Corondó: palaeoenvironmental reconstruction and palaeoethnobotanical considerations in a probable locus of early plant cultivation (south-eastern Brazil)

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The site of Corondó, situated in Campos Novos, in the São Pedro D’Aldeia municipio (Rio de Janeiro State, Brazil), was dated between c. 4000 and 3000 years BP. The high prevalence of dental caries in its population suggests that it might have been a locus of plant cultivation, a hypothesis supported by the presence of diverse plant remains and by the high frequency of grinding artefacts at this site. Anthracological analysis aimed to identify the environment of the site. The charcoal spectrum suggests that it was situated in a restinga forest, near to the Atlantic forest and with the presence of mangrove and open restinga in the environment. Firewood supply was probably obtained by the random gathering of dead wood. The combination of anthracological results with data provided by archaeological and bioanthropological research indicated that the population which constructed this site (1) had a relatively stable sociocultural system; (2) carried out a range of individual activities that remained constant throughout the occupation period; (3) lived in a relatively stable environment.

Keywords: palaeoenvironment, anthracology, archaeology, shell mound, Brazil

Introduction

Archaeobotanical studies are as yet very rare in Brazil. Archaeological and fossil charcoal are still not commonly used as a source of palaeoenvironmental evidence. Anthracology, the study of charred wood with palaeoenvironmental and palaeoethnological objectives (Ballaouche and Neumann 1995; Scheel-Ybert 2000), is beginning, however, to provide interesting data on the environment in which prehistoric Brazilian populations lived (Scheel-Ybert 2000; 2001a; Scheel-Ybert and Solari 2005), as well as providing palaeoethnological information concerning firewood economy and diet (Scheel-Ybert 2001b; 2003).

The site of Corondó (RJ-JC-64), dated between c. 4000 and 3000 BP, is very important to Brazilian archaeology, because of the hypothesis that it could have been a locus of plant cultivation (Dias and Carvalho 1983). This hypothesis, essentially based on the high prevalence of dental caries in the population (Turner and Machado 1983; Machado 1984), was supported by the large number of mortars and other artefacts attributed to plant processing, along with many seeds, charred palm nuts, and other plant remains retrieved by archaeological excavations (Dias and Carvalho 1983).

Anthracological studies aimed to improve our knowledge of this site, since charcoal collected during the archaeological work had never been analysed. The objectives of the study were to provide information on the environment in which this population lived and to compare this to palaeoenvironment reconstructions obtained for more coastal shell-mounds. If possible, palaeoethnological data would be used to contribute to a better comprehension of the way of life of the site inhabitants.

Study area

The site of Corondó (22°45’S, 42°03’W) is located in Campos Novos, in the São Pedro d’Aldeia district,
Rio de Janeiro State, Brazil (Fig. 1). The site stands on a small elevation of c. 1.40 m, 8 km east of the Atlantic Ocean, 6 km north-east of the Una river, and c. 10 km south-east of the Araruama lagoon, at an altitude of 4 m asl, near the Malhada marsh.

The present climate is tropical: wet and hot, with a mild dry season in the winter (Aw in the Köppen classification Nimer 1989). The mean annual temperature is 22–4°C; the mean precipitation is c. 1500 mm/year (Nimer 1989). The area undergoes frequent and intense penetration by strong north-east, occasionally south-east, winds.

The region is characterised by a great plain, separated from the sea by extended sandy beach ridges that have isolated a former marine depression. This depression presently comprises alluvial-fluvial plains, as well as large flooded areas amongst small crystalline elevations. The Malhada, Ramalho and Pai Domingos marshes represent ancient lagoons presently filled in (Lamego 1974; Sant’Anna 1975). Unlike the Araruama lagoon, into which few rivers drain, this region contains several water courses, with a succession of meanders and large flooded extensions, constituting a strongly disorganised drainage zone. Mangroves from the Una river plain penetrate until c. 6 km inland, near to Corondó.

At present, the region is almost entirely occupied by pasturages and secondary vegetation. Halophytic vegetation occurs in flood-prone areas, lagoon margins and marshes. However, there are records that beach ridges were entirely covered by restinga vegetation (Lamego 1974).

The restinga ecosystem is typical of the Brazilian coast. In its geomorphological sense, this term refers to diverse recent marine deposits of multiple origins. However, its use has been gradually abandoned in geomorphology, as it is preferable to use more precise terms to describe each relief form. In its botanical sense, restinga is used to refer to all types of vegetation occurring on quaternary coastal formations from the ocean to the foothills (Rizzini 1979). The term is also commonly employed in a broader ecological sense to refer to the landscape as a whole, including quaternary coastal formations (beach ridges, but also lagoon margins and shifting sand dunes), as well as the plant communities occurring in these topographic zones (Araujo 1989).

The restinga is characterised by a mosaic of habitats presenting various vegetation types with distinct physionomies and organisation patterns, normally distributed according to a zonation that goes from the beach inland (Araujo and Henrique 1984). These plant associations consist of open communities and forests. The former comprise herbaceous (psamophyte in the foredune; swampy in low relief localities) and shrubby formations (either open, forming thickets interspersed with bare sandy areas, or closed, presenting a continuous canopy); the latter includes the sandy restinga forest, with slender, well ramified trunks and a continuous canopy, and
the inundated restinga forest, occurring in low parts of
the relief which are periodically or permanently
flooded (Araujo 2000).

In the mid-twentieth century, swampy areas from
the Campos Novos region were colonised by Typha
domingensis and surrounded by palm trees and
Heliconia shrubs. A dense and diverse sandy restinga
forest existed. Medium to tall trees were covered by
climbers, lianas, epiphytes and bromeliads. Palm
trees were very abundant. Few herbaceous plants
grew in the open understory (Lamego 1974). Unfortu-
nately, no floristic study has ever been conducted in
this region prior to its clearing.

Archaeological context

The Corondo´ site is formed by two interligated
mounds with a small depression between them. The
site’s area is presently of 4800 m². Evidence of
occupation areas was provided by fireplaces, food
remains concentrations and burials (Dias and Carvalho
1983). A very large number of postholes was found
(Dias 1980), many of them demarcating burial loci
(Machado 1992).

Archaeological sediments up to 2 m thick encom-
pass four archaeological layers. The superficial layer
I, undated, contains a large quantity of archaeologi-
cal material; lithic artefacts are particularly abund-
ant. Layer II, dated to 3010±80 BP (2921–3346 cal.
BP), is localised in the depression between mounds; it
varies from 20 to 40cm thick, being more slender at
the site periphery; features interpreted as habitation
areas and burials were reported. Layer III, dated to
3215±90 BP (3142–3591 cal. BP), is up to 70cm in
thick; it presents pockets of gastropod remains
(Pomacea) and features interpreted as cooking areas,
habitation areas, and burials. Layer IV, dated from
3720±95 BP (3702–4257 cal. BP) to 4260±65 BP
(4529–4865 cal. BP), is up to 120cm thick; habita-
tional structures and hearths are the main features
identified; fish remains are very abundant; shell
artefacts are the most frequent (Dias 1993).

Many flaked lithic, especially quartz, implements
were found. Other rocks, particularly gneiss and
diabase, were employed in the fabrication of manos,
metates, axe blades, hammerstones, polishing stones
and other groundstones, which are common in all
archaeological layers. Grinding artefacts are indic-
itive of plant processing, and may be taken as indirect
proof of plant consumption (Dias 1980; Dias and
Carvalho 1983). A great diversity of bone and shell
artefacts, particularly some manufactured with the
hard valves of Macrocalista sp., complete the
industry recovered at this site (Dias and Carvalho
1983).

Many burials, for the most part primary, were
recovered. They were preferentially located in a
sector on the mound periphery throughout the
occupation period. Funerary offerings (implements
and ornaments made of bone, stone or shell), which
occurred very frequently, were more common with
women than with men. The presence of dyes and clay
deposited in burial loci was probably related to
funerary rites. Hearths, lit before the deposition of
corpses, were probably also an important element in
funerary ceremonies. Charcoal and vestiges of burn-
ing were regularly found in the base of burial places
and near to burial sites. However, there were no signs
of calcination of human bones (Machado 1984).

Analysis of 445 skeletons provided rich informa-
tion on this mound-building population (Machado
1984). They were genetically homogeneous, moder-
ately robust, with strong sexual dimorphism and
small stature. Physical characteristics are similar
to those of coastal shell mound (sambaqui) builders. The
estimated age at death of adults varied between 16
and 57 years (mean value of 35 years for men and 37
for women).

Child mortality was quite high in the first year
(53%). Machado (1984) attributes this to malnutri-
tion, which could be aggravated by parasites or
diarrhoea due to poor hygiene conditions, or else to
the practice of infanticide. The latter could be due
either to a process of demographic limitation or to
cultural factors, e.g. death of the mother during
breastfeeding (Machado 1984; cf. Meggers 1971). A
high frequency of Harris lines, present in c. 70% of
the population, suggests general health problems in
childhood and youth.

Traumatic events resulting in bone lesions were
more frequent in men. They were attributed to
accidents or falls, and more rarely to violence.
Articular osteoarthrosis was more frequent in the
knees, followed by elbows, wrists and ankles. A
severe lumbar osteoarthrosis developed relatively
erlier in women than in men, and affected, in the
former, a higher number of vertebrae. This was
attributed to the practice of activities provoking a
strong tension in the lower part of the back
(Machado (1984) suggests hunting, fishing and
gathering, but the practice of cultivation might also
be responsible for this pattern). On the other hand,
degeneration of the temporal-mandibular articulation
was more frequent in men, suggesting a stronger use
of jaws in males. Specific morphological features on
lower limb bones suggest that the people from Corondó frequently sat in a squatting position (Machado 1984).

A paleodemographic estimate, based on mortality and survival curves and on a table of rough mortality, indicated that the average size of the population occupying the site in different periods was about 100 people (Machado 1991; 1992). They were probably sedentary (Dias and Carvalho 1983).

Caries was present in 82% of the adults. Together with tooth wear pattern, this is indicative of a diet which might be abrasive and rich in carbohydrates, at a level found only in horticulturalists. A peculiar kind of severe tooth wear, affecting the lingual face of superior anterior teeth, was identified in young adults and adults. It was attributed to the use of teeth for peeling or processing plant material (Machado 1984; 1992).

Archaeological data suggest a varied and plentiful diet, including fishing and hunting products, molluscs and plants. Plant consumption is attested by the abundance of lithic artefacts related to plant processing and by the presence of charred seeds and palm fruits, as well as other plant remains, in all archaeological layers (Carvalho 1984). This is confirmed by the prevalence of caries in all age classes of this population (Turner and Machado 1983; Machado 1984). The particularly high caries prevalence, higher than in several agricultural populations from different parts of the Americas, supports the hypothesis of food production by this site’s inhabitants (Dias and Carvalho 1983).

Material and methods
Charcoal samples were collected during the archaeological excavations (Table 1) which were performed by archaeologists of the Brazilian Institute of Archaeology, under the supervision of Dr Ondemar F. Dias, between 1974 and 1978. Detailed excavation techniques were described by Dias (1981). Soil samples were collected from each excavation level and dry-sieved in the field. All the material retained by the sieves was later sorted by hand in the laboratory.

For the anthracological analysis, charcoal pieces were hand-broken along the three fundamental wood sections (transversal, tangential longitudinal, and tangential radial) and examined under a reflected-light microscope with bright field and dark field. Taxonomic identification was carried out by exhaustive comparison of the unknown sample’s anatomical structure with well identified extant samples from a reference collection. The identification process was supported by the identification program “Atlas Brasil” (Scheel-Ybert et al. 2002), as well as by reference books and papers from the literature (Détienne and Jacquet 1983; Mainieri and Chimelo 1989; Metcalfe and Chalk 1950, etc.).

A charcoal diagram was plotted using the program C2 Data Analysis, version 1.3 (Juggins 2005). It was based on the relative frequencies of the different taxa calculated on the basis of the number of identified fragments and indeterminate pieces included (Ni). The total number of fragments analysed (Nt), as presented in Fig. 2, comprises the identified fragments plus non-identifiable pieces (e.g. knots, bark, tiny stems, poorly-preserved fragments).

Results
Anthracological analysis of 851 charcoal pieces, from three out of four archaeological layers at Corondó, allowed the identification of 56 taxa from different vegetation types (Fig. 2). Floristic diversity of the charcoal sample is relatively great, except for the two upper levels, where too few charcoal pieces were available for analysis. For that reason, identification results for these levels were presented as presence/absence data. The number of taxa in the lower levels varies between 34 and 45, which represents a high floristic diversity, comparable to that of phytosociological studies (e.g. some recent phytosociological studies from different Brazilian vegetation types which identified, in areas of 1–1.5 ha, 592 to 924 specimens attributed to 31–54 taxa — Silva and Scariot 2004; Hack et al. 2005; Peixoto et al. 2005; Scherer et al. 2005). The Gini-Lorenz index of these samples varies between 26.74 and 27.73 (Fig. 3), indicating that the plant equitability is similar to that

<table>
<thead>
<tr>
<th>Coordinates</th>
<th>Level (cm)</th>
<th>Ni fragments</th>
<th>Archaeological layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>NL 15</td>
<td>40–60</td>
<td>7</td>
<td>II</td>
</tr>
<tr>
<td>OC 1</td>
<td>60</td>
<td>2</td>
<td>II base</td>
</tr>
<tr>
<td>LA 15 / CE 107</td>
<td>60–90 (75)</td>
<td>32</td>
<td>III sup</td>
</tr>
<tr>
<td>SI 5</td>
<td>70–80</td>
<td>3</td>
<td>III sup</td>
</tr>
<tr>
<td>NA 11</td>
<td>80–90</td>
<td>1</td>
<td>III</td>
</tr>
<tr>
<td>NJ 15</td>
<td>90</td>
<td>14</td>
<td>III</td>
</tr>
<tr>
<td>NA 12</td>
<td>90–100</td>
<td>5</td>
<td>III base</td>
</tr>
<tr>
<td>NB 11</td>
<td>90–100</td>
<td>1</td>
<td>III base</td>
</tr>
<tr>
<td>LA 11</td>
<td>110–120</td>
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<td>IV sup</td>
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<td>IV sup</td>
</tr>
<tr>
<td>NF 12</td>
<td>185</td>
<td>16</td>
<td>IV sup</td>
</tr>
<tr>
<td>NF 17</td>
<td>180–190</td>
<td>335</td>
<td>IV med</td>
</tr>
<tr>
<td>NF 17</td>
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<td>IV base</td>
</tr>
<tr>
<td>NF 17</td>
<td>200–220</td>
<td>66</td>
<td>IV base</td>
</tr>
</tbody>
</table>

Table 1 Relationship of analysed samples from Corondó to archaeological layers
Figure 2 Charcoal percentage diagram for Corondo. Nt: total number of fragments analysed; Ni: number of identified fragments (non-identifiable fragments excluded); Nsp: number of taxa

<table>
<thead>
<tr>
<th>Time (yrs BP)</th>
<th>Atlantic Forest</th>
<th>Atlantic Forest/Restinga forest</th>
<th>Restinga forest/Open restinga</th>
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</thead>
<tbody>
<tr>
<td>3010 ± 80</td>
<td>Ervicea sp.</td>
<td>Erythroxylum sp.</td>
<td>Erythroxylum sp.</td>
</tr>
<tr>
<td>3215 ± 90</td>
<td>Erythroxylum sp.</td>
<td>Erythroxylum sp.</td>
<td>Erythroxylum sp.</td>
</tr>
<tr>
<td>3720 ± 95</td>
<td>Erythroxylum sp.</td>
<td>Erythroxylum sp.</td>
<td>Erythroxylum sp.</td>
</tr>
<tr>
<td>4260 ± 65</td>
<td>Erythroxylum sp.</td>
<td>Erythroxylum sp.</td>
<td>Erythroxylum sp.</td>
</tr>
</tbody>
</table>

### Myrtaceae

<table>
<thead>
<tr>
<th>Time (yrs BP)</th>
<th>Myrtaceae sp.</th>
<th>L. sp.</th>
<th>M. sp.</th>
<th>Erythroxylum sp.</th>
<th>L.-dominated taxa</th>
<th>Nt</th>
<th>Ni</th>
<th>Nsp</th>
</tr>
</thead>
<tbody>
<tr>
<td>3010 ± 80</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td>9</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>3215 ± 90</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td>56</td>
<td>56</td>
<td>14</td>
</tr>
<tr>
<td>3720 ± 95</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td>214</td>
<td>187</td>
<td>34</td>
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<tr>
<td>4260 ± 65</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td>335</td>
<td>297</td>
<td>45</td>
</tr>
</tbody>
</table>

Restinga Mangrove
of extant plant associations. These concentration indices point to adequate sample sizes.

Note that in palaeoenvironmental studies, evaluation of sample reliability is usually done by the analysis of saturation curves, but the use of Gini-Lorenz concentration curves has also been providing good results (Scheel-Ybert 2002). These indices give a measure of vegetation equitability, i.e. the higher the index the lower the equitability in the analysed sample. In tropical Brazilian plant associations, normal indices are usually between 28:72 and 22:78. These indices can be employed for the estimation of sampling efficiency because small samples have abnormally low concentration indices, since the vegetation structure is not adequately represented.

All samples show a strong predominance of Myrtaceae species, which are typical of the restinga environment. Although different anatomical types were found, they were all grouped at the family level, because of the great difficulty in performing more precise identifications based on wood anatomy. In general, Myrtaceae genera are very difficult to distinguish, either because of the relative homogeneity of anatomical characters in this family, or because of the inter-specific heterogeneity of certain genera, especially Eugenia (Détienne and Jacquet 1983).

Different plant associations are represented in the charcoal diagram. The most representative taxon for the Atlantic forest is Securinega sp. Other taxa characteristic of this vegetation type are Terminalia sp., Vismia sp., Caesalpinia sp., Cassia sp., Sessea sp., and Melastomataceae. Although some Melastomataceae species are typical of the swampy herbaceous formations frequent in the depressions between beach ridges, and others of the open thickets shrubby formation, these are typically small plants with slender trunk and branches. The fragments found in the anthracological sample had parallel rays, indicating that they originated from timber of a relatively large diameter (cf. Nelle 2002) and, therefore, from forest tree taxa.

Several taxa may occur either in the Atlantic forest or in the restinga forest. The better represented belong to the Leguminosae family (Bauhinia sp., Clitoria sp., Lonchocarpus sp., Machaerium spp., Poecilanthe falcata, Piptadenia sp.), but Anacardiaceae, Baccharis sp., Casearia sp., and several Euphorbiaceae, Rubiaceae and Rutaceae species also occur in fairly significant proportions. Tabebuia sp., Sebastiania sp., and Sapotaceae species are more characteristic of the restinga forest. Lythraea sp., Maytenus sp., Chaetocarpus sp., Erythroxylum sp., Myrsine sp., and Sideroxylon cf. obtusifolium are typical of open restinga. The occurrence of a Combretaceae species, probably Laguncularia racemosa, suggests that mangrove vegetation also existed in the region.

A summary charcoal diagram, grouping taxa characteristic of each plant environment, is also presented (Fig. 4). Notice that the apparent oscillation between the different vegetation types in the upper part of the summary diagram, corresponding to the more recent period of occupation, is not a sign of environmental change. This stochastic oscillation is due to an excessively small charcoal sample, and should not be considered significant. At least 200 to 300 charcoal pieces should be analysed from each level in order to produce a good palaeoenvironmental interpretation based on percentages (Scheel-Ybert 2002). Analyses of only 10 to 50 pieces, as
was the case for levels II and III, provide aberrant percentages and can only be used in qualitative interpretations.

**Discussion**

The mound was situated in a forested environment, with mangrove in the vicinity (Figs. 2 and 4). Typical open *restinga* elements are rare, but Myrtaceae species are very abundant. Myrtaceae species are common in several Brazilian plant associations, but the abundance and diversity of this family is a distinctive characteristic of the *restinga* flora (Araujo and Henriques 1984; Silva 1990; Assis *et al.* 2004; Dorneles and Waechter 2004), both in open *restinga* and in *restinga* forests (Silva 1990).

For that reason, the high proportion of Myrtaceae, associated with the other elements of the anthracological spectrum and with the environmental characteristics of the area, may be taken as indicative that at least the majority of the taxa that may occur either in the Atlantic forest or in the *restinga* forest originated from the latter. Although this site is situated in a moist environment, with the presence of marshes and floodable areas, this forest was probably not inundated, as the species typical of this formation (*Symphonia globulifera*, *Calophyllum brasiliense* and *Tabebuia cassionoides*, according to Araujo and Henriques 1984; Araujo 1989; and Silva 1990) do not occur or are rare in the diagram (Fig. 2).

The existence of a *restinga* forest, with the presence of Atlantic Forest nearby, is in accordance with the geographic location of the site, that is to say the continental margin of a lagoon. It corroborates previous studies, indicating that the anthracological record essentially represents the local vegetation (Scheel-Ybert 2000).

The presence of several charcoal pieces showing traces of decay before carbonisation indicates that the firewood collected was already dead. There is no evidence of preferential selection of any particular timber for firewood.

No food remains were found in this analysis. This is probably a consequence either of a sample insufficient for the finding of parenchymatous remains, or of the preservation biases for this kind of tissue. Differential preservation of charcoal (wood remains) and food remains (parenchymatous fragments of edible plant organs) is a problem well known to the scientific community. It presents serious difficulties for the study of diet based on the analysis of macro-remains, because vestiges of tubers, roots and even seeds are rarely preserved (Miksicek 1987; Hather 1994). A greater investment in the analysis of micro-remains, especially phytoliths and starch grains, might be a better way of shedding light on this question.

The environment represented by the anthracological record is qualitatively the same in all archaeological layers. Although reliable frequencies of each vegetation type are available only for the three lower levels, this seems to indicate that no significant environmental changes occurred during the occupation period, at least not between 4865–4529 and 4257–3702 cal. BP.

This result, besides corroborating previous results of the analysis of shell mounds contemporaneous to Corondó and located in the same region, although nearer to the beach (Scheel-Ybert 2000), agrees with...
the interpretation of archaeological and bioanthropological data. The latter showed a strong cultural continuity, expressed by archaeological features and artefacts, as well as by physical characters, indicating a well defined and homogeneous culture with a relative cultural stability (Machado 1984; 1992). No significant modification in the technological characteristics (Dias and Carvalho 1983), in burial pattern or ceremonial aspects (Machado 1992), nor in the pattern of occurrence of degenerative diseases (Machado 1984), was observed in the analysed series. This is indicative of a population which had a relatively stable sociocultural system, where individual activities were relatively constant (Machado 1984), and which lived in a relatively stable environment that has not been modified by environmental changes nor, apparently, by anthropogenic influences associated with possible agricultural activity.

Note that the absence of variation in the anthropological record does not necessarily mean an absence of climatic change. Previous work demonstrated that the *restinga* vegetation is relatively stable and resistant to climatic changes, at least those of small amplitude (Scheel-Ybert 2000; 2001a). Climatic changes probably occurred in that region (Tasayco-Ortega 1996; Scheel-Ybert 2000), as well as variations in the mean relative sea level that affected the lagoon’s water surface. These might have determined the disposition of the *restinga* in the environment without affecting its phytosociological characteristics.

These results point, in the same way as has been suggested for shell mound dwellers in a general way (Scheel-Ybert and Gaspar in press), to specific environmental management strategies which might have assured a sustainable exploitation of natural resources and common land, assuring a rather conservationist environmental evolution.

This is in contrast to Europe and the Levant. There, agricultural evolution was directly reflected in the environment, with rather rapid anthropogenic modifications and significant land clearing aimed at extending agricultural frontiers (Smith 1998). On the other hand, in the tropical American slash-and-burn system, employed by indigenous agriculturalists known so far, there is no significant detriment to the environment nor important modifications of the local plant formations. We may present the hypothesis that the agricultural system of the Corondô inhabitants was based on slash-and-burn or another equally conservationist system. Note, also, that dead wood exploitation, with the wood collected randomly in the environment, is also very conservationist in environmental terms.

The efficiency of lithic implements is not questioned, and stone axes found in this mound probably served to clear slash-and-burn parcels, cutting trees for the construction of huts, posts and other wood implements, and maybe also for boats or canoes. Experiments performed with stone axes demonstrated that these implements can be highly efficient (Petrequin and Jeunesse 1995; Prous *et al.* 2002). However, the data obtained so far suggest that there was no need to cut trees for firewood, and that the wood available in the environment might have been enough to provide for the needs of this population. In addition, we should take into consideration the fact that a strategy of cutting trees specifically for burning is particularly costly both in terms of physical effort and with reference to stock management. This is because recently cut wood is not suitable for firewood and, in natural conditions, the time necessary for drying may be quite long (Théry-Parisot 2001). However, if slash-and-burn agriculture was practised, trees locally removed for cultivation could also have been used as firewood.

The Malhada marsh was probably formed in a lagoonal system similar to that of the Araruama lagoon (Senra *et al.* 2003). The formation of the palaeolagoon is attributed to a phase of erosion of the São João river plain and of the Retiro creek, associated with a sea level rise at *c.* 5100 BP. A date of 5080 ± 140 BP was obtained from a shell layer next to the base of the palaeolagoon (Castro *et al.* 2004). Oligohaline conditions developed initially, with incipient mangrove implantation, indicated by rare ostracids shells. Faunal analyses point to a salinity increase in the palaeolagoon, indicating environmental changes that initiated a hypersaline environment. A drier environment, with intensification of the upwelling in the Cabo Frio and Arraial do Cabo coast during the mid Holocene, probably accounted for the salinity increase (Senra *et al.* 2003). This interpretation is corroborated by sediment analysis in several lagoons (Tasayco-Ortega 1996) and by anthropological analysis in the Cabo Frio region (Scheel-Ybert 2000). The latter indicated that, after a more humid period that lasted until *c.* 5000 BP, the regional climate became drier until *c.* 2300 BP. Afterwards, a brief rainy episode between 2300 and 2000 BP was followed by a new dry period that lasted at least until *c.* 1400 BP.

Stability of the *restinga* vegetation, corroborated by anthracological analysis of several coastal sites so
far (Scheel-Ybert 2000; 2001a), is in agreement with Lamego’s (1974) opinion. He considered the sandy *restinga* plains a particularly stable environment, which he attributed to the floristic cover. *Restinga* vegetation immobilises the beach sand, providing topographic stability and impeding the wind that transports the sandy dunes. This process maintains the topography. Moreover, as there is no circulation of lagoon waters under the low level of the plain, there is no landscape evolution towards a juvenile relief. For this reason, the *restingas* might be the only geologically stable zones known, with the exception that marine transgressions can occur. This is because the horizontality, the low level relative to the sea, and the floristic cover protect the *restingas* from land sculpting forces. At the same time, the coastal lagoons maintain primitive low level, even after they have dried up. Floristic cover is so efficient in the stabilisation of the sandy sediments that the *restinga*, immobilised by these processes, resists erosion.

This fact has important consequences for human populations. Archaeological data, as well as physical characters and health status, point to a relative cultural stability throughout the occupation period (Dias and Carvalho 1983; Machado 1984). The environment, both in geomorphological (Lamego 1974) and in floristic and ecological aspects (Scheel-Ybert 2000; 2001a), is also characterised by relative stability. This environmental stability may in fact have been one of the factors enabling the maintenance of the sociocultural system of this mound-building population. It may also have provided the natural conditions necessary for the development of food production.

Note that the *restinga*, although presenting a flora related to semi-desert regions, is differentiated from the latter by a phenomenon inherent to its formation process: presence of water at a shallow level. Drinkable underground water, frequently less than one metre deep, is a generalised occurrence (Lamego 1974).

The apparent infertility of *restinga* sandy soils should also be mentioned. Lamego (1974) observes that the mere addition of small quantities of humic elements to the *restinga* soil renders it suitable for the cultivation of such a demanding cultivar as sugar-cane. The same author stresses that, in spite of their poor appearance, soils from the São João da Barra region (which are similar to soils of the Campos Novos region, our study area) are an excellent substratum for the cultivation of manioc.

**Conclusions**

Anthracological analysis of the Corondo site demonstrates that it was situated in a *restinga* sandy forest environment, with Atlantic Forest nearby. A few elements of open *restinga* and mangrove indicate that these plant formations also existed a relatively small distance away and were exploited by these mound builders. In the same way as had already been demonstrated for neighbouring shell mounds (Scheel-Ybert 2000; 2001b), firewood provision was based on random gathering of dead wood.

The combination of anthropological results with data provided by archaeological and bioanthropological analysis indicates that this population had a relatively stable sociocultural system, that individual activities in general had been relatively constant throughout the occupation period, and that they may have lived in a relatively stable environment, which was affected neither by climatic changes nor by anthropogenic influence derived from possible agricultural activity. It was suggested that this population may have had specific strategies of environmental management that might have guaranteed a quite conservationist environmental evolution.

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**References**


