchment area of firewood. Gathering of deadwood is suggested for Morro Grande (SE Brazil) and Hatahara (Amazonia) sites, coupled, in Morro Grande, with the use of wood wastes from the specific exploitation of some useful trees. In Southern Proto-Je sites firewood might be obtained by deadwood gathering or wood felling, but selection of a particular species for technological and/or symbolic value is also suggested.

While pointing to the collection of firewood in secondary vegetations probably surrounding the settlements, the anthracological results from Amazonian, Southeastern, and Southern Brazilian sites provide evidence for practices of succession management, resources manipulation, and creation of areas of secondary vegetation around the settlements since at least 3000 years before present. The data provided are an important contribution to a better understanding of the relationship between past Brazilian populations and their landscapes. These people interacted with the natural vegetation, influencing and transforming it in a series of ways – including the creation of area of secondary vegetation and possibly the concentration of useful plants. The establishment and maintenance of sedentary or semi-sedentary settlements, swidden cultivation, horticulture, plant gathering, exploitation of forest products, forest management, hunting, ceremonial activities, and others, all interfere with the environment and shape the landscape, either as a physical reality and as social constructs. These people have therefore adapted to the environment while concomitantly adapting the environment to their necessities and signifying it accordingly to their beliefs, creating landscapes that changed through time and were certainly very far from the ideal of “pristine” Atlantic or Amazon Forests.

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