Man and Vegetation in Southeastern Brazil during the Late Holocene

Rita Scheel-Ybert*

Laboratoire de Paléoenvironnements, Anthracologie et Action de l’Homme (UMR 5059), Université Montpellier II, Institut de Botanique, 163 rue Auguste Broussonnet, 34090 Montpellier, France

(Received 22 June 1999, revised manuscript accepted 24 March 2000)

Despite the great interest shown by archaeologists in the environment of Brazilian fisher–gatherer–hunter populations and their diet, little is known. Desiccated plant remains are rarely recovered in these archaeological sites, but charcoal, an invaluable source of palaeoenvironmental information, is usually abundant. Six shell-mounds from the southeastern coast of Rio de Janeiro State (Brazil) were studied. Anthracological analysis of over 15,500 charcoal fragments showed that this region was covered by different plant associations during the Late Holocene, and that no significant variations affected the vegetation during this period. Palaeoethnological observations suggest that the random gathering of dead wood supplied most of the wood fuel used by man. Gathering of plant food was certainly much more important to these populations than it has been previously thought. The great number of carbonized palm fruit shells, seeds and monocotyledon tubers found testifies to their importance on human diet.

Keywords: CHARCOAL, TUBERS, SHELL-MOUNDS, PALAEOETHNOLOGY, PALAEOENVIRONMENT, BRAZIL.

Introduction

Fisher–gatherer–hunter populations lived along the Brazilian coast from at least 7000 to 450 years BP (Gaspar, 1996). The principal archaeological remains of this occupation are the sambaquis, shell-mounds usually established on the margins of large water bodies, in sectors where the coastline is indented and in the vicinity of a wide variety of ecological habitats (sea, lagoons, rivers, restingas, mangroves, forests). Sites are characterized by associated habitation material, waste deposits and burial sites. Most archaeological layers contain artifacts, burials and fire places. Habitation structures are also occasionally found. Archaeological sediments consist mainly of mollusc shells and fish bones, frequently alternating with sandy layers rich in organic matter and faunal remains (Gaspar, 1998). Composition of sedimentary layers varies from one site to another, but artifacts are similar in all of them (Gaspar, 1992).

The environment surrounding these populations and their diet have long been among the major interests of Brazilian archaeologists, but they are still very poorly known. Poor preservation of plant remains has never allowed palaeovegetation studies, and until now the palaeoenvironmental reconstructions have been based mainly on animal remains and stone objects. Some archaeologists consider that economic modifications and the disappearance of fisher–gatherer–hunter populations were due to environmental changes (Uchôa, 1981/82; Dias, 1987). However, this hypothesis has never been demonstrated. Gaspar (unpublished) argues that this sociocultural system maintained itself for more than 6000 years and that at no moment do material remains indicate a real change, suggesting a stable culture. Gaspar (1992, 1995/96) suggests that Brazilian fisher–gatherer–hunter populations might have been sedentary. She points out that sites are strategically located, and give access to abundant renewable resources. Furthermore, Yesner (1983) considers that marine resources are better exploited from a single place. Fisher–gatherer–hunter populations were established in extremely rich areas, where both marine and plant resources were available all the year round. Sedentary settlement was therefore possible.

Sambaquis are usually rich in charcoal, which represent an invaluable but largely ignored source of information. Charcoal analysis, or anthracology, provides information concerning palaeoethnological aspects such as wood exploitation by prehistoric populations, but also palaeoenvironmental and palaeoclimatic reconstructions. Although the analysis of archaeological charcoal has been widely recognized as a tool for palaeoecological reconstruction, most of the studies concern temperate European and Mediterranean regions (Vernet & Thiébault, 1987; Vernet, 1990, 1992; Heinz, 1991; Badal, Bernabeu & Vernet, 1994; Figueiral, 1995; Thiébault, 1997; Heinz & Thiébault, 1998 etc.), and more rarely Africa
Very few studies have been carried out in areas under tropical climate, where floristic diversity is far greater. Application of charcoal analysis to the tropics has concerned mainly palaeoethnological aspects, e.g. in Ecuador (Pearsall 1979, 1983), southern Florida and Caribbean (Newson, 1991, 1993, in Thompson, 1994) and Thailand (Thompson, 1994). In South America, anthracological studies are known only for French Guyana (Tardy, 1998a, b) and Patagonia (Solari, 1990, 1993/94; Piquè i Huerta, 1999).

The main objectives of our work are: (1) to reconstruct the palaeoenvironment of the Brazilian fisher-gatherer-hunter populations; (2) to evaluate the relationship between these populations and their environment, looking for possible anthropic influences on the vegetation or, inversely, for climatic conditioning on their customs, and (3) to look for palaeoethnological information concerning plant use by these communities.

Study Area

Six sambaquis from the southeastern coast of Rio de Janeiro State (Brazil) were studied. The Sambaquis do Forte, Salinas Peroano and Boca da Barra are situated at the Cabo Frio region (22°53’S, 42°03’W), on both sides of the Itajuru Channel, which connects the Araruma Lagoon to the sea. The Sambaqui da Ponta da Cabeça is situated at the Arraial do Cabo Peninsula (22°57’S, 42°14’W), upon a crystalline hill near the Massambaba Beach. The Sambaquis da Beirada and da Pontinha are located at the Saquarema region (22°55’S, 42°33’W), on the back of the Pleistocene beach ridge between the Saquarema Lagoon and the sea (Figure 1). Detailed information concerning the climate, the geomorphology and the present vegetation of this area are presented elsewhere (Scheel-Ybert, 1998, 2000).

Figure 1. Geographical location of sites (after Scheel-Ybert, in press). (1) Sambaqui do Forte; (2) Sambaqui Boca da Barra; (3) Sambaqui Salinas Peroano; (4) Sambaqui da Ponta da Cabeça; (5) Sambaqui da Beirada; (6) Sambaqui da Pontinha.

Material and Methods

Charcoal fragments were collected from vertical profiles along the top of each sambaqui. Each sample consisted of a sediment layer of 2 m width, 50 cm depth and 10 cm thick. Sediment was dry-sieved in the field using a 4-mm mesh. Residual charcoal was later recovered in the laboratory with a flotation machine (Ybert, Scheel & Gaspar, 1997). At Sambaqui da Ponta da Cabeça, charcoal fragments were collected during the archaeological excavation and plant remains were sorted by hand.

Charcoal samples were examined under a reflected light brightfield/darkfield microscope. Transverse, tangential longitudinal and tangential radial sections were cut manually. Systematic determination was obtained by comparing the anatomical structure observed with that of extant charred samples and with descriptions and photographs from the literature (Détiéenne & Jacquet, 1983; Mainieri & Chimelo, 1989; Record & Hess, 1943). As wood anatomy of tropical plants is very poorly known, especially in this region, we have assembled a reference collection of charred woods containing over 1800 determined samples. Charcoal identification was facilitated by the elaboration of a

program for computer-aided identification specially conceived for charcoal analysis, coupled to a data bank of anatomical features from extant and ancient charcoal (Scheel-Ybert, Scheel & Ybert, 1998).

All the charcoal fragments over 4 mm were analysed. Smaller fragments are normally impossible to identify, because in general they do not present enough important characters. Conventionally, results are presented either by weight or by number of charcoal fragments. In this study, fragments were counted, for two main reasons: (1) tropical woods present a very wide range of density values that may distort biomass estimations based on weight; and (2) frequently, charcoal fragments from shell-mounds are deeply impregnated with carbonates that increase the sample weight in uncontrollable proportions.

**Results**

**Palaeoenvironment**

Anthracological analysis of over 15,500 charcoal fragments has demonstrated that distinct plant associations occupied the southeastern coast of Brazil during the Late Holocene: restingas, mangroves and xeromorphic forests. Inland, the Atlantic Forest was also present (Scheel-Ybert, 1998, in press). The restinga ecosystem, characteristic of the Brazilian coast, presents a mosaic of vegetation types with diverse physiognomies associated to the coastal sandy beach ridges. It varies from sparse open communities ("open restinga") to dense evergreen forest ("restinga forest"), and is characterized by high percentages of Myrtaceae. The xeromorphic forest, up to 8 m high, is typical from the Cabo Frio region rocky shore.

Charcoal assemblages from Sambaquis do Forte, Salinas Peroano and Boca da Barra show that all these plant associations existed in the Cabo Frio region from c. 5500 to 1400 years BP (4244 BC–772 AD). Restinga forest, open restinga, xeromorphic forest and mangrove taxa are present in the three sites in variable proportions (Figure 2). Open restinga is better represented in the Sambaqui do Forte, while forest formations are more important in Sambaquis Salinas Peroano and Boca da Barra. This is a consequence of geographical location. The first sambaqui is situated
near the beach, in the phytosociological domain of open restinga, while the later ones are situated on the eastern margin of the channel, on crystalline hills dominated by the xeromorphic forest.

At the Arraial do Cabo region, the charcoal assemblage suggests a landscape where restinga was predominant, but elements from the xeromorphic forest and mangrove are also present. Anthracological results from Sambaqui da Ponta da Cabeça suggest that open restinga formations were locally predominant over restinga forest and xeromorphic forest from c. 3300 for 2000 years BP (c. 1731 BC–66 AD) (Figure 2). This agrees with what might be expected from the geographical location of this site. At present, it is very near the beach, despite being situated on a crystalline hill.

At the Saquarema region, sandy beach ridges were already occupied by the restinga vegetation during the Late Holocene, between 4300 and 3800 years BP (2911–1345 BC) and from c. 2300 years BP until after 1800 years BP (at least 808 BC–125 AD). Open restinga formations were predominant, but the existence of Atlantic Forest and mangrove vegetation is equally shown (Figure 2). Low percentages of taxa from these formations do not signify that they were rare during this period. They may have been growing further away from the sambaquis where the wood exploitation was less important. Atlantic Forest vegetation was probably situated on the northern side of the Saquarema Lagoon, and mangrove vegetation on its margins. The slight increase of Atlantic Forest elements at the Sambaqui da Pontinha’s level 100–120 cm, i.e. around 2300 years BP (808 BC–125 AD), is not significant and can not be interpreted as a consequence of environmental change.

The only significant variation on the charcoal diagrams concerns mangrove vegetation. In the Cabo Frio region, these variations might be related to climatic oscillations provoking lagoon salinity variations (Scheel-Ybert, 1998, in press). This interpretation is corroborated by the analysis of the curve of isotopic variation on carbonates in the Araruama Lagoon (Tasayco-Ortega, 1996), which confirms the existence in this region of at least two dry episodes, separated by a brief humid episode. In the Arraial do Cabo region, two hypotheses may be proposed to explain the increase of mangrove elements in the upper levels: either it is due to a real increase of this vegetation in the environment, or it might be a consequence of a change in the wood exploitation from the beginning to the end of the occupation. Indeed, Tenório, Barbosa & Portela (1992) describe the first 90 cm of this profile as “a large hearth which grows on and aggregates with numerous small fire places”, while the upper 30 cm are composed mainly by shell remains and are considered as the occupation’s climax. The study of more material, and a better understanding of the archaeological context are necessary before we can decide for any one of these possibilities that are not mutually exclusive. The identification of mangrove elements is very important, because this vegetation, which was probably established on the southeastern margin of the Araruama Lagoon, is presently absent from the Arraial do Cabo region.

Palaeoethnology
Random gathering of dead wood might have been the main source of firewood for Brazilian fisher–gathering–hunters populations. Collection of dead wood is suggested by both traces of decaying before charring and signs of insect larvae attack (Figure 3). Random gathering is suggested by the great diversity of the charcoal assemblage (Scheel-Ybert, 1998, 2000). More than 100 taxa were identified in the single Sambaqui do Forte.

Our analyses showed that 4% of the material may be considered as food remains. Palm fruits, seeds and tuber fragments are present on most archaeological levels. Tubers, found for the first time in sambaquis, are never abundant. Although most of them could not
yet be specifically identified, we already know that a large diversity of species was used. All remains are from monocotyledons. Some of them could be identified as Gramineae/Cyperaceae, others as Dioscorea sp subterraneous and/or aerial tubers (Figure 4). Some remains might belong to Typha domingensis.

Figure 4. a, b—cf. Gramineae/Cyperaceae tuber, macroscopic and SEM views. Sambaqui Salinas Peroano (133–377 AD); c—Dioscorea tuber. Sambaqui do Forte (2454–2046 BC); d, e, f—unidentified monocotyledonous tubers; d—Sambaqui do Forte (3793–3547 BC); e—Sambaqui do Forte (404–194 BC); f—Sambaqui Boca da Barra (AD 562–772). Black scale=1 mm; White scales=100 μm.
To compare the abundance of plant food remains among the different sites, food remains:wood charcoal ratios were estimated for all samples. Charcoal was used in the denominator rather than sediment volume, to control differential preservation (Miller, 1988).

In the Sambaqui do Forte, palm fruit shells and seeds are present in almost all the samples (Figure 5). Tuber fragments and non-identified parenchyma (which can belong to seeds and/or tubers), absent from the surface levels, are relatively abundant in the lower samples. Food remains:wood charcoal ratios are higher between 20 and 190 cm, i.e. in levels where shellfish concentration in the sediment is higher. In the Sambaqui Salinas Peroano, plant food remains are more frequent in the upper levels. Animal food remains (shellfish and bones) are also much more abundant in the upper 40/50 cm, where they occupied the entire excavated surface (Franco & Gaspar, 1992). This suggests that, in sambaquis, higher concentrations of charred plant vestiges do not necessarily testify to an intensified consumption; they may result from concentration of food remains in a certain zone. Concentrations of shellfish and bones are frequent in most of the known sites, but only extended excavations and a better understanding of site heterogeneity (Gaspar, Barbosa & Barbosa, 1994) will show whether they really correspond to an increase of population.

Less palm fruit shells were found at Sambaqui Boca da Barra (Figure 5). Food remains:wood charcoal ratios are high in the lower levels, and significantly lower in the two upper levels, which might testify to a real decrease in plant consumption by the end of the occupation. This sambaqui is composed of shellfish-rich sediments only. This is in agreement with the definition of a declining phase for the upper levels (Heredia, 1984, 1987).

No tuber remain was identified at the Sambaqui da Ponta da Cabeça. The presence of seeds, unidentified parenchyma and palm fruit shells testify to the importance of plant use by the inhabitants of this sambaqui. We do not have access to the entire palm fruits’ samples for this site, so these results are an underestimation. However, association of plant and animal food remains is once again confirmed as the upper levels are characterized by a high concentration both of plant food and shellfish remains (Figure 5).

The Sambaqui da Beirada (Figure 5) is also entirely composed of shellfish-rich sediments. In contrast, plant remains, including wood charcoal fragments, are particularly rare. Unfortunately, it is still not known if this is a consequence of either an archaeological heterogeneity on site or an exceptionally low rate of conservation. In the Sambaqui da Pontinha, equally composed mostly by shellfish debris, plant food remains are abundant in all samples, with a higher concentration in the upper levels.

Discussion

Fisher–gatherer–hunters populations have long been considered almost exclusively as shellfish eaters, and it is only recently that fishing was recognized as predominant over shellfish gathering (Figuti, 1993, 1996). Plant gathering is usually considered as a secondary activity, with negligible importance on diet. We recall that diets based on shellfish gathering, fishing or hunting leave many more remains on archaeological sites than plant gathering. In sambaquis, plant consumption is testified to only by the presence of a few seeds, charred palm fruit shells and stone objects having probably been used in food preparation (Kneip, 1977, 1994; Gaspar, 1995; Tenório, 1991; Tenório, Barbosa & Portela, 1992 etc.). As it is usually difficult to prove plant use, this activity is generally underrated in favour of diets that leave more visible rests in the archaeological sediments.

However, the restinga ecosystem is extremely rich in plant food. High diversity of tubers can be found. Many Dioscorea species exist in the open restinga and in the restinga forest, while various Gramineae and Cyperaceae species, as well as Typha domingensis, are abundant in the marshy areas.

Legumes are also very abundant in the restinga, as well as numerous species bearing edible fruits during all seasons (Maciel, 1984), such as Myrtaceae (Eugetia, Gomidesia, Myrcia, Myrciaria, Psidium), Anacardiaceae (Spoudeias, Tapirira), Annoneaceae (Aroma, Duguetia), Bromeliaceae (Ananas, Bromelia), Cactaceae (Cereus), Celastraceae (Maytenus), Chrysobalanaceae (Chrysobalanus), Malpighiaceae (Byrsonima), Moraceae (Ficus), Palmae (Astrocaryum, Bactris, Syagrus, Allagoptera), Passifloraceae (Passiflora), Sapotaceae (Pouteria, Sideroxylon). It is remarkable that several of these genera are present in the anthropological record (Scheel-Ybert, 1998, in press). The case of Sideroxylon obtusifolium is particularly interesting, as it is a very common species in most of the charcoal samples and a plant that is, at present, very frequent in the vicinity of sambaquis. It is possible that fisher–gatherer–hunters might have encouraged the spread and development of these trees for their edible fruits.

Palm fruits, probably mostly from Astrocaroum, Bactris and Syagrus genus, are frequently found in shell mounds (Heredia & Beltrão, 1980; Carvalho, 1984; Kneip & Pallestrini, 1987), conversely of seeds and tubers. This is certainly due to differential preservation. In fact, besides preservation under waterlogged conditions, conservation of plant remains under tropical climate is achieved almost exclusively by carbonization, which depends on whether or not the plant material is directly exposed to fire. Palm fruit shells are likely to be thrown on the fire after the edible parts of fruits are removed, and even recycled as a supplementary fuel. Seeds, which are commonly parched before consumption or storage, can be accidentally preserved if a few seeds spill into a fireplace, for example. Tubers, on the other hand, fit the category of non-dense plant
Figure 5. Histograms showing number of tuber, non-identified parenchyma, seed and palm fruit shell fragments in the different levels of the sambaquis. Ratios food remains:wood charcoal are presented under the level names on the x-axis.
foods with a high moisture content, which are usually eaten fresh or boiled, like leafy greens and pulpy fruits (Munson et al., 1971, in Miksicek, 1987). They are unlikely to be preserved by carbonization and are therefore rarely identified in archaeological sites. The conservation of numerous charred tuber fragments in all our sites shows that they were widely used by these populations and that plant gathering greatly contributed to their alimentation.

Conclusions
The paleoecological assemblage identified in all sites reveals no great variations through time (Figure 2), which shows that vegetation was not greatly affected either by climatic or by anthropic perturbations. Besides the climatic oscillations affecting mangrove vegetation, no other significant evidence of vegetation change is noticed. This is probably due to the edaphic character of the coastal mainland vegetation and its consequent stability concerning climatic changes (Scheel-Ybert, 1998, 2000). Environmental stability had undoubtedly important consequences to prehistoric populations. We believe that this has been a decisive factor in the sedentarity and in the maintenance of a stable socio-cultural system by the fisher–gatherer–hunters. In our sites, occupation is confirmed during almost 5000 years and at no moment is it possible to demonstrate a significant modification in the archaeological vestiges.

Charcoal analysis allowed many palaeoecological observations, in particular concerning the wood supply and the fisher–gatherer–hunters diet. Gathering of dead wood certainly provided most of the wood fuel used. High diversity of species in the charcoal diagrams suggests that this gathering was randomly carried out.

Gathering of plant food was certainly much more important to these populations than fisher–gatherer–hunter specialists often assume. The great number of charred palm fruit shells, seeds and monocotyledons tubers found in all sites testifies to the importance of plants in these people diet.

This finding parallels studies carried out elsewhere in Brazil and beyond, mostly for inland hunter–gatherer populations (e.g. Prous, 1978/79/80; Resende & Cardoso, 1996). In a Late Pleistocene fisher–gathering Amazonian site, Roosevelt et al. (1996) identified various carbonized fruits from common tropical forest trees. In the Santa Elina rock shelter (Mato Grosso State) the exceptional conservation of desiccated and carbonized macro-remains at the Late Holocene levels allowed the identification of a great number of edible fruits and seeds, mainly from Leguminosae and Palmae (Scheel-Ybert & Solari, unpublished). Mansur studied the wear patterns on stone tools from Late Pleistocene and Holocene sites from Central Brazil and showed that in these occupations they were primarily used on plant material, in contrast to lithics from Patagonian sites, which show predominance of wear pattern related to faunal materials. The analysis of organic residues in stone tools also attested plants use in Panama (Piperno & Holst, 1998) from before 7000 years BP until 700 AD, where starch grains from various tuber plants were present.

Our study has allowed us to identify tubers for the first time in Brazilian sites. The findings throw new light on the understanding of plant consumption by pre-ceramic Brazilian coastal populations. It is interesting to note that, even if there are indications of human management, these populations are outside an agricultural context.

Acknowledgements
This work was accomplished while holding a doctoral scholarship from the CAPES, Brazil (1994–1998). Thanks are due to Maria Dulce Gaspar, Lina Kneip and Maria Cristina Tenório, archaeologists responsible for the studied sites, and to Erik Pears Three and Anne de Piazza, who have driven my attention over parenchyma food remains. We also acknowledge Isabel Figueiral for revising the English text and an anonymous referee for valuable suggestions that greatly improved the manuscript.

References


