CHARACTERISATION OF CHARCOAL ASSEMBLAGES FROM ARCHAEOLOGICAL SITES IN THE COLOMBIAN AMAZON REGION. A MODEL BASED ON ETHNOGRAPHY.

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ABSTRACT

This thesis reports on research concerning archaeological charcoal assemblage characterisation from the tropical rain forest in the Amazon region of Colombia. A charcoal assemblage from the archaeological site of Peña Roja has been studied in detail. Peña Roja site is located in the middle Caquetá river of the Colombian Amazon region. Two prehistoric human occupations have been reported from this site. The earliest has been radiocarbon dated to 9250±140, 9160±90 and 9125±250 years BP; and is associated with hunter-gatherers who were aceramic but probably practised small scale horticulture. The later occupation of the site is associated with a ceramic culture where agriculture was practised. This has been dated to between 1900 and 400 years BP according to radiocarbon dates reported at other related sites from the middle Caquetá river.

The specific objectives of this research are to build a model to investigate charcoal assemblage formation in archaeological sites from the Colombian Amazon; to formulate hypotheses about prehistoric uses of wood in the middle Caquetá region and to assess the current charcoal analysis in archaeobotany by means of the analysis of a test sample of charcoals from Peña Roja. The identifications of archaeological charred wood fragments were made to Family level and in some cases to Genus level. A model to investigate charcoal assemblage characterisation is based on ethnographic information about present day indigenous traditional uses of wood. The model is applied to the test sample of Peña Roja and may be used to formulate hypotheses about prehistoric wood selection in the region.

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1. INTRODUCTION

Figure 1.1 Map of South America showing the geographical location of Colombia, the middle Caquetá river and the Amazon basin.

This thesis deals with prehistoric wood selection and the use of the tropical forest in the Colombian Amazon. The investigation forms part of a multidisciplinary programme of the Erigaie Foundation which aims to further our understanding of interactive processes between people and the environment in the tropical rain forest from the time of their arrival in the region about 10000 years ago.

Excavations carried out at Peña Roja (on the middle Caquetá river) in 1991 and 1993 by the archaeologists from the Erigaie Foundation yielded large amounts of archaeobotanical macro-remains along with other cultural materials such as lithics and pot sherds. Manual collection, water screening and flotation were used to recover charred fragments of seeds and wood. These materials were sorted and packed in plastic bags by students under the supervision of the Erigaie Foundation archaeologists.

In 1993 I started a project to study the charcoal from Peña Roja collected by the excavators as part of the archaeobotanical research program of the Erigaie Foundation. Then in September 1994 I undertook fieldwork in the middle Caquetá region with the aim of collecting modern wood samples used by the indigenous communities inhabiting the area at present. Thirty four woody taxa were collected together with information about their uses.

Three radiocarbon dates are available for the earliest human occupation of the site: 9250 ± 140 BP (Beta 52964), 9160 ± 90 BP (Beta 52963) and 9125 ± 250 BP (Gx 17395). The latest human occupation is related to societies that inhabited the region between 1900 and 400 years BP (Cavelier *et al.* 1995). The middle Caquetá region is located in the southeastern part of Colombia and forms part of the western Amazon basin (Figure 1.1). Several indigenous groups inhabit the area at present. Most of them live in settlements located along the main rivers.

Archaeology in some areas of the Amazon basin, particularly in the Brazilian Amazon, has focused on several aspects including the definition of environmental constraints to the development of complex societies, agricultural origins, social and political complexity of the societies inhabiting the area, and the antiquity of human presence in the region.

Archaeological investigations have been carried out in the middle Caquetá region since the 1970s. These investigations have dealt with several topics including pottery analysis and soil characterisation in relation to human occupation and different activities practised in the area during the prehistoric time (Reichel-Dolmatoff E. 1976a, Herrera *et al.* 1980-1981, Herrera 1981, Reichel-Dolmatoff and Hildebrand 1982-1983, Eden *et al.* 1984, Andrade 1986, 1988).

More recent research has focused on integration of soil studies and human plant relationships. The aims of these studies include the understanding of the processes of formation and particular uses of black soils during the past as well as the identification of cultivated products and changes in the forest as a result of human activities during the past (Herrera *et al.* 1988, 1989, 1992a, b, Cavelier *et al.* 1990, 1995, Mora *et al.* 1991).

The archaeobotanical research in the wide area of the American tropical lowlands has focused mainly on the reconstruction of past human subsistence patterns. Archaeological plant micro-remains (pollen and phytoliths) and macro-remains (seeds) have been studied in order to reconstruct ancient food production patterns (e.g. Piperno *et al.* 1985a, Pearsall 1988a, Piperno 1989, Bonzani 1997, 1998, Piperno and Pearsall 1998).

During the past few decades archaeobotanical research in the Colombian Amazon forest has contributed to the understanding of subsistence patterns of the prehistoric inhabitants of the area. Analysis of pollen from archaeological sites from the middle Caquetá region has showed the antiquity of maize and manioc cultivation as well as cultivation of other plants including fruit trees (Mora *et al.* 1991, Herrera *et al.* 1992a, b, Piperno 1999, Herrera and Cavelier 1999). Identification of charred seeds have suggested early forest resource exploitation by humans and the selection of palm and tree fruits for human consumption (Morcote 1994a, Cavelier *et al.* 1995, Morcote *et al.* 1996, 1998).

The tropical forest has been seen as a barrier for human occupation during the past as a result of preconceptions such as those established by early evolutionary classifications of societies from the tropical lowlands. Recent studies have shown that human groups of foragers have occupied several parts of American tropical rain forests since the Late Pleistocene and Early Holocene periods (Piperno *et al.* 1985a, Cavelier *et al.* 1995, Roosevelt *et al.* 1996, Piperno and Pearsall 1998, Roosevelt 1998). Since that time people were using a broad spectrum of plants for their subsistence as well as for other purposes such as fuel for cooking and to provide light. The archaeological site of Peña Roja in the middle Caquetá river of the Colombian Amazon is one of the earliest sites located in the tropical rain forests of America.

One of the most common natural resources used by humans since past times is wood. Wood and charred wood from archaeological sites are the evidence of past use of wood as fuel (Shay and Shay 1978, Pearsall 1983, 1988a, b, Miller 1985, Johannessen and Hastorf 1990, Shackleton and Prins 1992, Heizer 1995) and as the raw material for manufacturing buildings and other structures, artefacts required in daily life or in ceremonies and items of transport such as canoes or rafts. Wood and charred wood also provide evidence of part of the past vegetation and environment of the archaeological sites and their surroundings (Godwin and Tansley 1941, Johannessen 1988, Smart and Hoffman 1988, Cartwright and Parkington 1997, Vacher *et al.* 1998, Cowling *et al.* 1999). Archaeobotanists have approached the study of archaeological wood and charcoal from different perspectives: palaeoenvironmental reconstruction; palaeoethnobotany, i.e., selection of specific woods as fuels and for other purposes; and methodology which include methods of description, identification and quantification (Popper 1988, Thompson 1994, 1996, Cowling *et al.* 1999).

Analyses of charred wood fragments from archaeological sites have been used to investigate firewood collection strategies during the past. Pearsall (1983) studied the prehistoric firewood collection patterns from several sites in the Ecuadorian Pacific lowlands. Johannessen and Hastorf (1990) studied the history of the management of fuel resources by the inhabitants of the Mantaro valley in the Peruvian highlands.

Quaternary palynological data from the South American tropical rain forest gives an idea of the vegetation changes that occurred during the past. However, the extent of human intervention, especially with regard to selection of particular taxa, is unknown. Specific human activities associated to the use of different woods in the past have not been considered in the archaeological investigations carried out in the area of this research.

Preservation of animal or plant remains in archaeological sites from tropical areas is very difficult. However, charred wood preservation in any climatic and soil conditions from the American tropical lowlands is very common. Traditionally, archaeologists collect charred wood fragments from excavations to use them for radiocarbon dating. There are relatively few studies on charred wood fragments from archaeological sites in the South American lowlands. Some have investigated ancient firewood collection patterns (Pearsall 1983) and others have used charcoal identifications as evidence of past vegetation in archaeological sites (Vacher *et al.* 1998). This thesis presents the first study of archaeological charred woods from Colombia undertaken for a purpose other than for dating. The pioneering study presented in this thesis not only demonstrates the great potential offered by this field of research, but sets out clear guidelines and a protocol for charcoal analysis and interpretation.

In order to investigate human selection of wood during the past in the Colombian Amazon region, a model was invoked to explain charcoal assemblage formation in archaeological sites from the area. In this thesis the word formation is not used to describe "site formation processes". It is used rather more in the sense of "characterisation". The model is based on the current ethnographical information about traditional indigenous uses of wood. The model was applied to analyse a test sample of charred wood from the archaeological site of Peña Roja. Hypotheses on the ancient uses given to some of the identified taxa are derived from the model.

At present the Colombian Amazon region is inhabited by several indigenous communities who still use the forest resources according to their traditions. Indigenous peoples have a deep knowledge of the ecology of many plant and animal taxa. Plants are widely used for many different purposes by all the communities from the region. The ethnographical information from the Colombian Amazon is then used to formulate hypotheses on the probable uses given to the woods during the past.

The model is useful for the interpretation of archaeological charcoal assemblages from the Colombian Amazon region and it could also be useful for the interpretation of charcoal assemblages from other areas. The application of the model requires detailed information on the archaeological contexts, on the process of deposition and redeposition of charcoals in archaeological sites and on the anatomical micro-structure of the woody taxa from the region considered.

Charred wood fragments are the most common plant macro-remain found in archaeological sites from the American tropics. The study of charred wood contributes information about past environments and about human patterns of use of woods during the past. This is also useful when archaeological investigations consider past human activities involving woods as fuel and as materials for manufacturing artefacts or for structures.

According to the current archaeobotanical information, the extremely fragile ecosystem of the Amazon tropical rain forest has been exploited by humans since early Holocene times. Ethnographical data on the present indigenous inhabitants from the region shows that the traditional indigenous ways of management and use of forest resources is sustainable (see Van der Hammen M. C. 1992, Correa 1993a, b, Reichel-Dolmatoff 1993, Dufour 1993, Pineda 1993, Rodríguez and Van der Hammen 1993, for examples from the Colombian Amazon). Our understanding of the ancient human-plant interactions could help in the implementation of modern management strategies in the region.

1.1. Objectives and methods of the research

The aims of this research were tackled through different sources of information: ecology, palaeoecology, ethnography, ethnobotany and archaeology.

The specific objectives are:

1. To build a model which investigated charcoal assemblage formation in archaeological sites from the Colombian Amazon region.
2. To formulate hypotheses about prehistoric wood uses in the middle Caquetá river.
3. To assess current methods of charcoal analysis by means of the study of a test sample from the archaeological site of Peña Roja.

A reference collection of the main woods used by some of the indigenous societies who live at present in the Colombian Amazon region was made in order to have comparative material when identification of archaeological charred wood was carried out. This collection of woods was vital for learning the techniques employed in the description and identification of micro-anatomical features of woods. Wood anatomical description of reference collection specimens was carried out based on IAWA (International Association of Wood Anatomists) parameters (Gregory 1980, IAWA Committee 1989).

Identification of a test sample of charcoals from Peña Roja has been made by using different strategies: computer aided wood identification program (Guess), comparison with photographs in published atlases and comparison with reliable identified modern wood specimens from Kew Gardens, Utrecht University and our own project reference collections herd at the Erigaie Foundation in Bogotá.

General palaeoecological studies on the Amazon forest, as well as specific research carried out in the middle Caquetá river, were studied and evaluated in order to have a framework to suggest past use of the forest. A test sample of charcoals from the archaeological site of Peña Roja was described for identification. Ethnobotanical and ethnographical information already published and collected during the field trip, was evaluated and used to build the model of characterisation of the charcoal assemblage. This information was then used to formulate hypotheses of wood use by the inhabitants of the Peña Roja archaeological site through time. Archaeological information was analysed and assessed when the model was applied to the test sample of charcoal from Peña Roja.

1.2. Problems and limitations

The general aim of the research presented here is to explore different ways of interpreting archaeological charcoal assemblages from the humid tropics of South America. Identification of charcoal is central to charcoal analysis and the investigation presented here is the first attempt for the Colombian tropics. In order to explore charcoal identification a small sample of charred wood fragments was identified from the archaeological site of Peña Roja in the middle Caquetá river of Colombia. Other aspects of charcoal interpretation were explored through ethnographical and ethnobotanical data from the area. As a result the model created to investigate characterisation of charcoal assemblages from the area was applied to the archaeological data from Peña Roja site. The application of the model is in its early stages because of the limitations of both the archaeology and the small amount of charcoals identified.

Charcoal analysis is usually practised in regions with less biodiversity than the Amazon basin. In several regions these studies have been used in combination with other archaeobotanical data in order to reconstruct palaeoenvironments (e.g. Salisbury and Jane 1940, Godwin and Tansley 1941, Pearsall 1983, 1988a, b, Smart and Hoffman 1988, Johannessen 1988, Cartwright and Parkington 1997, Cowling *et al.* 1999). In the Amazon region there are many ethnographical and ethnobotanical studies that can contribute to the archaeological interpretations in several ways. According to this ethnographical information, modern-day indigenous people inhabiting the area have a deep knowledge of the flora and its properties. Woods are very well known and it is very clear that people have a very specialised knowledge of many of the properties of woody plants. However, this ethnographical information has to be taken with caution because both wood gathering strategies, changes in economy and in the woody flora could have affected the types of woods people used since prehistoric times.

Preservation of organic plant remains in the tropical rain forest is extremely poor. Charcoal fragments are the most common plant macro-remain found in archaeological sites of the tropical Amazon lowlands. For this reason, one of the objectives of this thesis was to assess the potentiality of charcoal fragments for identification and their contribution to the archaeological interpretation of particular contexts within the sites. Although identification of charred woods from Peña Roja site was possible, it has greater potential with a better knowledge of the wood anatomy of the main trees traditionally used. At present, the high diversity and variability within families and genera of woody plants from the tropical rain forest do not allow the identification of woods with accuracy further than family level and, in some cases, genus level.

The richness of the ethnographical information on wood uses at present by the indigenous inhabitants of the region is useful. However, it has some limitations such as high diversity of species of the region because this aspect makes difficult identification and interpretation of the wood archaeological assemblages. Taking into account these facts a model based on the ethnographical information available which includes qualitative data on the traditional use of woods could be a useful tool for future archaeological studies in the tropical lowlands of Colombia. In addition, there would be a need for other plant macro-remain studies such as pollen, phytolith and residue analyses.

1.3. Thesis structure

Initial chapters of the thesis contain background information which is used as a framework for the discussion of the archaeological, archaeobotanical and ethnographical importance of the Amazon region, particularly the middle Caquetá area in the Colombian Amazon. Chapter two contains a summary of the main geographical, ecological, palaeoenvironmental and ethnographical studies carried out in the middle Caquetá region. Chapter three summarises the archaeology of the Amazon region. Chapter four assess archaeobotanical studies carried out in the lower Central American and northern South American tropical lowlands.

Chapter five presents the archaeological information from Peña Roja site. Chapter six explains the methods used in this investigation. The methods include current botanical description of the wood anatomy of modern and archaeological samples and organisation and analysis of the ethnographical information from the Colombian Amazon. Chapter seven presents the results obtained. Chapter eight includes the model built to characterise charcoal assemblages from the Colombian Amazon. Finally, chapter nine contains the conclusions and implications for future research.

The radiocarbon dates considered and cited in this thesis are not calibrated. The reason that C14 dates are uncalibrated is that most of the published data (e.g. Schmitz 1987a, Kipnis 1998) from other sites in the South American lowlands are published in uncalibrated form. Therefore, for the sake of comparability, and to align Peña Roja with other relevant sites, it seemed logical to use uncalibrated dates throughout this thesis. None of my arguments depends on detailed chronological discussion, where the difference between calibrated and uncalibrated dates would be significant.

Laboratory numbers are mentioned when available in the consulted literature. Abreviations used for Laboratory numbers are: Gx (Geochron Laboratory, Krueger Enterprises Inc.), Beta (Beta Analytic Inc.) and GrN (Groningen University Laboratory), GIF (Gif-sur-Yvette Laboratory), IAN (Instituto de Asuntos Nucleares-Bogotá), SI (Smithsonian Institution), P (Pennsylvania), UCR (University of California, Riverside), CAMS (Center for Accelerator Mass Spectrometry). Photographs from the archaeological sites, cultural remains and landscapes from the middle Caquetá river belong to the Erigaie Foundation.

The catalogue on the flora from the middle Caquetá region by Sánchez Sáenz (1997) was used throughout this thesis. This names Angiosperm plants following Cronquist (1998), except for Caesalpiniaceae, Fabaceae and Mimosaceae which are grouped as Leguminosae. Gymnospermous plants were named following Mabberley (1990) and Pteridophytes following Tryon and Tryon (1982).

2. AREA OF STUDY

2.1. General Geographical aspects of the Amazon basin

The Amazon is the biggest tropical rain forest in the world. It covers an area of 6,400,000 square km which represents 7% of the earth's surface, and its flora and fauna constitute more than half of the world biota. Most of the Amazon region consists of a plain lower than 200 m above sea level but it also includes some isolated mountains as high as 900 m. About 403,650 square km of the northwestern Amazonian region are within Colombian territory. At present very few villages exist in the area. The Amazon river system flows through the countries of Bolivia, Brazil, Colombia, Ecuador, Peru and Venezuela. The river is 6762 km long and has about 1000 main tributaries coming down from the Andes, Guyana and Brazil. Almost all Amazonian tributaries in Colombia have rapids and waterfalls that make them unsuitable for navigation (BID-Inter-American Bank of Development-1992: xii, 16; Schultes 1988: 15. See Figure 1.1).

The Amazonian basin can be divided into two zones. One is liable to flooding and has marshy areas with Holocene sediments of about 6000 years old. The other is not exposed to inundation and is made up of Pleistocene terraces formed during interglacial periods. Zone one, the Amazon plain, is derived from clay sediments with areas of 150 to 200 m in height. According to their varying biological and physico-chemical characteristics, three river types can be characterised: white, black and clear water rivers. White rivers originate in the western Andes mountains; they carry sediments rich in nutrients. Black water rivers originate in the Amazon region and carry few sediments; their water is acid (pH<4) and poor in nutrient content. They appear black because of presence of humus and also because of incomplete decomposition of organic matter. Their origin is located at massifs built up of tertiary sediments. Rivers of clear waters carry few sediments and their water has a pH between four and seven according to the geological substrate (BID 1992: 17, Duivenvoorden and Lips 1993a: 37-40).

The climate in the Amazon region varies especially in peripheral zones. There is a range of seasonal precipitation cycles. In the northern Amazon maximum precipitation occurs between June and July, while in the southern Amazon the maximum is between November and March. Eastern and western areas have high levels of precipitation all year round. Vegetation is very important to the hydrological balance of the Amazon basin; 75% of the precipitation in the Amazon basin returns to the atmosphere as water vapour through evapotranspiration (BID 1992: 18).

Two main types of soils can be found within the Amazon region but in general they are both considered to be low in fertility. Latisols or clayey soils are present beneath forests not exposed to annual flooding. Podzols are present in areas liable to flooding and also in isolated areas of bleached white sands called "caatingas". These are covered by small trees with limited canopy cover (Schultes 1988: 11-12).

Within the Amazon basin there are several diverse vegetation types: evergreen forest, vine and bamboo forest and savannah areas (Balée 1989, Prance 1987 quoted by Piperno and Pearsall 1998: 45). The Middle Caquetá river is located within in an evergreen forest area (see Figures 2.1 and 2.2). The western Amazon basin, along the slopes of the Andean mountains contains the wettest regions. Areas of swamp forest exist on the margins of major rivers which are flooded annually (Prance 1987 quoted by Piperno and Pearsall 1998: 49).

Figure 2.1 Map of the South American tropical lowlands showing different vegetation types. Adapted from Piperno and Pearsall 1998: 95.

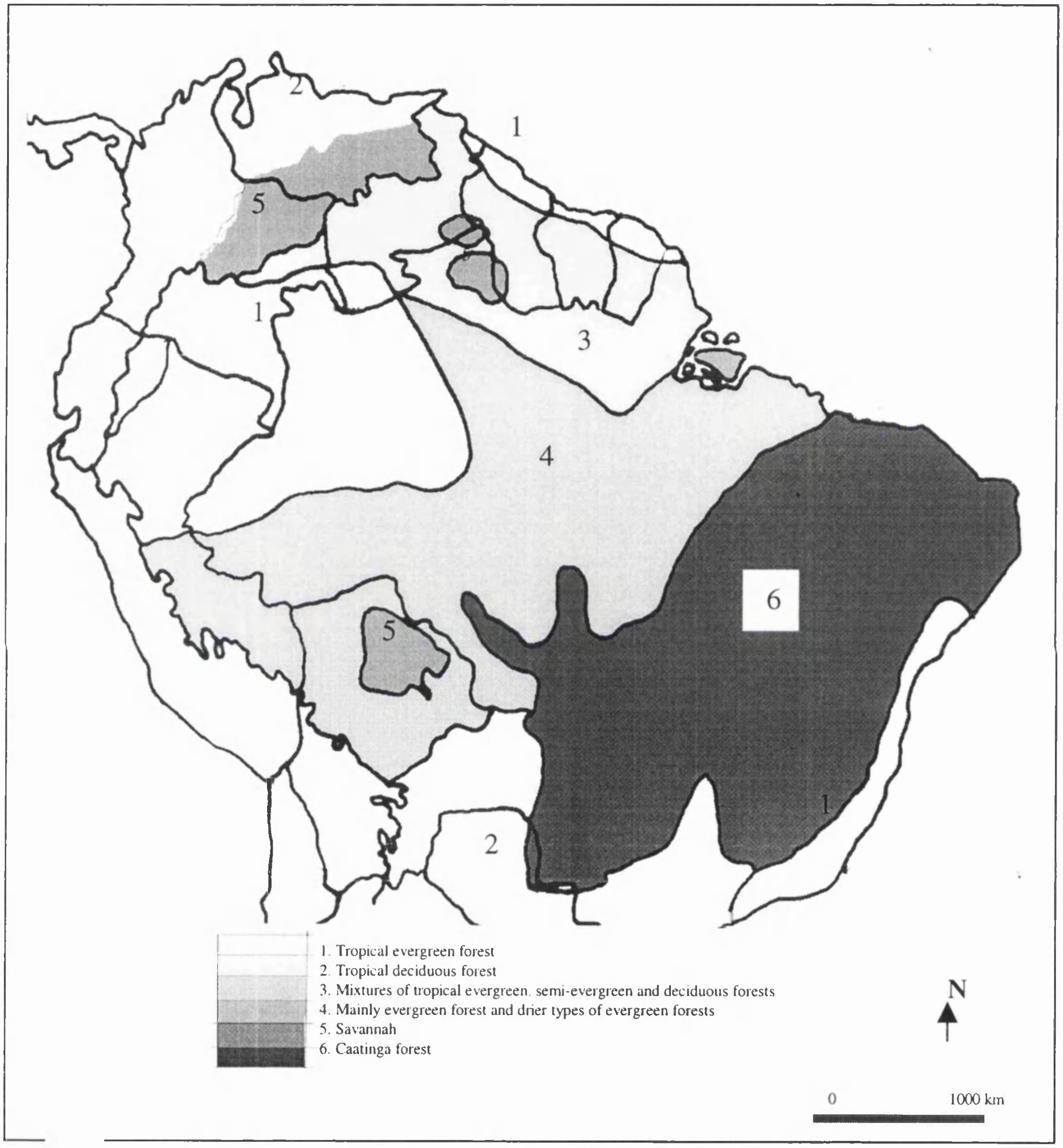


Figure 2.2 Photograph of the evergreen forest in the middle Caquetá region.

2.2. Human occupation of the Colombian Amazon during historic times

Here the term "historic" is used to refer the period of time between the 16th Century and the present; while the terms "prehispanic" and "prehistoric" refer to the period of human occupation of the area before the arrival of Europeans.

2.2.1. Early interest in the region and resource exploitation

The Amazon forest is not a pristine environment. Humans have left their impact upon the area since ancient times, possibly as long as 13,000 years ago (see Chapter three). At the time Europeans discovered the area, a myth about richness of the region was created. The belief that the land of “El Dorado” was in the region motivated the first excursion (down the Amazon river), of the explorer

Francisco Orellana. Later it also stimulated extraction of commercial forestry products and during the 20th century big development projects and road construction, particularly in the Brazilian Amazon. Today it is recognised that the high ecosystem biodiversity represents the richness of the area. This had been known in practice by indigenous population of the area since antiquity (BID 1992: 7. See Chapter three).

During the 17th and 18th centuries, the Spanish colonial government allowed catholic missions to carry out Christian conversion of the indigenous population. During the second half of the 19th Century and the beginning of the 20th, attempts to incorporate indigenous communities from the area into the Colombian political and economic systems resulted in exploitation of several forest products such as quinine and rubber. Extraction systems were based mainly on the indigenous labour force. As a result the indigenous people were enslaved. The slave trade was practised by commercial traders who incited intertribal wars in order to capture prisoners who were then moved to be sold at places where rubber and other gums were exploited and/or traded. During some periods there were certain indigenous groups who also participated in the slave trade (Gómez 1996-1997).

The Middle Caquetá region was first colonised by the Portuguese during the second half of the 17th Century. The demographic impact of the slave trade in the Amazonian region and in Caquetá area was severe. Many indigenous communities disappeared whilst others were moved from their original territories (see Llanos and Pineda 1982, Pineda 1985 and Van der Hammen M. C. 1992). Demographic data indicate that over a decade, the indigenous population from the area was reduced from 50,000 to 7000 individuals (Schultes 1988: 21).

2.2.2. Present day inhabitants of the area

Negative images of the Colombian Amazon region and their native inhabitants have been constructed since the arrival of the Europeans to the region. First explorers and missionaries described people as cannibals, profane, unfaithful, barbarians, devils and sorcerers. During the 19th century commercial traders contributed to the negative image to the detriment of indigenous communities. All these factors have led to the consideration of the region as a marginal territory. During the last decade scientific research has demonstrated the successful adaptive strategies of native communities (Gómez 1996-1997: 51,52).

In 1993, the total population in the Colombian Amazon was 541,512 inhabitants of whom more than 80% came to the region from the Andean mountains over the past 80 years. The indigenous population consists of 63,634 individuals; however many groups have sectors of their population settled in territories at present belonging to other Amazonian countries (Correa 1993a: 18,26).

Although catholic missionaries have protected indians from exploitation and brought them medical aid, they have played an important role in the cultural change of indigenous populations. In particular they have been trying to convince people to avoid shamanistic practices, which relate to traditional medicine (Schultes 1988: 21).

2.3. Diversity of the Amazon region

The Amazon region has several diverse aspects. Today the area is inhabited by many distinctive ethnic groups. There are different climate types, geological formations, altitudes and landscapes within which diverse soil types and vegetation can be found (BID 1992: 3).

Biodiversity can be observed at three levels: genetic, species and ecosystem. Genetic biodiversity refers to the genetic information contained in species which form flora, fauna and microbiota. The large number of different species in the region is augmented by the specific adaptation of organisms to different habitats or ecosystems present in a given area. Ecosystem diversity takes into account the number of ecosystems and their frequency but also reflects diversity of habitats, biotic communities and ecological processes (BID 1992: 19).

2.3.1. Vegetation

Amazon vegetation is highly heterogeneous: there are dense forests, inundated forests ("varzeas") sometimes covered by *Mauritia* sp. palms and less frequent intra-amazonic savannahs locally called "caatingas" (BID 1992: 19). Gentry (1986 quoted by Van der Hammen 1996) showed that in low tropical forest there is a very direct relationship between precipitation and vegetation. In the Caquetá region, where annual precipitation is approximately 3000 mm, Duivenvoorden *et al.* (1988) found more than 300 species per 0.1 ha on "tierra firme", i.e. land not exposed to flooding. Urrego (1997) found values of 150 species per 0.1 ha. on flooded forests areas in the same region. By comparison, in the dry tropical forest in the inter-Andean valleys of Magdalena and Cauca rivers of Colombia (see Figure 2.3), where annual precipitation is 1000 mm, 50 species per 0.1 ha have been reported. This means that if the precipitation is higher than 3000 mm the number of species per 0.1 ha increases, in this case from 50 to 300 (Van der Hammen 1996: 483).

A broad description of flora in the southwest Colombian Amazon (see Figure 2.3, provinces of Putumayo, Amazonas and Caquetá) includes many different plants. Most trees belong to the Leguminosae and Euphorbiaceae families which are the tallest in the forest; especially important is *Hevea guianensis*. *Couma* sp. trees from the Apocynaceae family are numerous at some localities. *Jessenia* and *Mauritia* are amongst the most common palms. Understorey trees are even more diverse and include trees from Melastomataceae, Sterculiaceae (particularly *Theobroma* spp.), Moraceae, Lecythidaceae (Brazil-nut family, especially *Eschweileira* and *Gustavia*), Myristicaceae (nutmeg family, especially *Virola* and *Iryanthera*), Myrtaceae (especially *Eugenia*) and Rubiaceae families. *Piper* spp. are abundant as are Cyclanthaceae and Araceae families. Many lianas from the Bignoniaceae, Sapindaceae, Malpighiaceae, Menispermaceae and Loganiaceae families are also present. Wide areas which remain flooded during the rainy season such as Caquetá river islands are covered by members of the Cecropiaceae, Moraceae, Polygonaceae and Aracaeae families (Schultes 1988: 15-16). Many of

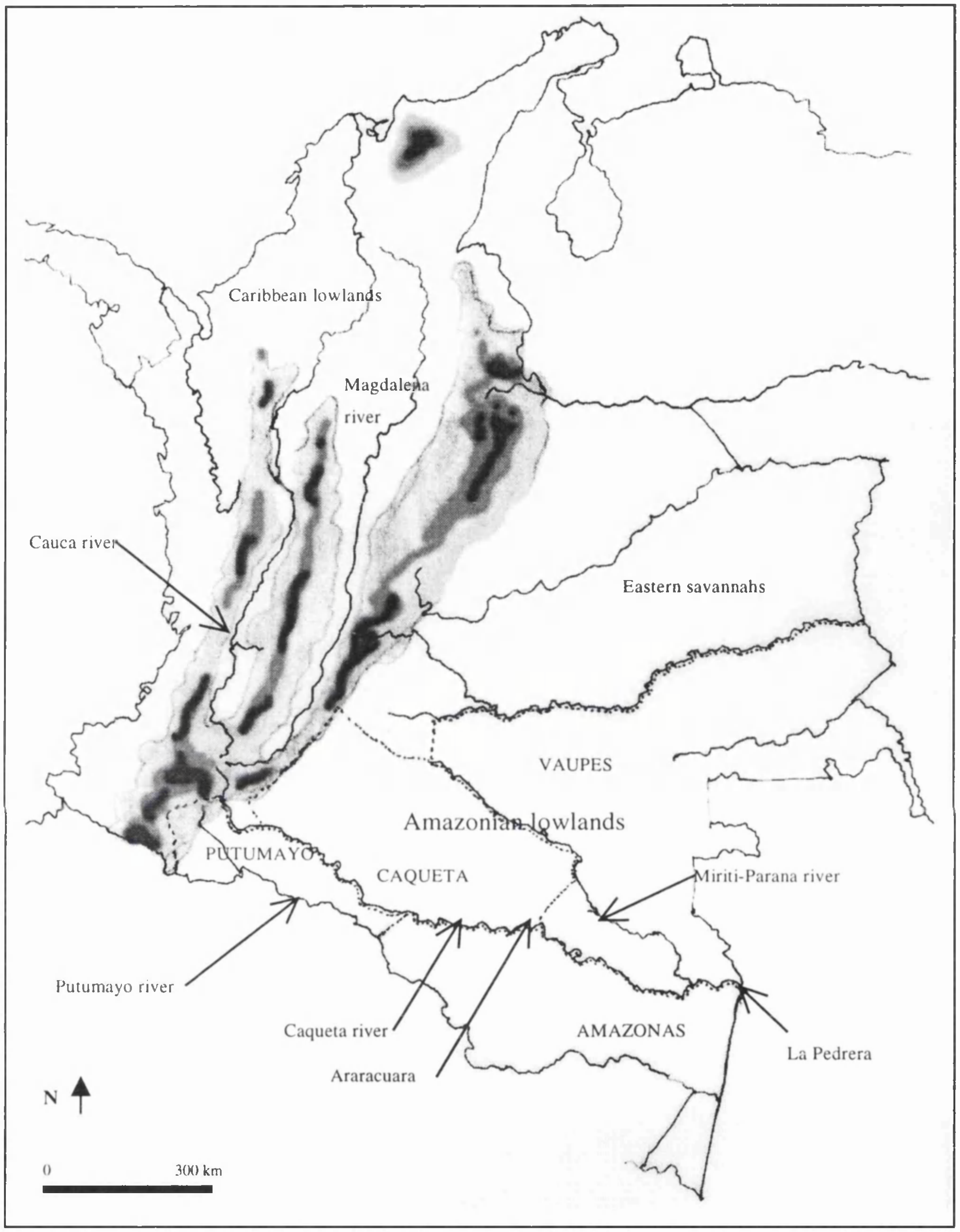


Figure 2.3 Map of Colombia showing the Andean area (shaded), the Caribbean, the eastern savannah and the Amazon lowlands. Adapted from The Times Atlas of the World. Concise edition (1995: 162-163).

these trees have been in constant use for many purposes by indigenous communities (see Chapters seven and eight).

There is still no scientific consensus to explain the existence of such high floral diversity in the Amazon region. Current hypotheses focus on the number of species that can live together, the time and opportunity that flora and fauna have had to diversify, the different physical conditions required by different plants, pest pressure, environmental stability and also environmental variation (Leigh 1990).

2.3.2. The refugia theory

The refugia theory has been discussed as a possible explanation of high diversity. Several authors have proposed that high diversity in the Amazon forest and other tropical areas was caused by drought periods during the Pleistocene which restricted the humid tropics and their fauna to isolated refugia (Haffer 1969, 1974, Vuilleumier 1971 and Prance 1982 quoted by Leigh 1990: 88). It is possible that the plant population became diversified during such isolation and when they spread during subsequent wetter periods, they had became genetically isolated, or if they were able to cross their hybrids, were sterile. Selection favoured breeding between individuals from the same refugia and speciation then could have occurred.

Other scholars, such as Leigh (1990: 88), have criticised the ways the above authors have identified refugia during Pleistocene drought periods. Leigh highlights the following aspects: climatic fluctuations are not seen to be a necessary condition to diversity. Other tropical forest areas, for example, New Guinea, where diversity is also high, was not a refugium during the Pleistocene. In addition, a population in isolation does not necessarily diverge, neither do different sectors of a continuous population stop diverging.

Supporters of the Amazon refugia hypothesis based their assumptions on pollen records reported from several parts of the Amazon basin. These pollen sequences show replacement of rain forest by savannah and savannah forest vegetation during the Pleistocene. Those who do not support the existence of refugia also base their hypothesis on pollen records reported for other parts of the Amazon, where rain forest was not replaced by savannah vegetation. Hooghiemstra and Van der Hammen (1998) think that both views are valid (see below in this chapter for palaeobotanical data).

The theory of refugia has been used by Meggers (1982, 1987) in order to explain cultural movement in South America during the Pleistocene and Holocene periods. Meggers has excluded the possibility that human groups of foragers have lived in the Amazon basin, because supposedly the extent of the forest was not enough to offer the resources required by humans. Palaeoenvironmental data from the central Amazon basin do not support the assumption of a large-scale reduction of the forest in the terra firme areas (Piperno and Pearsall 1998: 98).

Pollen records and the assumption that local changes in vegetation occur uniformly all over the region have also been criticised. There are other factors which are also very important to vegetation change such as distribution patterns of precipitation within the area and throughout the year, light levels, local hydrology and soils. On the other hand, in the case of savannah environments it is important to take into account human impact on environment when its creation or development is considered (see for example Whitten 1979: 245).

2.4. Middle Caquetá river area

The Middle Caquetá area forms part of the Colombian Amazon lowlands and covers an area of approximately 289,000 square km. At present human settlements are restricted to small areas along the Caquetá and Miriti-Parana rivers (Figure 2.3). Most of the inhabitants are indigenous people while white people are settled around or in the small villages of Araracuara and Puerto Santander. According to Rodriguez (1992), at present commercial fishing is the main and consistent economic activity. Other extractive processes have taken the form of opportunistic booms.

2.4.1. The river

The Caquetá is one of the major white water rivers of the Colombian Amazon. It is approximately 2200 km in length, its headwater is located in the southern Colombian Andes and ends in the Amazon river in present Brazilian territory. It flows mostly through low banks but includes islands, rapids, streams and backwaters. At Araracuara the river flows through a series of rapids and waterfalls (see Figures 2.4, 2.5 and 2.6). Other rapids are found down the river at "La Pedrera", where a mountain called "Kupati" was considered in the past to be a sacred place by indians. They engraved rocks below the rapids, probably as part of ritual practices (Schultes 1988: 17). Places where rapids occur have been occupied by humans since very ancient times. In these areas faunal and forest resources are highly valued and remains of prehistoric human settlements have been reported (see Mora *et al.* 1991, Herrera *et al.* 1992a and also Chapters three, four and five).

Figure 2.4 Photograph of the Araracuara canyon.

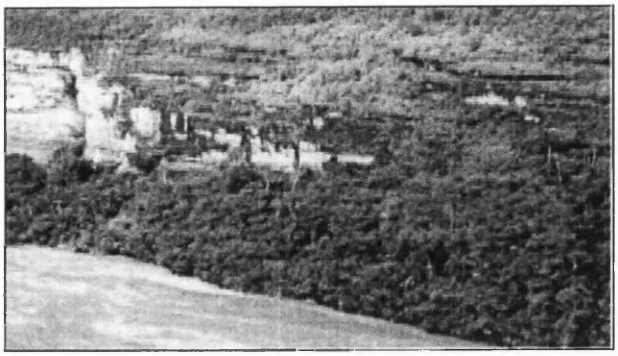


Figure 2.5 Photograph of the Araracuara canyon from the top of the Araracuara hill.

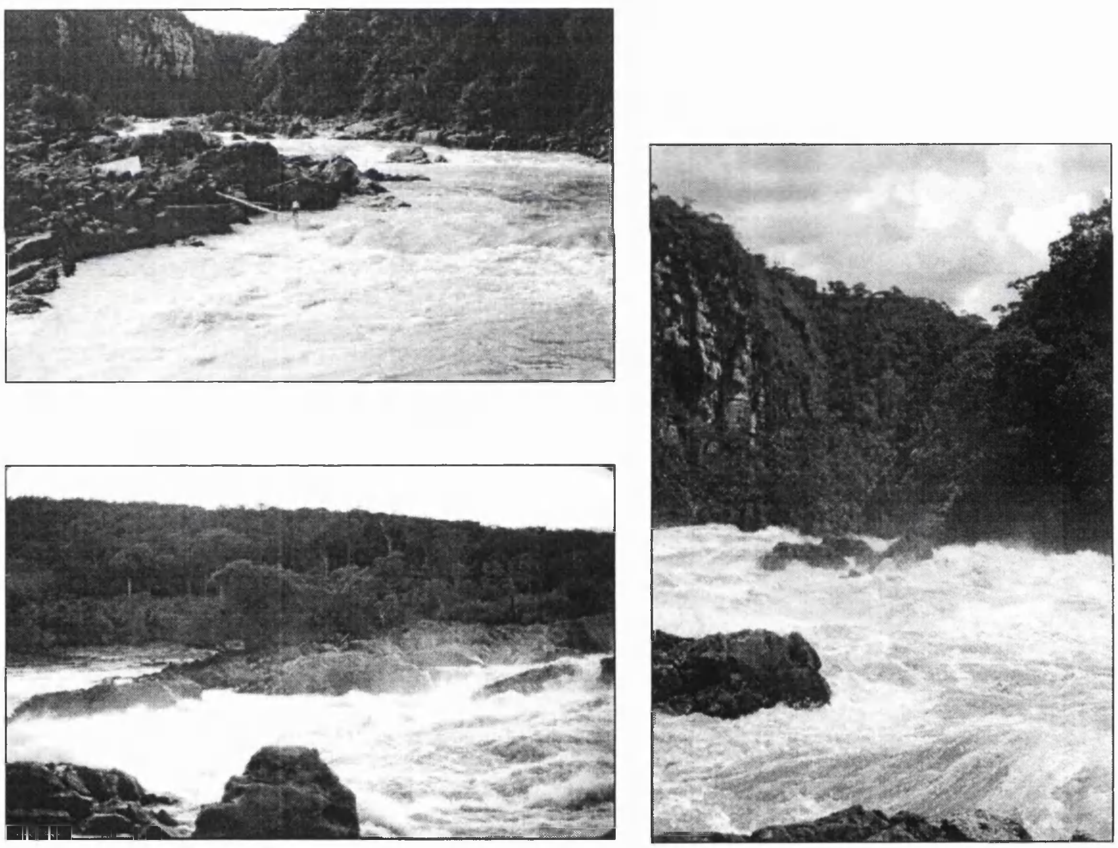


Figure 2.6 The Araracuara rapids in the middle Caquetá river.

2.4.2. Local climate

According to the Holdridge *et al.* system (1971), the middle Caquetá River has a tropical humid forest climate (Bh-T). Important temperature fluctuations occur daily but not seasonally. Day time temperatures are between 29° and 32°C, and night temperatures are between 21° and 23°C. Relatively humidity is 75%. Precipitation is always higher than potential evapotranspiration during the summer months of December to February. Precipitation is lower than in the rainy season, which occurs between April and July. The altitude is 150 m above sea level. Soils in the area include well drained, poorly drained and podzol soils. Most of the middle Caquetá region is covered by mature forest (Duivenvoorden and Lips 1993).

Local landscape

In order to study and characterise forest ecosystems in the western Colombian Amazon an investigation was made of 600,000 ha in the Middle Caquetá region. Correlation between physiography, soils and forest was assessed. Four complex land systems have been recognised according to their geomorphic and parental materials: the alluvial plain of the Caquetá river, the alluvial plain of Amazonian rivers, tertiary sedimentary plain and hardrock forms of the Palaeozoic and Precambrian ages. Alluvial plains of both Amazonian and Caquetá rivers include terraces (see Figures 2.8 and 2.9 and map in Figure 8.1). Most units associated with alluvial plains and areas developed on hardrock show a high variation in forest and soils due to variation in drainage patterns (Duivenvoorden *et al.* 1988: 35-36). It is important to take into account these units and their formation history, when an archaeological survey is planned in the region.

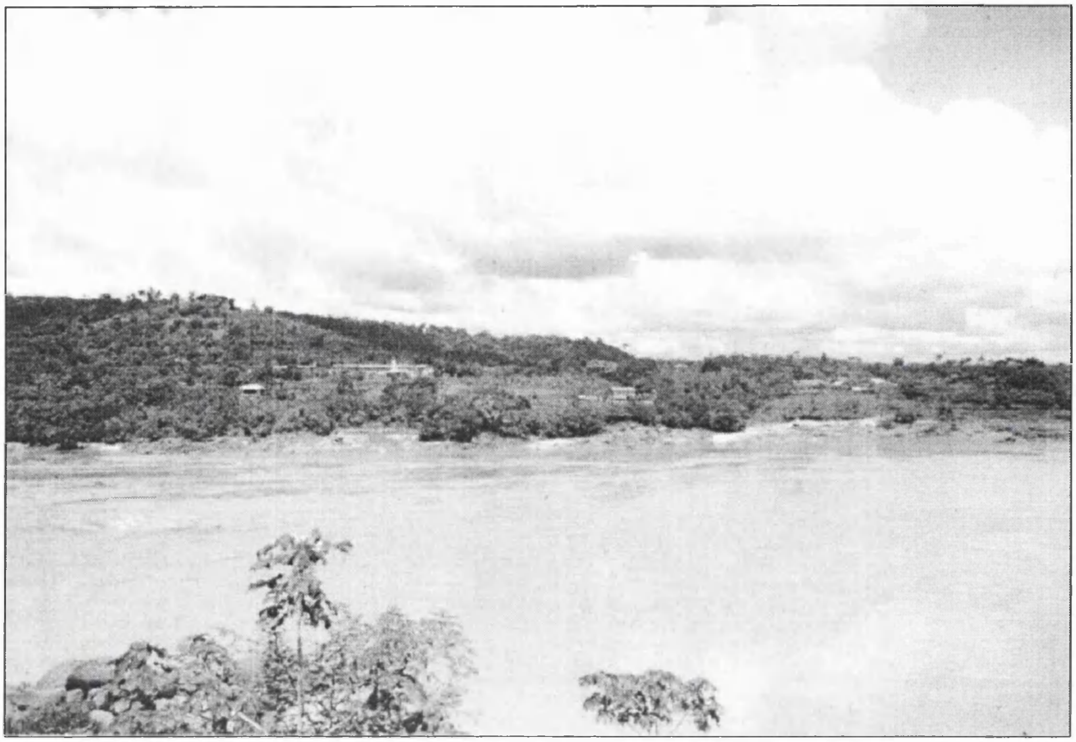


Figure 2.7 Photograph showing terraces, river plains and "terra firme" forest in the middle Caquetá region.

Figure 2.8 Landscape and forest in the middle Caquetá river.

Within the alluvial plain of the Caquetá River a flooded area with two levels can be distinguished: the lower is inundated every year and the highest is inundated occasionally although the periodicity is not well known. According to information given by the present inhabitants of the area, flooding occurs with a periodicity of three to twenty years. The difference between the two plains is only one to three m in height. Low terraces, flat in topography, are also found 10 m above the lowest level of the Caquetá river. Small meandered streams and narrow valleys with marshy areas covered by *Mauritia flexuosa* palm forests can be found on those terraces. Three other levels of high terraces are present (25, 40-45 and 55-60 m above mean lower level of the river). These terraces are also flat in topography but sometimes have sloping areas, but no marshy areas are present (Duivenvoorden and Lips 1993a).

Within the area there are micro-environments which are exploited by humans for their particular characteristics. For example, salt licks where animals congregate to drink salty water, rich in phosphorous, calcium, magnesium, sodium, potassium and chlorine, provide important hunting areas. Other marshy areas, covered by *Mauritia* sp. palms, are important for gathering fruits.

2.5. Palaeoenvironmental and Palaeoecological data

The palaeoenvironmental infomation summarised here is useful as a framework to correlate with archaeological information concerning site location, chronology and the spatial distribution of human settlements during the past (see Chapters three, four and five). Palaeoecological investigations in northern South America have been carried out mainly in the Colombian and Venezuelan Andean uplands (Van der Hammen and Gonzalez 1963, Van der Hammen 1986a) and in the lowlands including the coasts (Van der Hammen 1986b), savannahs (Wijmstra and Van der Hammen 1996) and the Amazon forest (Colinvaux and Liu 1987, Colinvaux *et al.* 1988, Colinvaux 1989, Van der Hammen *et al.* 1991a,b, Urrego 1997, Athens and Ward 1999, Behling *et al.* 1999, Berrio and Hooghiemstra 1999) in Guiana, Surinam, French Guiana, Brazil, Ecuador, Venezuela and Colombia (see Van der Hammen 1992 for a summary). Palaeoenvironmental reconstruction has been focused on climatic changes: fluctuations in temperature and effective precipitation being the main factors affecting ecosystems and their development during the past (see Van der Hammen 1961, 1974).

2.5.1. The Amazon region

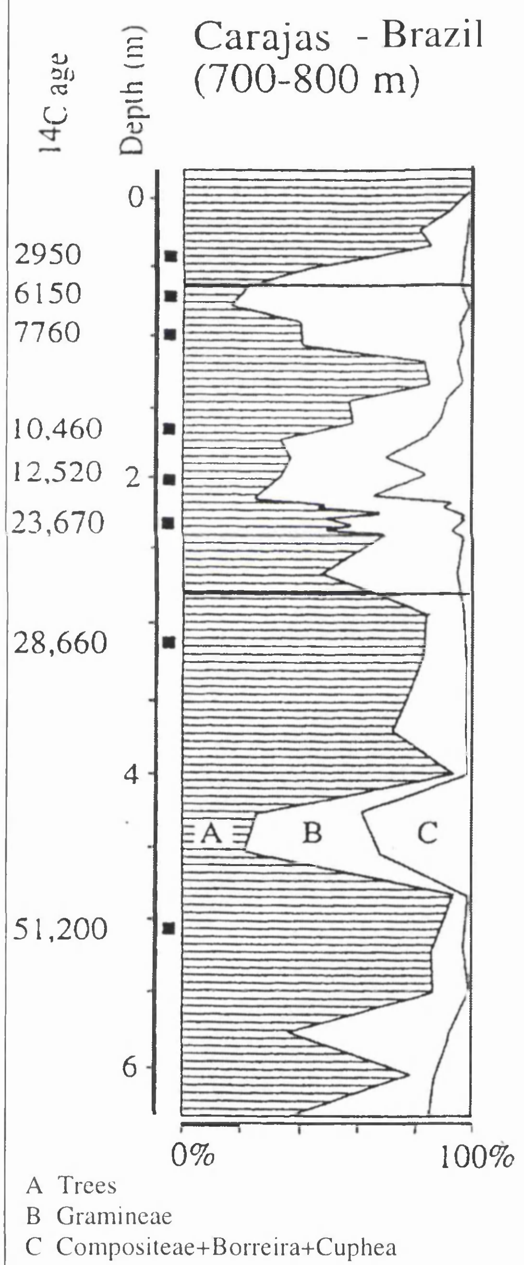


Figure 2.9 Pollen diagram from Carajás, Brazil. After Hoogmiestra and Van der Hammen 1998: 152.

The most important fact demonstrated by investigators is that the tropical rain forest of South America was affected by climatic change during the Quaternary; therefore some areas within the Amazon basin cannot be considered as homogeneous throughout that period. Several areas have been affected by precipitation and temperature changes and river dynamics. However it is still unclear whether environmental stability or dynamic conditions has contributed to the present high diversity of tropical rain forests (Hooghiemstra and Van der Hammen 1998: 147-148).

Flora formed in the Amazon during conditions alternating between fresh water swamps and periods of marine incursions during the Miocene and Pliocene, were affected by Quaternary glacial periods. The glacial/interglacial temperature changes caused altitudinal shifts in vegetation belts in areas close to mountains, such as along the foot hills of the Andes in central-eastern Brazil. This phenomenon might have allowed exchange of flora elements between different altitudes, stimulating biodiversity in that peripheral area of the Amazon region (Hooghiemstra and Van der Hammen 1998: 151).

Recent research has been focused on study of the latitudinally shifting Intertropical Convergence Zone (ITCZ) which is the major system determining the geographical distribution of precipitation near the equator. Because a tropical rain forest requires a non-seasonal annual precipitation of 1500 to 1800 mm, oscillations in the ITCZ during the past, as well as the related monsoon system, are important in understanding the development through time of tropical rain forests (Hooghiemstra and Van der Hammen 1998: 150). A typical example of a pollen diagram from the Amazon region showing Late Pleistocene and Holocene climatic fluctuations is shown in Figure 2.9 (see also Athens and Ward 1999 for comparison of different pollen diagrams from the Amazon basin).

Hooghiemstra and Van der Hammen (1998) have summarised the factors influencing Amazon Quaternary climatic history.

1. Annual migration of the caloric equator (ITCZ) between 8°N in July, and 3°S in January causes annual latitudinal change of the equatorial rain belt leading to seasonal variations in precipitation. Most of the Intertropical Convergence Zone has two dry and two wet periods in a year.
2. The precession cycle of orbital forces causes an oscillation of the equatorial rain belt with a period of 20,000 years. Today the southern hemisphere is tilted towards the sun under the present orbital configuration and the caloric Intertropical Convergence Zone is south of the geographical equator. This configuration implies a higher precipitation in the southern and central Amazon region, but in the past when the precessional cycle was at its mid-point, 11,000 years ago, the situation was the opposite to that of today. The northern hemisphere was tilted towards the sun and the caloric equator was north of the

geographical one and produced more precipitation in the northern Amazon and the Caribbean.

3. Quaternary temperature was modulated by glacial / interglacial cycles. In the Andean highlands temperature varied by 8°C while in the Amazon it was of the order of 5°C. This could produce vegetation changes.
4. The concave shape of the eastern slopes of the Andes (5°N to 15°S) acts as a trap for humid Atlantic air masses, causing continuous rain in the northwester Amazon irrespective of precession forces. Therefore this zone of the Amazon receives continuous high precipitation which explains why the area was covered by rain forest during the Quaternary.

When the four aspects are considered together it is clear that there were many local palaeoecological histories within the Amazon region: continuous forest cover, expansion of savannahs and dunes and lowering of temperatures (Hooghmiestra and Van der Hammen 1998: 154). Seen in this light, refugia and non refugia theories do not exclude each other.

According to current palaeoenvironmental data it appears that most of the Amazon region was forested during the Pleistocene period. More open vegetation

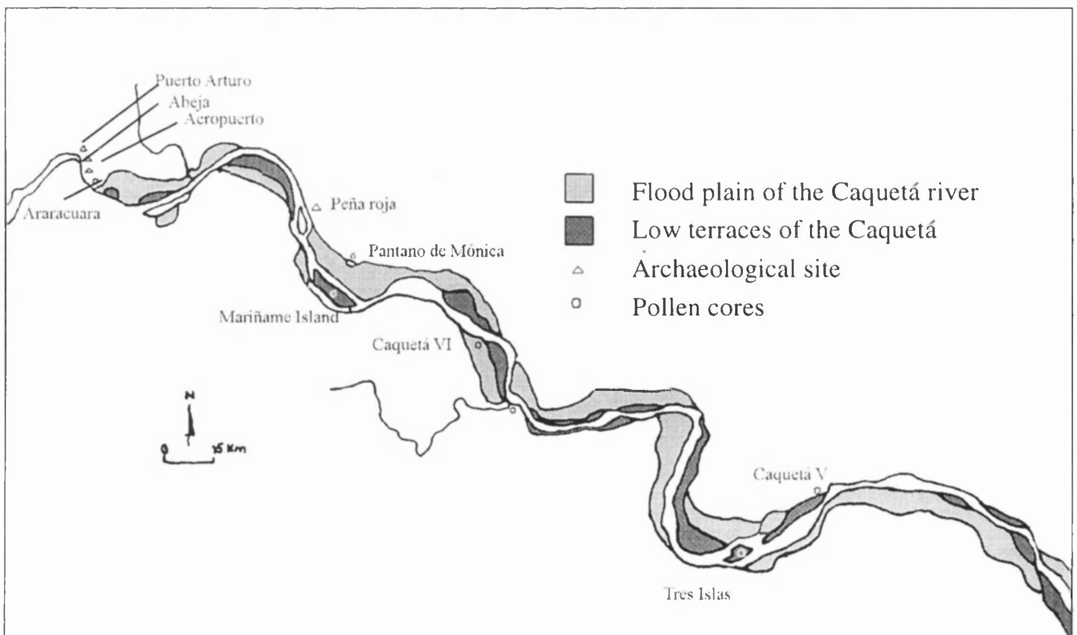


Figure 2.10 Map showing the location of the archaeological sites and places where pollen cores were taken in the middle Caquetá region. After Van der Hammen *et al.* (1991b: 110).

compositions could have existed, mainly in the drier east corridor that runs northwest-southeast (between Obidos-Santarem and the mouth of the Xingú river), and also in other seasonal areas of the Amazon such as the "cerrado" or savannah areas of central Brazil (see Figures 2.1 and 2.2). This corridor could have been a route used by people coming down from the savannah lowlands of Northern Colombia and Venezuela. Roosevelt *et al.* (1996) studied an early archaeological site located at that corridor (Piperno and Pearsall 1998: 99). Late Pleistocene migrations within the tropical areas of the South American continent could have occurred about 20,000 to 11,000 years ago if we accept that people could have reached the continent before the Pleistocene Clovis people (Piperno and Pearsall 1998: 90).

Dry and humid periods during the later Holocene may have affected populations of farmers inhabiting varzea or flooding areas along white water rivers in the Amazon (see Chapter three). During a dry period it would have been possible to practice agriculture but not during the humid period, when high river levels caused inundation of varzeas. Probably populations inhabiting these areas had to migrate to other less fertile areas. The dry period sequence is 4800 BP, 4000-3200 BP, 2800-1400/1300 BP, 800-400 BP. In between these periods are the humid ones (Van der Hammen T. 1992: 119).

2.5.2. The middle Caquetá river region

Palaeoenvironmental research has been carried out in the middle Caquetá river valley in order to describe history of the region during the Quaternary. Studies on alluvial sediments, fluvial bank formation and lower terrace formation, together with pollen analysis of alluvial sediments of the Caquetá river have provided an understanding of the palaeoecology of the area (Van der Hammen *et al.* 1991a,b,Van der Hammen T 1992, Urrego 1997, Behling *et al.* 1999, Berrio and Hooghiemstra 1999).

At the beginning of the Holocene, approximately 10,000 years ago, the Caquetá river valley was inundated until it was filled with sediments and the present inundation areas were formed. Different precipitation patterns in the western Andes mountains caused water level fluctuations in the Caquetá region. These fluctuations are reflected in sedimentation rates which can be seen also from the extension of peat deposits (Van der Hammen *et al.* 1991a,b, Urrego 1997).

In Chapters three, four and five palaeoecological data from the region are correlated with archaeological data known at present. Locations of the places where pollen sequences were taken, together with the archaeological sites, are shown in the map of Figure 2.10.

Three cores taken in the Pantano de Monica region (Behling *et al.* 1999) on a lower terrace of the Caquetá river (see Figure 2.10) produced the following information. The sequence reported in core one covers the period between 11,150 and 4730 years BP. During the Last Glacial and the early Holocene the swamp was smaller and its waters were shallower than today. This suggests that the lower terrace was better drained than today, probably due to changes in drainage system. Core two was taken in another swamp 1000 m away from core one and covers the time between 4000 and 3080 BP. Changes in forest composition were documented: for example, an increase of *Cecropia* sp. suggesting disturbance, was followed by a quick recovery represented by an increase in *Psychotria* sp. After 3080 BP swamps developed again in the area (Behling *et al.* 1999: 201-209).

The third core covers the period between 3080 BP and the present day and was located in the wet forest between the two swamps where cores one and two were taken. An increase in palm pollen, probably *Euterpe* sp., is noted and could indicate a change to less well drained conditions in the lower terraces of the Caquetá river during the late Holocene. However it could also indicate an intensive human impact on the forest of the lower terraces (Behling *et al.* 1999: 209).

Urrego (1997) made a study of pollen records from sediments taken at Mariñame Island (Urrego 1997) and Quinché stream in the middle Caquetá region (Van der Hammen *et al.* 1991a,b. See Figure 2.10 of this thesis). The aim of the research was to evaluate possible climatic and vegetation changes occurring in the flood planes of Caquetá river during the Holocene. Particular attention was given to changes produced by climate and fluvial dynamic, the main factors responsible for vegetation composition within flooding forests of the area. Structure, composition and diversity of these forests are determined by several factors related to frequency and length of flooding: physiographic position, drainage patterns, organic matter deposition through time, and soil nutrients. All these factors are related to movements of the main river channel and also with changes in water levels. At the beginning of the Holocene, about 10,000-9000 years BP, an open water environment existed, *Cecropia* sp. forest was dominant, levels of river water fell and sand flats were formed. Between 9000 and 7400 years BP, at Mariñame two, a process of seasonal varzea forest formation begun on river banks, while poorly drained backswamps were covered by *Mauritia* sp. forest. This phenomenon lasted until 5000 years BP at Mariñame one site (Urrego 1997: 211, 248).

Palynological analysis of samples taken at archaeological sites in the area produced interesting evidence for the history of environment management. One of the samples was taken at the Abeja two site located close to Araracuara village (Figure 2.10). This pollen sequence allowed Mora *et al.* (1991. See Chapter four) to assess the environmental impact of soil management during the time of site occupation. The sequence of agricultural practice was reconstructed from the pollen record.

Summarising, in general terms, palaeoecological information from the middle Caquetá region shows that there was continuity of tropical rain forest during the Quaternary. However changes in river and drainage patterns could have affected local vegetation compositions. The geographical distribution of human settlement during the past has been correlated taking into account palaeoenvironmental information from the area (see Chapter four).

2.6. Ethnography and Ethnobotany in Amazon region

Both ethnographic and ethnobotanical studies are important to this research because they are valuable sources of information on the traditional use of the environment. This information is used to formulate hypotheses about how people managed the environment during the past. In the middle Caquetá region human-plant interaction started more that 9000 years ago and still continues.

The earliest descriptions of Amazon peoples come from the 19th Century and were made by naturalists, travellers and explorers such as Spruce and Wallace (Schultes 1988). During the first half of the 20th Century a compilation of the ethnography of the area was made by Steward (1963). Models of cultural evolution have been built since then (see Chapter three). Studies of specific indigenous groups from the Colombian Amazon have been carried out since the beginning of the 20th Century and cover several anthropological aspects (e.g. Goldman 1963, Reichel-Dolmatoff G. 1968, 1976, 1978, 1985, 1986a, 1989, 1990, Jackson 1974, 1983, Hildebrand P. 1975, Pineda 1975, 1987, Reichel-Dolmatoff E. 1977, 1987, 1989, Correa 1980, 1987, 1993a,b, Hugh-Jones S. 1978, 1988, Hugh-Jones C. 1979, Hildebrand M. 1987a,b, Schroder *et al.* 1987, Walschburger 1987, Van der Hammen M.C. 1992, Arhem 1993, Cabrera *et al.* 1994, Politis and Rodríguez 1994, Torres 1994, Zambrano 1994, Politis 1996a,b, Van der Hammen and Rodriguez 1996).

Several different ethnic groups inhabit the Amazon region of Colombia. Figure 2.11 shows a map with the present day distribution of these societies within the area (for detailed information see Schultes 1988, Correa 1993). Most of the indigenous groups live in permanent settlements but there are some semi-nomadic groups such as Makú and Nukak people. Some of the settled people still live in communal or multi-family houses called "malocas", practice slash and burn agriculture, and fish and hunt using poisons extracted from plants. Farming is usually a female practice except for coca plants which are cultivated by men. The staple crop for most groups is bitter manioc (*Manihot esculenta*) which is harvested in domestic gardens and agricultural fields called "chagras". A flour called "fariña" is made from "cassava" (manioc) and it is the main source of carbohydrate consumed by people. Other cultivated plants include peppers (*Capsicum* sp.) and fruit trees.

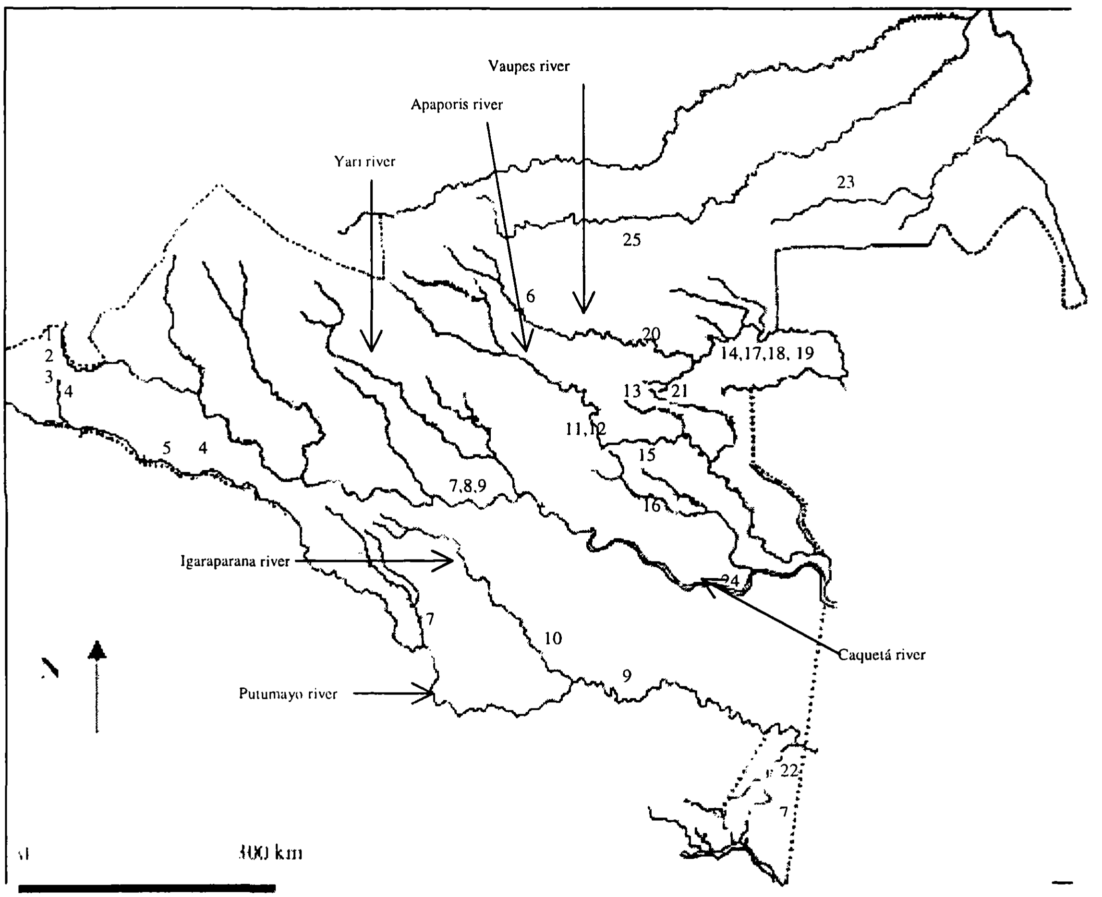


Figure 2.11 Map showing the approximate geographical location of the indigenous groups in the Colombian Amazon. Adapted from Schultes 1988: 8. Key for indigenous groups: (1) Inga; (2) Kamsa; (3) Ingano; (4) Siona; (5) Kofan; (6) Karijona; (7) Huitoto; (8) Andoque; (9) Muinane; (10) Bora; (11) Tanimuka; (12) Puinave; (13) Taiwano; (14) Barasana; (15) Makuna; (16) Yukuna; (17) Tukano; (18) Gwanano; (19) Desana; (20) Kubeo; (21) Karapana; (22) Tikuna; (23) Kuripako; (24) Miraña; (25) Nukak.

Most of the published studies contain infomation about human ecological adaptation and traditional ways of using forest products including woods (some relevant references for the present research are: Record and Hess 1943, Steward 1963, Hugh-Jones C. 1979, Glenboski 1983, La Rotta 1983, Triana 1985, Balick 1986a, Palacios 1987, Balée 1988, , La Rotta *et al.* 1989, Pérez Arbelaez 1990, Patiño 1990, Galeano 1991, Walschburger and Von Hildebrand 1991, Garzón *et al.* 1992, Van der Hammen M.C. 1992, Arhem 1993, Correa 1993a, b, Lee Dufour 1993, Alvarez *et al.* 1996, López 1996, Morcote *et al.* 1996, Van der Hammen and Rodriguez 1996).

Symbolic aspects that define the relationship between humans and nature and, in particular with cultivated plants, have also been studied. Crop distribution between domestic gardens is dictated by ritual and consumption patterns. The internal organisation and the way people cultivate these places, as well as the type of products, are related to native concepts of nature and its equilibrium. (e.g. Schroder *et al.* 1987, Walschburger 1987, Van der Hammen and Rodriguez 1996).

Research into native communities and their wide knowledge of vegetation, in particular the physical, chemical, pharmacological and toxic properties of plants have been studied. In the Colombian Amazon region, ethnobotanical research has been carried out amongst the Miraña, Muinane, Nonuya, Huitoto and Yukuna people (see Glenboski 1983, La Rotta 1983, Schultes 1983, Triana 1985, Palacios 1987, Schultes and Raffauf 1990, Sánchez Sáenz *et al.* 1991). Some of these studies deal with the role of shamans or medicine men, and women, within communities as experts in plant knowledge. They control consumption of hallucinogenic plants but also they prescribe medical treatments for people.

Some investigations deal with oral tradition and mythology because these contain traditional knowledge and sometimes regulations about the use and consumption of plants and animals. Many indigenous groups classify the natural world in the same terms as they classify their own social orders. This kind of research in the area has been carried out amongst Miraña, Huitoto and Yukuna societies (see Garzón and Macuritofe 1992, Van der Hammen M. C. 1992).

2.7. Summary

The Amazon region constitutes the biggest tropical rain forest in the world. It includes several vegetation types such as savannah, vine and bamboo forests and evergreen forests. The Amazon basin can be divided into two zones: the "varzeas" or flooding areas along the Amazon river and the "terra firme" or inter-fluvial areas, which are not exposed to seasonal flooding. Rivers are classified in three different types according to their biological and physico-chemical characteristics: black, white and clear water rivers. Climate in the Amazon varies particularly in the peripheral areas. Latisols and podzols are the two types of soils found in the Amazonian basin and both are considered to be of low fertility.

The Amazon region has been occupied by humans since late Pleistocene times. European colonisation of the area was stimulated by the economic exploitation of several forest products. The indigenous populations were devastated by the extractive colonial economy, based on indigenous forced labour. Present day populations include both indigenous groups and descendants of Europeans and current Brazilian, Peruvian, Bolivian, Ecuadorian, Venezuelan and Colombian populations.

Biodiversity in the Amazon region can be seen in the genetic information contained in the large number of species found in the area as well as in the large number of different ecosystems present throughout the area.

The middle Caquetá river area is located in the northwestern Amazon and is covered by an evergreen forest, climatically classified as tropical humid forest, with a annual precipitation rate of 3000 mm and a daily temperature of between 29° and 32° C. Four landscape units can be distinguished within the zone: the alluvial plain along the Caquetá river, alluvial plains along Amazonian rivers (those originated in the Amazon basin), Tertiary sedimentary plains and landforms developed on hardrocks of Paleozoic and Precambrian age.

According to palaeoecological and palaeoenvironmental reconstructions from northern South America, the Amazon region was affected by the Quaternary global climatic changes. Vegetation changes during the Quaternary may have occurred in some areas within the basin. The middle Caquetá area was covered by tropical rain forest vegetation during the Quaternary, although minor changes in forest composition have been recorded in local pollen diagrams. Pollen sequences taken in the middle Caquetá region illustrate the history of the human interaction with the environment in the area, since early Holocene times.

Ethnographic and ethnobotanical investigations have been carried out in the Colombian Amazon region. These studies are important sources of information for this study, to formulate hypotheses on the particular use that humans have made of the natural resources from the Amazonian area.

3. AMAZON REGION AND ARCHAEOLOGY

A brief summary of the archaeology of the Amazon region is presented. Archaeological investigations carried out in the Colombian Amazon area are described in more detail than those from other areas of the Amazon. This summary explains the relevance of the archaeological sites from the middle Caquetá river considered in this thesis. Tables 3.1 and 3.2 include the currently available information for the area and Figures 3.1 and 3.2 show the geographical location of the sites.

The site of Peña Roja, which was occupied at least 9000 years ago, is one of the most ancient in the Amazon region, according to the current available information. Other sites in the middle Caquetá river such as those located in the Araracuara plateau have contributed to our understanding of the complexity of human interrelationships with the environment during the past. The archaeological research carried out in the area has allowed re-evaluation of assumptions about the culture of people who inhabited the area during the past.

3.1. History of the archaeological investigations in the Amazon region

3.1.1. Main areas and topics studied

Most of the archaeological sites studied are located in the Brazilian Amazon. These sites include caves, rockshelters, shell middens and settlements on riverbanks. Some investigations have been done in eastern Peru at "San Francisco de Yarinacocha" (Lathrap 1970), and in the central Ucayali river (Lathrap 1968). The Napo river area in Ecuador was studied by Evans and Meggers (1968). In Colombia the main areas studied include the middle and lower Caquetá river and Leticia (Bolian 1975, Reichel-Dolmatoff E. 1976, Herrera *et al.* 1980-1981, Herrera 1981, Reichel-Dolmatoff and Hildebrand 1982-1983, Eden *et al.* 1984, Andrade 1986, Herrera *et al.* 1988, 1989, 1988, Cavelier *et al.* 1990, Mora *et al.* 1991, Herrera *et al.* 1992a, b, c, Cavelier *et al.* 1995. See Figures 2.4, 3.1 and 3.2).

The main topics studied in the area include population density, social stratification, levels of social complexity, different modes of subsistence, traditional agricultural systems and pottery traditions. Prehistoric societies from the Amazon lowlands have been compared with those inhabiting the Andean and Caribbean lowlands regions.

Population growth in the Amazon floodplains has been suggested as the main cause for population movements within the region (e.g. Lathrap 1970, Meggers 1992). Estimations of the aboriginal population in pre-contact and early contact periods have been made, amongst other authors, by Denevan (1976: 233). He estimates a population of approximately 6,800,000 people for the Greater Amazon, that is, the wide region that includes all the South American lowlands such as savannahs and coast lowlands.

Archaeological pottery classifications and correlation between different pottery styles, their geographical distribution and chronology have also been carried out. The quantitative method of seriation analysis has been used to reconstruct broad sequences of different pottery groups located along the main tributaries of the Amazon river (e.g. Meggers 1992, 1994b, 1995a). This method of cultural reconstruction was used to hypothesise patterns of diffusion, migration and invasion which were considered to be the main factors of cultural development in the area (Roosevelt 1991: 117).

Several authors have commented on the interpretative problems of ceramic seriation. For example, Barreto (1998: 577) says that "The assignment of sites to phases and traditions was influenced by sampling biases and by seriations based on too few and often irrelevant attributes". The definitions of concepts such as phase and tradition were contradictory and ambiguous concerning their representation as socio-cultural entities. The definition of different groups of ceramics based on one single feature such as decoration or temper, made the reliability of the phases defined uncertain. Other important research aspects such as function of the sites were hidden by the categories of phases and traditions.

Neves (1998: 627-628) also says that ceramic seriation does not allow "intrasite artefact variability at the same occupation levels" to be seen. The premise that the ceramic temper as "a universal indicator of cultural affiliations is questionable". The conclusions of ceramic seriations are based on small size samples "without apparent control". Ceramic seriation does not take into account the fact that there are natural and human factors that alter the archaeological occupation levels in the tropical forests.

In the Colombian Amazon archaeological surveys have used black soils as diagnostic of archaeological settlements. Presence of stone engravings at river rapids, sherds and lithic artefacts and/or lithic debris has also been used to locate archaeological sites.

In the last two decades systematic bioarchaeological research carried out in some areas of the Amazon region has allowed recovery of plant, animal and human macro and micro remains. Reconstruction of past subsistence patterns and environments have been postulated (Herrera *et al.* 1988, 1989, 1992a,b,c, Cavelier *et al.* 1990, 1995, Mora *et al.* 1991, Roosevelt 1991, Morcote 1994a, Morcote *et al.* 1996, 1998, Piperno and Pearsall 1998, Piperno 1999). Correlation between palaeoecological information and the archaeological evidence has been made by archaeologists working in the area. Climatic events such as "El Niño" episodes have been correlated with archaeological sequences. This correlation has in turn been used to explain cultural change in the past as a consequence of environmental change (e.g. Meggers 1994a,b, 1995a).

These ideas have generated much discussion. For instance, Neves (1998: 627) points out the difficulty with Megger's suggestions to explain gaps in cultural sequences as a result of arid intervals generated by El Niño episodes on the western coast of South America. These sequences are from the Marajó island, Llanos de Mojos, Lago de Silves/Lower Uatumã (Central Amazon) and the lower Xingú (lower Amazon). The gaps occurred between 2870±190 BP (Mangueiras phase) and 1940±230 BP (Formiga phase). Meggers relates these to the arid phases that occurred c. 2800 to 2000 BP and were detected in pollen cores from Marajó and other sites. These episodes were of short duration, while the gaps in archaeological sequences are of hundreds of years and the archaeological sites are located far away from the western South American coast.

3.1.2. Environmental models and cultural evolution

Models based on the environmental conditions of the Amazon region have been constructed to explain social and cultural evolution in the area. These models consider the environmental conditions as the main factors in the determination and limitation of social and cultural evolution (Hames and Vickers 1983: 7).

The first description and categorisation of indigenous societies from the Amazon region was by Julian Steward during the 40s (1963). Later Steward and Faron (1959 quoted by Hames and Vickers 1983: 8) described the people of the South American tropical area as societies which can be divided into: small single-lineage villages (less than 100 individuals) located near streams away from large rivers; large multi-lineage villages (more than 1,000 inhabitants) located along the Amazon river and its major tributaries, and family bands (25-50 individuals) inhabiting economically marginal regions.

These theories led to a paradigm of social and cultural evolution in the region that today is still referred to in anthropological, archaeological and ecological research in the region. Steward and Faron (1959) thought that chiefdoms or state societies did not emerge in the Amazon region because of its poor soils, sparse faunal resources, lack of efficient transportation and because of the isolation from main centres of cultural development in the Andean highland and Central American areas. Poor soils led to shifting cultivation as the main subsistence system in the area and it did not allow the existence of dense, permanent or aggregate populations, nor a surplus of food which could have supported a stratified society (Steward and Faron 1959: 61 quoted by Hames and Vickers 1983: 8, Whitehead 1996).

Steward's model of cultural evolution was later fully developed by anthropologists and ecologists who carried out ethnographic research and ecological studies in the Amazon. A distinction between floodplain and hinterland environments has been suggested by archaeologists and cultural ecologists working in the area (e.g. Lathrap 1970, Meggers 1971, Roosevelt 1980). According to this interpretation people inhabiting permanent settlements along main rivers were practising intensive cultivation of staples such as maize and beans. They also could be sure of the availability of animal and fish protein sources. On the other hand, peoples inhabiting the hinterlands, which have poor soils, were practising slash and burn agriculture. In these areas, major ecological constraints determined the ephemeral character and small size of their settlements.

The implication of fallow agriculture is that households have to be repeatedly moved and that this agricultural system limits the length of site occupation. However archaeological data from the middle Caquetá river and Brazilian eastern Amazon show that the length of occupation at some sites was as long as 1500 years (Roosevelt 1990, Herrera *et al.* 1992a, Mora 1993).

Hypotheses based upon environmental determinism, dealing with cultural evolution, have several problems which have been discussed by some authors. Neves (1991), evaluated poverty of soils as a determining factor for settlement movement and settlement split in the hinterlands. These phenomena can occur for other reasons than poverty of soils or subsistence patterns, as Carneiro demostrated for the Kuikuro people (Carneiro 1972). Village fissioning may be related to internal disputes within a society especially when chieftainship is notoriously weak, as has occurred among most Amazonian villages. The political mechanism for keeping a growing community together and in the face of divisive forces did not exist. In addition, no great ecological factors prevent a faction from splitting off from former community. Suitable land is easily found (Carneiro 1972:105). Carneiro also showed that slash and burn agriculture allows permanent settlements. In addition, Johnson showed that swidden agriculture can produce a surplus (Johnson 1982, 1983 quoted by Neves 1991: 9-10).

Donald Lathrap (1968) used an ecological historical approach to model human adaptation in Amazon region. He suggested that the first humans entered the region following the main river systems, where aquatic resources supplied them with protein, fat and salt-rich "varzea" soils, adapted to permanent cultivation. He thought that these conditions together allowed the developed of complex societies. Once the population grew, some people were forced to moved to "terra firme" or inter-fluvial areas where hunting was not so profitable and where they practised slash and burn agriculture. His explanation about the origin of Amazonian cultures contrasts with Megger's thesis on the Andean origin of these cultures (see Myers 1992: 85).

Lathrap explored the concept of the domestic garden in order to formulate hypotheses about the transition from hunting, fishing and gathering to agriculture. Linguistic inter-relationships between different language groups and archaeological traditions were used by him as a model of population movements out of the central Amazon region (Oliver 1992: 293).

More recently Anna Roosevelt (1980) has attributed the development of stratified societies in the Amazon region to the cultivation of maize and beans in alluvial or "varzea" areas. She suggests that these factors allowed an increase in population which led to the practice of intensive agriculture and to the need of authorities to organise production. This allowed very efficient use of aquatic resources and in turn allowed surplus production which supported the social stratification.

Data presented later in this chapter (3.2 and 3.3) will show how archaeological research in the Amazon region has demonstrated that human populations have occupied the area since Late Pleistocene and early Holocene times. These people were interacting with the surrounding environment in different ways and they independently developed subsistence systems and agricultural technologies, as well as other cultural manifestations such as ceramic and lithic industries. Cultural evolution and complexity is postulated for societies inhabiting the Middle Caquetá area (see Mora *et al.* 1991, Mora 1993). Cultural evolution and complexity therefore cannot be attributed only to the societies that inhabited the highland areas of South America. The development of cultural evolution and social complexity cannot be directly correlated to the occupation of a particular type of environment.

3.2. Earlier human occupation. Non ceramic manufacturing people

Large game hunters of the so called "Paleo-Indian culture", which is characterised by finely chipped fluted bifacial projectile points such as Clovis and Folsom styles, have been located in several sites in North America. These sites were occupied at about 11,200 to 10,900 and from c. 10,900 to 10,200 years BP. It was believed that these highly specialised hunters moved through open temperate environments. Tropical lowlands were considered as natural barriers to the large game hunters because apparently these areas did not provide enough resources for human feeding and also because it was believed that slash and burn agriculture was a precondition of living in tropical rain forests. Bifacial projectile points have also been found in some caves of eastern Brazil Their presence in lowland eastern tropical areas of South America open the debate about subsistence patterns and their antiquity in the continent (Roosevelt *et al.* 1996: 373).

Kipnis (1998: 582) points out that there was variability in early human adaptations in the Americas during the late Pleistocene period. He presents evidence from several sites in Central Brazil where specialised big-game hunting lithic assemblages do not characterise the sites. He highlights the fact that lithic assemblages from South America are distinct from those found in North America and that this could be related to the human adaptation of a very ecologically diverse and new environment.

During the last two decades several "Paleo-Indian" sites have been located in forested areas of Central and South America. The lithic industries associated with the faunal remains in these sites have been dated to late Pleistocene and early Holocene times but they are not associated with large game faunal remains. These findings have two implications for general modelling of peopling the continent. First, that the earlier hunter-gatherer groups were not just found in the open savannahs, and second that they not only hunted large game but also medium and small game. The fact that many of the remains have appeared in the forest lowlands of eastern South America widens the spectrum of probable routes of migrations within the continent.

Different models have been proposed to explain early human subsistence strategies during the late Pleistocene and early Holocene period for the region. For instance, the archaeological evidence from Central Brazil shows that the subsistence pattern of late Pleistocene and early Holocene groups was based on foraging of wild plants and small animals. Gathering strategies were more important than hunting according to preliminary faunal and osteological studies (Kipnis 1998:590). A different model for the human subsistence pattern of late Pleistocene/early Holocene from the same area has been suggested by Schmitz (1987b). According to him the earlier people from Central Brazil based their subsistence strategy on the hunting of large mammals such as peccaries, tapir, and deer; later they change this strategy to one based on plants.

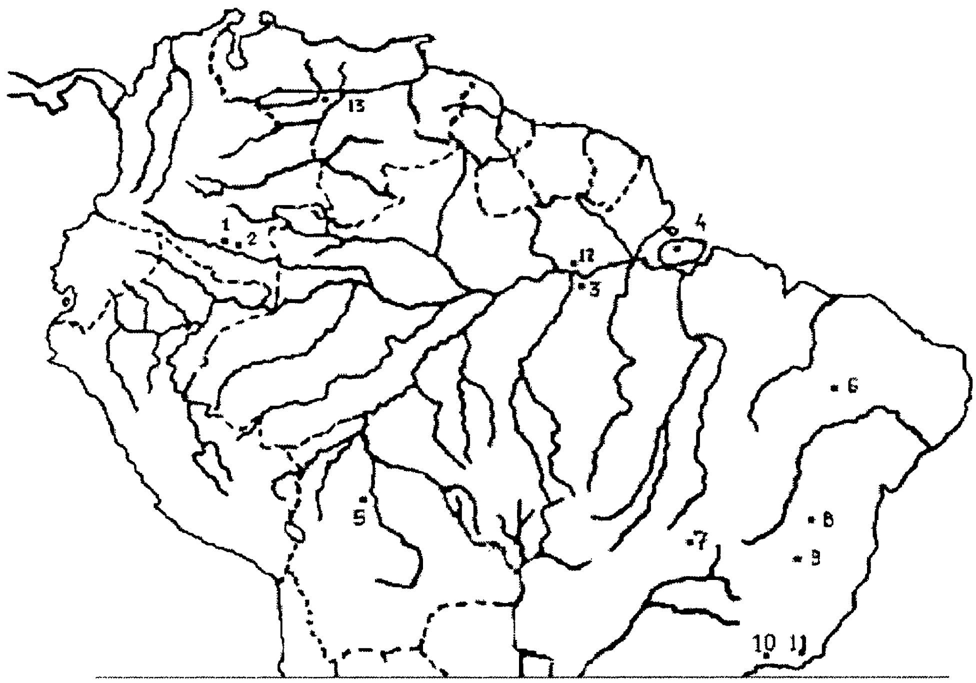
Specialised large game hunters from North America were not the sole source of migration into South America. Stratified sites with several human occupations, such as those detected at Pedra Pintada cave in the Brazilian Amazon, show that the region was a place where a dynamic evolution process of human patterns of subsistence occurred. During Pleistocene times foraging bands inhabited the area, and during the Holocene period it was inhabited by fishers, in villages along waterways. Horticulture was adopted and the use of pottery became common. Farming societies, with complex social organisations inhabited the area from the beginning of the Christian era (Roosevelt *et al.* 1996: 381-382).

Small human groups of Paleo-Indian hunter-gatherers in the Amazon region were present, as is indicated by numerous pre-pottery archaeological sites dated to the latest part of the Pleistocene period: between about 11,400 and 10,000 years BP (Simoes 1976, Bryan 1983, Miller 1987, Schmitz 1987a quoted by Roosevelt 1994: 4). The most common stone tools of these early complexes are both large and small (five to 13 cm in length) finely chipped, tanged spear points (Roosevelt 1994: 4).

3.2.1. Sites, chronology and archaeological remains

There is no general agreement on when people arrived in the Amazon region but there is abundant evidence of late Pleistocene and early Holocene sites. In this section a summary of the archaeology from some of the most important sites in the area is presented. Table 3.1 includes the earliest and latest radiocarbon dates reported for these sites but also other dates from some sites when they were relevant to the discussion. The last column of the table includes the bibliographical references.

Several archaeological sequences have been reported in northeast Brazil at sites such as Toca do Sitio do Meio and Toca do Boqueirâo de Pedra Furada (see Table 3.1, map in Figure 3.1 and details of the sites in Guidon 1981, 1986, 1989, Guidon and Delibrias 1985 and Parenti et al. 1990). According to radiocarbon dates obtained at the sites, Guidon (1986) suggests three cultural phases. The first one dated between 31,500 and 14,000 years BP was characterised by the presence of flakes with very limited retouched quartz and quartzite pebble cores. These artefacts were probably used as cutting tools and scrapers. The second phase dated between 14,000 and 11,000 years BP was characterised by unifacial retouched "limaces" and siltstone, quartz or quartzite flakes. The third phase dated between 10,000 and 7000 years BP included large flakes, scrapers and knives of quartzite.



(1) Abeja and Araracuara sites; (2) Peña Roja; (3) Santarém; (4) Marajó Island; (5) Llanos de Mojos; (6) Toca do Sitio do Meio, Toca do Boqueirâo; (7) Gioás; (8) Minas Gérais; (9) Lapa Vermelha IV; (10) Alice Boër; (11) Itaborais sites; (12) Lake Geral, Caverna de Pedra Pintada, Taperinha; (13) Parmana.

Figure 3.1 Map showing the location of different archaeological sites in the Amazon region.

There is no consensus about the antiquity of the human occupation of Pedra Furada site. Meltzer *et al.* (1994) are sceptical of the Pleistocene human occupation of the site. They discuss in detail the main questions derived from the archaeological data. The most important questions are related to the reliability of the charcoals used to obtain dates and to the status of chipped pebbles as man made artefacts (see Schmitz 1987b, Bednarik 1989, Lynch 1990, Meltzer *et al.* 1994 and Guidon *et al.* 1996).

Meltzer *et al.* (1994: 702) point out that the origin of the charcoal fragments is not clear and it could be carried out to the interior of the shelter by natural factors. They also say that it is not clear how the purported lithic artefacts differ from natural stones. It is necessary to have more information about the natural fall of material into the shelter from spalling events and from cobble debris carried down the chutes (Meltzer *et al.* 1994: 712). The opinions between the excavators and different investigators differ, the question is therefore still open (see Meltzer *et al.* 1994 and Guidon *et al.* 1996 for a reply).

Schmitz (1987a) proposes several lithic traditions for the eastern region of Brazil. The Uruguai tradition, characterised by bifacial stemmed projectile points is associated with open environments in the southeast Brazilian area. The Itaparica tradition includes unifacial lithic artefacts that have been found in several sites of the eastern tropical parklands of Brazil (parklands extend from the Northeast across central Brazil to the Southeast). Rock art paintings are associated with the Itaparica tradition. The Humaitá and Sambaqui traditions are reported by about 7000 years BP. The Humaitá tradition is characterised by bifacial artefacts and absence of projectile points. This tradition has been reported in South Brazil.

In the Mato Grosso state in the southwest Amazon some lithic tools have been found at the rockshelter called Abrigo do Sol (MT-GU-1). These artefacts were radiocarbon dated to between 10,405±100 and 9370±70 years BP (Schmitz 1987a). At Caverna do Gariao in the Carajas region, south of Belem City, a preceramic human occupation in a rockshelter was reported. This occupation was radiocarbon dated to between c. 8000 and 6000 years BP. Evidence of a broad spectrum small game hunting, fishing and gathering subsistence pattern were found at the site (Lopes *et al.* 1989: 186 quoted by Roosevelt 1991: 112. See Figure 3.1).

Table 3.1 Archaeological sites from the Late Pleistocene and the Early Holocene periods in the Amazon region. Key for references: 1(Guidon 1986), 2 (Schmitz *et al.* 1976), 3 (Schmitz 1976-1977) 4 (Schmitz 1980), 5 (Barbosa *et al.*1976-1977), 6 (Schmitz 1987a), 7 (Lopes *et al.* 1989), 8 (Laming-Emperaire 1979), 9 (Prous 1986b), 10 (Prous 1981a), 11 (Kipnis 1998), 12 (Dillehay *et al.* 1992), 13 (Beltrão 1974a), 14 (Roosevelt *et al.* 1996), 15 (Cavelier *et al.* 1995), 16 (Piperno 1999), 17 (Correal *et al.* 1990).

Archaeological site	**Uncalibrated years BP and laboratory numbers**	**Period/Culture**	**Subsistence pattern**	**Reference**
Pedra Furada	31,500±950 (GIF 6041) 26,400±400 (GIF 5962) 26,300±600 (GIF 5963) 25,000 (GIF 5348 & 5398) 17,400±400 (GIF 5397)	Late Pleistocene & Early Holocene.	hunting and gathering	1 1 1 1 1
Toca do Sitio do Medio	14,300±400 (GIF 5399) 13,900±300 (GIF 4927) 12,440±230 (GIF 5403) 12,200±600 (GIF 4628)			1 1 1 1
Goiás rockshelters: GO-JA 1, 2, 3, 13c, 14, 20, 22, 26	10,740±90 (N 2348) to 8,370±85 (SI 5562)	Itaparica tradition		2 3,4
GO-NI 49	10,750±300 (SI 2769)	Itaparica tradition		5
GO-JA 1, 2, 3, 13c, 14, 22, 26	7,420±80 (SI 3694) to 6,690±70 (SI 3691)	Serránopolis phase		2 2
Abrigo do Sol	10,405±100 (SI 3476) 9,470±70 (SI 3479)	Early Holocene	hunting and gathering	6 6
Gariao cave	8,000 and 6,000	Early Holocene, Pre-ceramic occupation	small game hunting, fishing, gathering	7
Lapa Vermelha IV	11,680±500 10,200±200 9,580±200 (GIF 3208) 6,830±150 (GIF 2373) 5,120±130 (GIF 3214) 4,170±120 (GIF 2543)	Early Holocene	megafauna (ground sloth) hunting, gathering	8 8 8 8 8 8
Santana do Riacho rockshelter	11,960±250 (GIF 5089) 9,460±500 3,990±70	Late Pleistocene. Unifacial tools.	hunting and gathering	9 10 11

Table 3.1. (Continued).

Archaeological site	Uncalibrated years BP and laboratory numbers	Period/Culture	Subsistence pattern	Reference
Lapa do Boquete Lapa dos Bichos	12,000±170 (CTDN 2403) 10,450±70 (Beta 100397)	Late Pleistocene. Unifacial tools.	hunting and gathering	11 11
Alice Boër	Bed III:14,200±1150 10,900±1000 6,135±160 (SI 1206) 6,050±100 (SI 1205)	Late Pleistocene	hunting	12 12 13 13
Itaborai	*c.* 12,000 – 9,000	Late Pleistocene & Early Holocene	hunting	12
Pedra Pintada cave	*c.* 11,200-10,500 10,200-10,100 10,100-9,800	Initial period Middle period Later period	hunting, fishing, gathering	14
Peña Roja	9,250±140 (Beta 52964) 9,160±90 (Beta 52963) 9,125±250 (GX 17395) 8,090±60 (UCR 3419, CAMS 27728)	Early Holocene, Pre-ceramic occupation	hunting and gathering	15 15 15 16
Guayabero 1 rockshelter	5,000 –2,000	Middle Holocene, Pre-ceramic occupation	hunting and gathering	17

In the Minas Gérais state, several caves have been located in the Lagoa Santa area (see Figure 3.1). In these caves evidence of association between lithic artefacts and megafauna remains (ground sloth bones) have been found. Ground sloth bones were found at Lapa Vermelha IV rockshelter in association with organic remains dated to between 10,200±200 and 8580±200 years BP (Dillehay *et al.* 1992: 166). Other radiocarbon dates obtained at the site are 11,680±500, 9580±200, 6830±150, 5120±130 and 4170±120 (Schmitz 1987a). Flakes, unifacial tools, human bones and hearths were found at some of these caves. At the rockshelter Grande Abrigo de Santana do Riacho the human occupation was dated to between 11,960±250 and 3990±70 years BP (Prous 1986b, Prous 1992-1993 quoted by Kipnis 1998: 587). Most of the lithic artefacts found in the rockshelter were of quartz and quartzite and included side scrapers, end-scrapers, borers and rare bifacial points (Prous 1991 quoted by Kipnis 1998: 587). Use-wear analysis of some of these lithic artefacts indicated evidence of wood working (Alonso 1991 quoted by Kipnis 1998).

The Lapa do Boquete rockshelter dated to 12,000±170 years BP and the Lapa dos Bichos rockshelter dated to 10,4550+70 years BP; the lithic industry includes flint and silicified sandstone artefacts such as end-scrapers and rare bifacial projectile points. Microwear analysis indicated that the majority of these artefacts were used to work wood (Prous *et al.* 1992 quoted by Kipnis 1998: 587).

The lithic industry from the archaeological sites in the Minas Gerais state is expedient, with many scrapers, rare bifacial points and few highly curated tools. Botanical remains found in the sites indicate the exploitation of wild fruits. Subsistence is characterised by the gathering of fruits and roots and the hunting of small animals (Kipnis 1998).

Open-air sites on river terraces have also been located and studied. At Alice Böer in southeastern Brazil (Figure 3.1), several types of lithic artefacts were reported. These include unifacial scrapers, cores and flakes. From five levels of occupation, the so-called Bed III contained bifacial tools such as projectile points. Bed III artefacts were associated with a radiocarbon date of 14,200±1150 BP and a thermuluminiscence and radiometric date of 10,950±1000 BP (Beltrão 1974a,b; Bryan and Beltrão 1978; Beltrão *et al.* 1986; Hurt 1986 quoted by Dillehay *et al.* 1992: 166). Other radiocarbon dates from the site are 6135±160 and 6050±100 years BP (Beltrão 1974a).

At the Itaborai site located in south-eastern Brazilian Amazon area, stemless projectile flakes, retouched cores and other lithic artefacts were dated between *c.* 12,000 and 9000 years BP (Beltrão 1970; Beltrão and Sarciá 1987 quoted by Dillehay *et al.* 1992: 166).

A human campsite has been found at Caverna da Pedra Pintada in the Monte Alegre area at the confluence of the Amazon and Tapajos rivers in the Brazilian Amazon (Figure 3.1). Organic material has been radiocarbon dated, and lithic artefacts and sediments have been dated by means of luminescence dating techniques. More than 60 dates indicate a Pleistocene age for the remains found. Roosevelt *et al.* (1996: 380; 1998: 167) estimate that the site was occupied during the long initial period from c. 11,200 to 10,500 years BP, the middle period was dated from c. 10,200 to 10,100 years BP, and the later period from c. 10,100 to 9800 years BP.

Wall paintings, triangular and bifacial lithic spear points and other different artefacts have been found at Pedra Pintada cave. Charred tree fruits and wood as well as faunal remains have also been reported from the site. The charred tree fruits and wood came from several forest trees, including palms (see Chapter four). Although faunal remains were poorly preserved in the sandy soils of the cave the findings indicate a diverse exploitation of animals. Remains include charred fragments of bone and shell, teeth, jaws, cranial fragments, otoliths, spines, vertebrae, ribs, pelvises, long bones, phalanges, claws, carapace and plastron fragments. These remains belong to fishes, rodents, bats, bivalve and univalve molluscs, tortoises, turtles, snakes, amphibians, birds and large land mammals (Roosevelt *et al.* 1996: 379-380).

Roosevelt and colleagues identified the human occupation of the cave as the Monte Alegre Paleo-Indian culture, who made and used bifacially and unifacially chipped stone tools, and stylised rock art, and who practised a subsistence economy of tropical forest and floodplain foraging. They suggest that people were visiting the cave for more than 1200 years (Roosevelt *et al.* 1994: 4-5, 1996: 380. See Figure 3.1).

In the Middle Caquetá region of the Colombian Amazon, early human occupation was reported at the site of Peña Roja. It was radiocarbon dated to between

9125±250 and 9250±140 years BP (GX-17395: 9125±250; Beta-52963:9160±90; Beta 52964:9250±140. Cavelier *et al.* 1995: 28. See Figure 3.1).

At Peña Roja archaeological site from the Middle Caquetá river, numerous plant macro-remains were recovered and identified (Morcote 1994a, Cavelier *et al.* 1995, Morcote *et al.* 1996, 1998). Within them several palm genera could be distinguished. Phytolith analysis has revealed the presence of cultivars as well as trees (Piperno and Pearsall 1998: 203, Piperno 1999, Herrera and Cavelier 1999. See Chapter 4). Lithic artefacts included scrapers, flakes and bifacial choppers. Some of the lithic artefacts have been interpreted as grinding stones, as well as choppers and anvils which could be used to crack nuts. Two axes, probably hafted, were used for gathering roots because their size and weight, and material indicate that they were used on relatively soft surfaces (Cavelier *et al.* 1995: 33).

A rock shelter called Guayabero one (Figure 3.1) was located at the locality of Angostura in the northwestern Colombian Amazon region. Radiocarbon dates indicate that the site was occupied by humans about 7000 years ago. Two different occupations were reported by the excavators. The earliest one was a pre-ceramic hunter-gatherer group. The later one was using pottery. The pre-ceramic occupation was dated between 5000 and 2000 years BP. Lithic artefacts include prismatic, concave, triangular and retouched flakes, terminal disk-like lateral and circular scrapers (Correal *et al.* 1990: 245).

Summarising, people living in the lowlands of South America at the end of the Pleistocene period and at the beginning of the Holocene inhabited different types of environments including forest, savannah and parkland areas in the Amazon region. These different ecological areas offer a wide variety of animal and plant resources suitable for the human diet. Lithic assemblages recovered in caves, rockshelters, and river-side sites include unifacial and/or bifacial artefacts. Different assemblages of artefacts have been interpreted by archaeologists as products of different cultural traditions and regional economies. The first inhabitants of the Amazon region developed long term adaptation to the tropical rain forest.

3.3. Later human occupation. Ceramic manufacturing people

Several authors have carried out archaeological research on the eastern slopes of the Ecuadorian, Peruvian and Bolivian Andes (e.g. Porras 1961, 1974, 1975, 1978, 1987, Izumi and Sono 1963, Lathrap and Roys 1963, Allen 1968, Isbell 1968, Lathrap 1968, 1970, Raymond 1972, 1976, Athens 1984, Reindel and Guillaume-Gentil 1995, Salazar 1998). This area is known in the literature as the "Montaña" region and corresponds to the upper Amazon basin. The environmental conditions in this area are very different to those in the middle and lower Amazon basin. Rivers in the upper Amazon have narrow steep-sided canyons as soon as they cut through the eastern ranges of the Andes. In the middle and lower Amazon the rivers have the pattern of meandering rivers and their valleys have active flood plains. The forest vegetation in the steep eastern slopes of the Andes is also different from the vegetation in the middle and lower Amazon basin. In the Upper Amazon basin the tropical forest is less tall and far denser. This type of vegetation is typical between 600 to 2000 m above sea level and is called "ceja" vegetation (Lathrap 1970). According to current archaeological information from the area it was occupied by humans c. 2000 years BC and 1500 AD (Lathrap 1970: 45). Several ceramic traditions have been defined in this area.

During the early Holocene period human groups specialised in fishing and shell-fishing established permanent villages along the banks of the Middle and Lower Amazon River and in the Atlantic coast estuarine areas and began to use pottery. Their stone tools consisted mainly of flakes, grinders and abraders and appear crude and non-specific in purpose compared to the chipped tools of early hunters and gatherers, and to the ground and polished stone tools of later inhabitants of the area. Many of these settlements left shell middens (Roosevelt 1994: 5).

Villages were established along the major floodplains of the Amazon region at about 4500 and 2000 years BP. Indirect archaeological evidence of manioc processing has been found on some sites (Cruxent and Rouse 1958-1959, Hilbert 1959, Lathrap 1970, Roosevelt 1978, 1980, 1990, n.d., Boomert 1983 Roosevelt *et al.* n.d. quoted by Roosevelt 1994: 6). The evidence consists of ceramic griddles and stone grater chips. Ground stone axes, probably used for felling trees in areas to be used in slash and burn agriculture, have also been found. Decorated ceramic vessels are associated with the above mentioned archaeological remains. The decorations of the vessels include applied modelled figurines of animals, painted geometric motifs and sometimes incised lines and red and white painting

Chiefdoms existed in the Amazon region by about 2000 years BP. These peoples decorated their pottery with elaborate designs including female figurines and large effigies. Large cemeteries were designated for the burial of the dead, commonly in large funerary urns. This later occupation seems to have been larger and as evidenced by denser than previous occupations, deep and extensive black soil middens, numerous traces of houses and hearths, abundant artefacts and, in some areas, large earthworks. According to the results of archaeological research as well to the ethnohistorical accounts of the first Europeans, these peoples had a subsistence economy based on seed crops and on the hunting of small game and fishing. About 1000 years ago maize became a staple food in some areas, both in floodplains and upland areas of the region (Roosevelt 1980, 1989a, 1990, 1991, Bush *et al.* 1989, Roosevelt *et al.* n.d. quoted by Roosevelt 1994: 7).

Other societies exhibiting some complexity have been reported in the Middle Caquetá river and their cultural remains are related to dark coloured soils, different ceramic styles and lithic industries. No monumental earth works or other type of public construction have been found. Other previous investigations had been carried out in the Caquetá region (see Reichel-Dolmatoff E. 1976, Herrera *et al.* 1980-1981, Reichel-Dolmatoff and Hildebrand 1982-1983, Eden *et al.* 1984 and Andrade 1986, 1988). Intensive archaeological research has been carried out since 1986 in some of these settlements (Herrera *et al.* 1988, 1989, Cavelier *et al.* 1990, Mora *et al.* 1991, Herrera *et al.* 1992a,b,c, Cavelier *et al.* 1995).

Archaeological research in the middle Caquetá region has led to re-evaluation of some assumptions such as the low population density, and the absence of high levels of social and political integration. The evidence shows that there were other agricultural systems in the region that allowed human settlement concentration and intensification of food production (Mora *et al.* 1991).

3.3.1. Sites, chronology and archaeological remains

3.3.1.1. The Montaña Region

This area has a cultural sequence going back to c. 2000 BC (Lathrap 1958, 1962, 1970) but studies have concentrated in ceramic typologies. None of these sites produced significant environmental information. For purposes of comparison with Peña Roja it should be noted that the Polychrome Tradition present in the ceramics at Peña Roja by c. 1900 to 400 BP, is represented, in local variants, in the Ecuadorian and Peruvian Montaña. By using the archaeological and linguistic data Lathrap (1970) argues that the earliest sites in the Ucayali and Pachitea rivers of the Peruvian montaña were inhabited by proto-Arawak-speaking peoples who had migrated into the montaña area from the Amazon lowlands (Raymond 1988).

3.3.1.2. The Middle and Lower Amazon

A shell mound at Taperinha near Santarem was investigated by Roosevelt *et al.* (1990). Thirteen radiocarbon and some thermoluminiscence analyses date the site to about 7500 BP (see Table 3.2 and Figure 3.1). Pottery found at the site could be amongst the earliest known in the Amazon region if not in South America (Roosevelt 1986, 1989a, 1989; Roosevelt *et al.* 1990 quoted by Roosevelt 1991: 113; Roosevelt 1994: 8; Roosevelt 1995). However, there is still controversy

Table 3.2. Archaeological sites from Middle and Late Holocene periods in the Amazon region. Key for references: 1 (Lathrap 1970), 2 (Evans and Meggers 1968), 3 (Salazar 1998), 4 (Roosevelt 1991), 5 (Roosevelt 1980), 6 (Roosevelt *et al.* 1996), 7 (Mora *et al.* 1991), 8 (Eden *et al.* 1984), 9 (Cavelier *et al.* 1995).

Archaeological sites	Uncalibrated years BC, BP,AD and laboratory numbers	Period/Culture	Subsistence pattern	Reference
Yarinacocha area settlements. Peruvian montaña				
Casa de la Tía site	1,778±65 BC (P 991)	Cobichaniqui ceramic complex	hunting, fishing, gathering and	1
	1,637±95 BC (P 992)	Cobichaniqui ceramic complex	agriculture	1
	1,418±77 BC (P 990)	Cobichaniqui ceramic complex		1
	1,275±68 BC (993)	Pagotsi ceramic complex		1
Cumancaya area	810± 80 AD (Y 1545)	Cumancaya occupation		1
Ecuadorian montaña				
Napo area.	50±90 BC (SI 300)	Yasuní ceramic complex	hunting, fishing,	2
	510±70 AD (SI 330)	Tivacundo phase	gathering and	2
	1,179±51 AD (P 269)	Polychrome tradition	agriculture	2
	1,168±53 AD (P 347)	Polychrome tradition		2
	1,375±105 AD (N 310)	Polychrome tradition		2
	1,320±60 AD (Y 1544)	Polychrome tradition		2
	1,480±180 AD (SI 299)	Polychrome tradition		2
Upper Upano valley	2,310±70 BP (Beta 89270)	Platform mound		3
Huapula site	2,160±80 BP (Beta 89267)	Platform mound		3
	1,790±60 BP (Beta 90630)	Central platform mound		3
	1,990±70 BP (Beta 100307)			3
Sitio La lomita	1,070 BP (Beta 100305)			3
Taperinha shell mound	7,500-5,000 BP	Early pottery culture	fishing, shellfishing, "incipient root horticulture"	4
Marajó island	500-1,300 AD	Late Holocene. Phases:Ananatuba, Mangueiras and Marajoara	foraging and intensive cultivation	5

Table 3.2 Continued

Archaeological sites	Uncalibrated years BC, BP,AD and laboratory numbers	Period/Culture	Subsistence pattern	Reference
Pedra Pintada cave	675-430 BP	Late Holocene	fishing, gathering, hunting, cultivation	6
Araracuara area sites	4,645±40 BP (GrN 14987)	Tubaboniba period	hunting, fishing, gathering and agriculture	7
	4,330±45 (GrN 13733)	Tubaboniba period		7
	1,815±105 (Beta 1503)	Camani phase		8
	1,800±85 (IAN 113)	Camani phase		8
	1,690±55 (Beta 1504)	Camani phase		8
	1,640±70 (Beta 21894)	Méidote period		7
	1,565±35 (GrN 16970)	Méidote period		7
	1,480±95 (Beta 1509)	Camani phase		8
	1,420±70 (Beta 1505)	Camani phase		8
	1,415±75 (GX 15750)			7
	1,330±30 (GrN 16971)	Méidote period		7
	1,320±30 (GrN 16969)	Méidote period		7
	1,120±65 (Beta 1508)	Méidote period		7
	1,145±80 (Beta 1507)	Camani phase		8
		Replacement of Camani by Nofurei ceramic		8
	1,010±110 (GX 15749)	Méidote period		7
	775±25 (GrN 16968)			7
	740±35 (GrN 14998)			7
	705±60 (Beta 1506)	Nofurei phase		8
	350±50 (Beta 1510)	Nofurei phase		8
Peña Roja site. Colombian Amazon	c. 1,900 to 400 BP	Late Holocene, ceramic occupation	hunting, fishing, gathering and agriculture	9

concerning the presence of pottery in these early shell middens from eastern Brazil as well as from others located in Guyana. The early Holocene occupation at Taperinha shell midden represented specialised fishers and shellfishers. The presence of grinding stones during the latest occupation of the shell mound suggests horticulture, perhaps of roots (Roosevelt 1991: 113).

Evans and Meggers (1968) investigated the Napo area of Ecuador and located large archaeological sites where elaborate polychrome pottery was found. Radiocarbon dates associated with different ceramic complexes and phases from the Napo river area include: 50±90 BC; 510±70 AD; 1320+60 AD; 1375±105 AD; 1168±53 AD; 1179±51 AD and 1480±180 AD. The polychrome ceramic style was also found by the authors at archaeological sites on the Marajó island (Figure 3.1). They thought that it originated in the Andean area, where environmental conditions were more favourable to intensive agriculture. (Roosevelt 1980: 14-18). At present Marajó island has a seasonal savannah environment, similar to that at the time of the archaeological occupation (between AD 500 and 1300). The survey and the excavation of several sites showed that there was no cultural decline as Meggers had postulated, based on pottery style comparisons (Roosevelt 1980: 19, 1991, 1988b: 8, Whitehead 1996).

Archaelogical research carried out in the eastern slopes of the Ecuadorian Andes (upper Upano valley) has shown the presence of 35 settlements, which include platform mounds, and interior plazas. A system of causeways in the region forms part of the urbanism of pre-columbian times. The archaeological sites have been dated to between 2450 BP and 500 AD (Salazar 1998. See radiocarbon dates in Table 3.2).

Heckenberg (1998) studied archaeological settlements in the upper Xingú river in the Mato Grosso state of Brazil. At present the area is inhabited by diverse cultural groups mostly belonging to a distinctive regional cultural pattern called Xinguano. The Kuikuro people studied by Carneiro (1972) are part of this Xinguano pattern (see sub-heading 3.1.2). The earliest archaeological occupation of the upper Xingú river is dated to c. AD 900-1500. According to the archaeological data the Xinguanos were sedentary manioc farmers and fisher-people. Cultural continuity between prehistoric and present day Xinguanos is demonstrated in the continuity of the ceramic technology, village spatial organisation and settlement location within the upper Xingú area.

The main traits of Marajó island archaeology are earthen mounds and a complex funerary art, which includes elaborately decorated pottery such as large funerary urns. Roosevelt defined this society as a complex one. The internal social organisation included several multi-family houses or "malocas". House platforms and baked clay cooking facilities were excavated. Human bone preservation was good and physical anthropological studies were carried out on the ancient population. Variations in settlement and grave sizes and types were also studied and suggest that there was differentiation within the population according to diet, health and activity. The subsistence system was probably intensive cultivation and foraging. Plant and animal remains were recovered and identified (Roosevelt 1988b, 1991: 2).

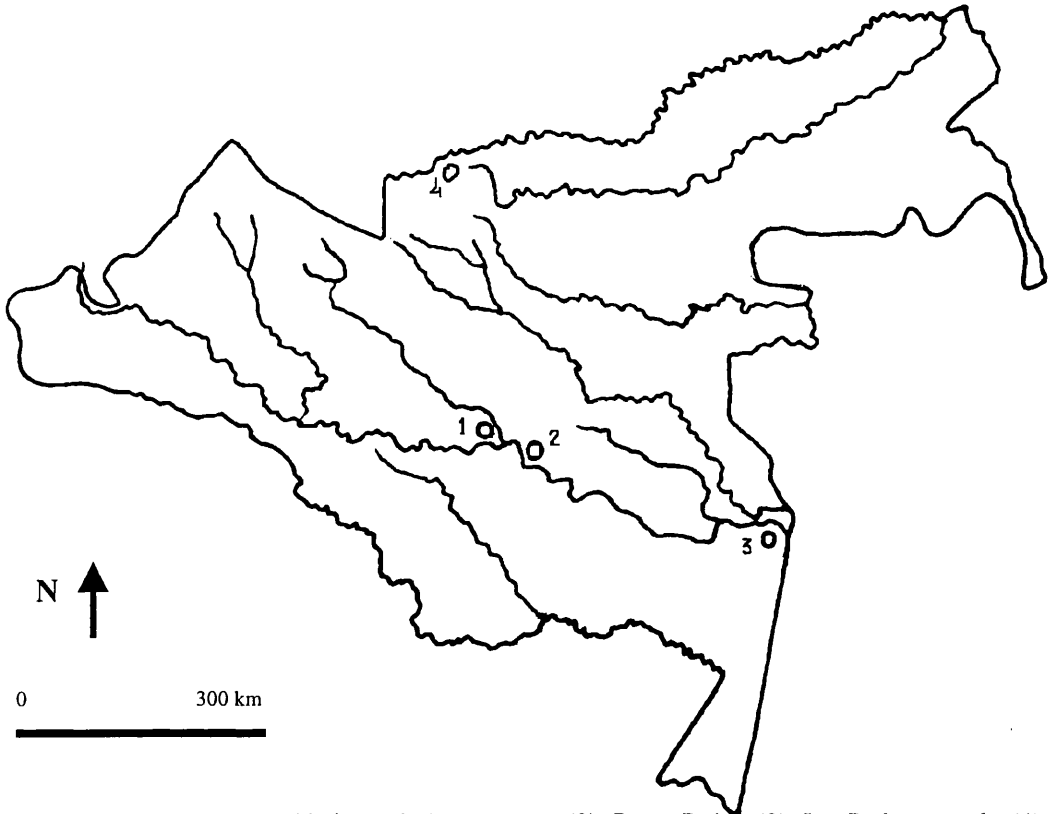
Although Roosevelt and collaborators have found evidence of social and economic differentiation they have not yet found evidence of a central political power at Marajó island (Roosevelt 1991: 95). Some of the archaeological sites at Marajó island have 20 to 40 individual mounds covering several square km (Farabee 1914-1915, Hilbert 1952, Roosevelt 1988a quoted by Roosevelt 1991: 114). Mound excavations revealed a variety of features such as kitchens, dwellings, refuse and earthworks. The most common geophysical feature was the baked clay stove or hearth. Micro-stratigraphical features were associated with stoves and included traces of pole, thatch and earth structures. Stoves were semi-tubular in shape, one metre long and half metre wide, of fired clay and arranged in groups of six to twelve or more. They contained ash, charred plant remains and bones and frequently fragments of ceramic vessels. Some of these structures were contemporary and usually were repaired and replaced and several times. Their arrangement and the associated structural remains suggest that people were living in multifamily matrilocal households (Roosevelt, 1988b: 8).

At Caverna da Pedra Pintada cave in the Monte Alegre area, a post-Pleistocene occupation was also reported by Roosevelt *et al.* (1996: 381). This so-called Paitura occupation was designated Holocene and was dated to between 7580 and

6625 years BP. Above these Holocene layers was a midden, of grey-brown sediments, which was radiocarbon dated to between 675 and 430 years BP. Archaeological finds included shell, fish bones, turtle shells, charred wood, seed fragments and pottery sherds. Roosevelt *et al.* (1996: 380-381) think that the findings confirm that it was a refuse deposit produced by specialised inhabitants of the river areas, who exploited faunal resources surrounding the areas of habitation. This is typical of early and middle Holocene settlements throughout America. On the other hand, the deposit may have been a temporary camp.

The latest occupation levels at Caverna da Pedra Pintada site belong to a midden. Its sediments contained dried and charred plant remains (such as maize cobs and decorated gourd fragments), faunal remains, sherds, rare lithic artefacts, cordage and the posts of an oval structure. Besides the fruit tree remains found in the earlier Pleistocene levels of the cave, these were also some cultivated species (Roosevelt *et al.* 1996: 381).

In the Peruvian Amazon, dark coloured or "terra preta" soils have been taken as evidence for dense populations in the Upper Amazon River. These large populations were reported by the earliest European travellers in the area. "Terra preta" soils have also been located at the Tapajos River area in Brazil where archaeological research has been carried out by Isaacson (1981). These sediments usually contain sherds and lithic debris and are connected with several ancient roads. Based on ethnohistorical accounts, Isaacson hypothesises that people living in the Tapajo area could produce large amounts of maize as well as other crops (Roosevelt 1988b: 37). Physical and chemical characterisation of dark coloured soils have suggested that they were appropriate for agricultural practices, and it is believed that these soils are the results of human activities. In the Colombian Amazon they occur in the La Pedrera area (Reichel-Dolmatoff E. 1976a, Reichel-Dolmatoff and Hildebrand 1982-1983), and in the Araracuara region (Herrera *et al.* 1980-1981, Eden *et al.* 1984, Andrade 1986, 1988). Figure 3.2 shows a map with the location of the archaeological sites in the Colombian Amazon.



(1) Puerto Arturo, Abeja and Aeropuerto; (2) Peña Roja; (3) La Pedrera and: (4) Guayabero.

(2)

Figure 3.2 Map showing the location of archaeological sties studied in the Colombian Amazon region.

Herrera *et al.* (1980-1981) suggested that in the Middle Caquetá area there were two different occupation phases, according to ceramic stylistic analysis, stratigraphy and radiocarbon dates. The first one was called Camani and was represented by a group of people who lived in the area between 100 and 850 AD. The second phase was called Nofurei and was represented by people who manufactured pottery related to the Amazonian polychrome horizon defined by Lathrap in 1970. This second phase of occupation occurred at about AD 800.

Six radiocarbon dates are available to the Camani phase: 1815±105 BP (AD 135. Beta 1503), 1800±85 (AD 150. IAN 113), 1690±55 (AD 260. Beta 1504), 1480±95 (AD 470. Beta 1509), 1420±70 (AD 530. Beta 1505) and 1120±65 (AD 830. Beta 1508). Camani pottery is characterised by small and medium-sized vessels; burnt bark and charcoal were used as temper and decoration was absent, although vessels present brownish or reddish slip. Fire dogs and pottery griddles suggested to Eden *et al.* (1984: 134-135) the consumption of bitter manioc. Nofurei ceramic includes a much wider variety of forms and elaborate decoration made by means of incision, excision, grooving or channelling impression, zoned punctuate and painting techniques. This group of pottery also included manioc griddles with leaf-imprints on the underside similar to those from Camani group. Two radiocarbon dates were associated to the Nofurei phase: 705±60 BP (AD 1245. Beta 1506) and 350±50 years BP (AD 1610. Beta 1510). At the site 15 on the bank of the river, close to Araracuara village, the Camani sherds were stratigraphically below of Nofurei sherds. A radiocarbon date of 1145±80 years BP (AD 805. Beta 1507) shows the replacement at that site of one style by the other.

Herrera *et al.* (1988), Cavelier *et al.* (1990), Mora *et al.* (1991) and Herrera *et al.* (1992 a), re-define the periods suggested by Herrera, Bray and McEwan (1980-1981). They argue that "This interpretation of the ceramic material was based primarily on decoration. However, in itself decoration is insufficient to define a ceramic complex, and the more advanced surface deterioration of older materials helps create an early "undecorated" assemblage" (Mora *et al.* 1991: 7).

Mora *et al.* (1991) proposed two periods of occupation to the area: Tubaboniba and Méidote, the latest with two subphases. The first one corresponds to a group of early farmers who inhabited the area at 4695±40 BP and 4330±45 years BP. The second occupation occurred between 1565+35 BP and 775±25 BP. This second occupation corresponds to the Camani and Nofurei phases defined by Herrera, Bray and McEwan (1980-1981). However Mora *et al.* (1991) do not specify whether they found any relationships between Méidote, Camani and Nofurei ceramics.

Herrera *et al.* (1989, 1992a), Cavelier *et al.* (1990) and Mora *et al.* (1991) think that there was a continuous occupation of the area between ca. 1500 and 800 BP. They consider that continuity is indicated by the use of some ceramic forms and by the presence of similar structures in both periods such as conical deposits containing charcoals and cultural material (Herrera *et al.* 1989). They also say that continuity is observed in the formation of soils of human origin which have been reported from AD 50 to the 16th Century (Mora *et al.* 1991: 7). In addition, the presence of Nofurei ceramics dated to AD 50 (1900 BP) in archaeological deposits from the Araracuara plateau suggests to them contemporaneity with Camani ceramics (Herrera *et al.* 1989: 198). In their opinion, the society inhabiting the area became more complex and they do not consider the possibility of a different group arriving into the area (Mora *et al.* 1991: 7). On the other hand, Herrera, Bray and McEwan (1980-1981: 241) found a mixture between Camani and Nofurei sherds in the middle strata of a trench excavated at La Sardina deposit.

These two interpretations highlight the fact that the archaeological deposits in the tropical forest are exposed to taphonomic processes which are difficult to elucidate. It is possible that in some deposits mixing of materials from different chronological periods occur. The lack of knowledge about site formation processes and taphonomy of the sites makes evaluation of the different positions held by the archaeologists difficult. Further investigations on the ceramic production and its affiliation to particular ethnic groups could help to clear the situation.

Soil formation processes were studied by Mora *et al.* (1991) at the archaeological site of "Aeropuerto", using the evaluation of soil characteristics, ancient agricultural methods and the social organisation of the group. Pollen and soil analyses carried out on samples taken within the black soils of the site showed that there were plots cultivated within the forest which covered the plateau's higher areas. This cultivation, probably by using slash and burn agriculture was practised between the beginning of the first century AD and AD 800. Addition of organic matter derived from domestic waste, dead leaves, wood and weeds improved soil conditions. According to the pollen sequence, the cultivation pattern consisted of short periods of cultivation and long fallows. Intensification of agriculture occurred at AD 800 when larger areas were used for longer periods of time and consequently fallow periods became shorter. Erosion problems were resolved by adding organic material and silt taken from waterlogged areas close to the river, about two km from the site. Silt addition is recorded in the pollen sequence by the presence of algae characteristic of waterlogged areas.

Transportation of silt sediments from the river required a greater labour force. Experiments in the Araracuara region showed that 245 tons of alluvial silt or 90 tons of litter are needed to produce a soil layer one cm thick to cover one ha (Paez 1990). In order to form one m of soil over 32 ha, the authors think that the population was organised under centralised leadership at about the same that the agriculture was intensified. The population could have been augmented by the inhabitants of neighbouring villages (Mora *et al.* 1991: 81).

The location of "Aeropuerto" site, at the top of the hill, has to be taken into account when its history is evaluated. The site is strategically located and allowed people to control a large area, in particular the non-navigable area of the Caquetá river. The Araracuara plateau is a Palaeozoic sandstone formation of 16 square km. Because of the scarcity of these sandstone formations in the Amazon region, they constituted zones where resources were concentrated. The area was probably colonised by groups who lived in dense settlements occupying strategic points to control river traffic (Mora *et al.* 1991: 81).

According to pollen diagrams taken in the Araracuara area, the six ha which constitute the site of "Abeja", was cleared for occupation during a dry period. The area was cleared in order to build houses and for cultivation, and it was continuously occupied for 900 years (Mora *et al.* 1991: 77). At this site dwellings, marked by darker patches, were rotated from place to place in the village (Mora *et al.* 1991: 81).

At the site of "Puerto Arturo", little human influence on the soil was noted. Few people inhabited the site, which was exposed to annual flooding, and there was little evidence of planting of crops. The authors hypothesise that this site controlled the jetty at the Araracuara canyon (Mora *et al.* 1991: 81).

Whitehead (1996: 247) points out that it is difficult to define the degree of intentionality involved in the formation of "terra preta" soils, the dynamics and the stability of human occupation. He says that the depth of the deposits has an unclear relationship between the density and duration of human occupation.

At "Guayabero one" rockshelter, a ceramic occupation for the later excavation levels was reported, but only a few sherds were found. Excavators relate these materials to the better known ceramic traditions of the Middle Caquetá river (Correal *et al.* 1990).

3.4. Summary

Tropical lowlands have been occupied by humans since very ancient times. This contrasts with the Andean diffusionist and evolutionist traditions which claim that "civilisation" derived from a long evolutionary sequence in Andean areas.

Earlier evidence of human occupation in the Amazon region is important to the framework of theories on foraging societies and human adaptation to tropical environments (Roosevelt 1998: 165) as well as to the general theories on the peopling of the South American continent and management of faunal and plant resources.

Because of the belief that the first hunters and gatherers of America were people specialised in hunting large game, it was assumed that tropical lowland forests from America, lacking in big game and starchy plant foods, could not have been inhabited by early hunter-gatherers. Then, it was hypothesised, lowland tropical areas were occupied only after the development of agriculture. Tropical lowlands have a wide range of rich and varied aquatic and faunal resources besides many edible tree fruits (Roosevelt 1998: 166, 186).

In a sense, the history of South American archaeology could be seen as a contrast between lowlands and highlands. Since Steward's definition of the "tropical forest culture", presence/absence of some cultural elements has been taken as evidence of a particular type of society. Some investigations in the lowlands have demonstrated that the "diagnostic" elements for lowland cultures are not always present within the societies archaeologists and ethnologists deal with. A typical example of these "diagnostic traits" is the presence/absence in archaeological sites of grinding stones or "metates" and/or ceramic baking plates or "budares".

Several attempts have been made to explain the contrast between different levels of development in societies which inhabited the highlands and lowlands of America in pre-European contact. The first models included hypotheses based on the diffusion or transmission of cultural traits between different regions. These hypotheses were formulated in order to explain why lowland societies did not exhibit higher degrees of stratification and many other cultural elements such as monumental architecture, intensive agricultural production and complex networks of interchange across broad territories.

Other investigations in the area have concentrated on trying to understand the type of societies which inhabited the area at the time of the European contact. According to ethnohistorical accounts, the most highly developed indigenous societies in the Amazon inhabited the present Brazilian coast on the large floodplains of major rivers and seasonal flooded savannah areas such as Marajó island and Llanos de Mojós in Bolivia.

There has been a great deal of discussion of the first appearance of pottery in America resulting in evolutionary schemes which try to explain cultural change and evolution through time. However, recent archaeological evidence showed that pottery was developed at about 6000 years BP in coastal lowlands of northern South America (see Oyuela-Caycedo 1993, 1995). Archaeological evidence for pottery in the Amazon region from the Holocene contradicts the assumption that pottery was one of the elements derived from highland Andean areas to the west, as pottery did not appear there until about 4000 years ago (Roosevelt 1998: 165).

Remains of early human occupation of the middle Caquetá region have been found at Peña Roja site and were dated to 9125±250 (Gx17395), 9160±60 (Beta 52963) and 9250±140 (Beta 52964) years BP. Complex societies and central organisation could have existed in the middle Caquetá as early as 1150 BP (AD 800). The archaeological sites studied in this area are very different from those reported by Roosevelt and collaborators on Marajó island in the mouth of the Amazon river. Differences include local environmental conditions as well as chronology. However it can be said that complex social organisations were present in the Amazon region, both in seasonal savannah and forest areas, as early as 1000 years BP.

The history of agriculture in the Americas is not fully understood. However it has been used to explain the development of societies both in highlands and lowlands. In Chapter 4 evidence about early agriculture in the lowlands of northern South America and lower Central America will be presented. According to this evidence, earlier inhabitants from the Amazonian lowlands practised agriculture at least as early as 4645±40 BP (GrN 14987). Archaeological research in the middle Caquetá river has confirmed the antiquity of plant human management in the Amazon region.

On the other hand, a correlation between different agricultural systems, such as slash and burn agriculture, and different types of society and ecosystem, is not confirmed by the archaeological data. Research in the middle Caquetá region showed that intensification of agricultural production was possible by soil improvement techniques.

4. ARCHAEOBOTANICAL RESEARCH IN THE TROPICAL LOWLANDS OF LOWER CENTRAL AMERICA AND NORTHERN SOUTH AMERICA

The first part of this chapter deals with the archaeobotanical research in the tropical lowlands of America, and its application to the region under study. In further sections, the current available archaeobotanical information on tropical lowlands of lower Central America and northern South America (0 to 1000 m above sea level approximately) is discussed. Information from the highlands of the same region (more than 1000 m in altitude), will be mentioned only where relevant for the discussion. The last part of this chapter discusses archaeobotany in the Colombian lowlands.

Investigations have emphasised aspects of food production and its origin, as well as aspects related to palaeoenvironmental reconstruction. Plant remains derived from other activities such as fuel, construction and manufacturing of domestic artefacts have not been the focus of the archaeobotanical studies.

4.1. The Archaeobotanical record

4.1.1. Problems of Preservation

Direct evidence of plant exploitation, i.e. the recovery of plant remains in itself, is a challenge in the Neotropical region. As Pearsall says, even when charred remains are found they are highly fragmented because of expansion and contraction processes occurring in soils. This makes detection and collecting of plant remains difficult. Identification of fragmented plant remains is even more difficult when samples have a high species diversity. The identification process has to be undertaken using a broad reference collection of plant materials (Pearsall 1995: 113, 129).

Tropical climatic and environmental factors affecting plant remain preservation in archaeological sites are high temperatures and humidity throughout the year, and fluctuating dry and rainy periods where a high climatic seasonality is registered (Piperno 1995: 130).

In spite of preservational problems of organic materials in the Neotropics it has been recently demonstrated (e.g. Pearsall 1988a, 1992, 1995, Mora *et al.* 1991, Cooke 1992, Morcote 1994a,b,c, 1995, Romero 1994, Cavelier *et al.* 1995, Morcote *et al.* 1996, 1998, Roosevelt *et al.* 1996, Bonzani 1997, 1998, Piperno and Pearsall 1998,) that charred organic materials may be found and identified. Plant macro-remains studied include maize cobs, kernels and rachis; tree and palm fruits; vegetable and legume seeds and charred wood fragments. In addition, as Zeidler pointed out (1995: 9), well stratified deposits and feature contexts are quite commonly found in the area.

4.1.2. Type of plant remains recovered and interpretation problems

4.1.2.1. Macro-remains

4.1.2.1.1. Seeds, kernels, cobs, roots and tubers

Plant macro-remains recovered from archaeological sites in the American tropical lowlands are usually charred. Desiccated macro-remains are very rare but some have been found in the desert areas of the Pacific coast of South America.

Problems of taphonomy could arise during the analysis of plant macro-remains or associated sediments or other organic materials. If ancient food is the main concern of a particular study, those foods which happened to be in contact with fire would be the only ones preserved and only the most robust would survive deposition, burial and recovery. Charred macro-remains are subjected to breakage because of soil shrinking and swelling, particularly when they have been deposited in dense clay soils. The most deeply deposited macro-remains can also break up due to soil compaction and pressure. These factors can cause interpretative problems when relative abundance of plant species within different assemblages is evaluated (Piperno and Pearsall 1998: 34).

Most of the studies on seeds, cobs, kernels, roots and tubers have been focused on aspects of food production. In Colombia there are few examples of investigations using archaeobotanical macro-remains to explain seasonal occupations of the sites (see Oyuela-Caycedo 1996, 1998, Bonzani 1997, 1998).

4.1.2.1.2. Wood and charcoal

Few studies on charcoal have been carried out in the lowlands of lower Central and northern South America. In addition to counts of diagnostic taxa for secondary forests and presence of diagnostic pioneer taxa, palynological studies used relative quantities of charcoal in core sequences in order to infer human interference on the landscapes through the clearance of former forested areas (see Piperno and Pearsall 1998 to find examples from the Pacific lowlands in Central Panama, the Ecuadorian Pacific lowlands, the Colombian southwestern highlands and the Amazon region).

Woody taxa present in pollen diagrams are used to assess possible tree fruits as food sources in the past, and in turn to infer subsistence in the past (see for example Piperno and Pearsall 1998 to find examples from the Central Pacific Panama and the Pacific Ecuadorian lowlands. See also Mora *et al.* 1991, Herrera *et al.* 1992a and Herrera and Cavelier 1999 for examples from the middle Caquetá river). In the Ecuadorian Pacific lowlands at the archaeological site of Real Alto, Pearsall (1983, 1988a), studied the charcoal assemblages from the several occupation periods of the region concerning ancient patterns of wood use. Vacher *et al.* (1998) studied charcoal assemblages from several archaeological sites in French Guiana. They identified to family, genus and in some cases to species level more than 4000 charred wood fragments. Unfortunately, the available published material does not include details on the methodology used for the identifications. The authors use the identification of charcoals to suggest the vegetation cover of the archaeological sites studied by them.

In spite of charred wood being the most common plant macro-remain found at archaeological sites in Colombia, specific studies on it have not yet been carried out. This is the first study of a particular charred wood assemblage recovered at an archaeological site. Charred wood from archaeological sites have been used mainly for radiocarbon dating. Its study has not been applied to any particular problem such as fuel use, other wood uses, or for palaeoenvironmental reconstruction. In Chapter eight a model on the characterisation of a charcoal assemblage from Peña Roja site is presented.

In Colombia very few wooden artefacts have been preserved at archaeological sites. Those that have been recovered include sarcophagi, seats, benches, loom tools, spindles, weapons such as blowpipes, and some ornaments. These were found as part of burial goods in graves that have became closed waterlogged contexts in the Andean highlands of southern Colombia and dry caves in the eastern cordilleras (see Cardale de Schrimpff and Falchetti 1980, Cardale de Schrimpff *et al.* 1992). Woods used to manufacture these artefacts have not been identified.

4.1.2.2. Micro-remains

4.1.2.2.1. Pollen

Palynological studies have been widely used in the Neotropics in order to reconstruct past vegetation. In addition, there have also been studies on the correlation between past environments and human subsistence during the Quaternary period, especially for the area of the Colombian highlands, Amazonian and Caribbean lowlands (Van der Hammen T 1961, 1974, 1986a,b, 1992, Van der Hammen T. and Gonzalez 1963, Wijmstra and Van der Hammen T. 1966, Plazas *et al.* 1987, Van der Hammen T. *et al.* 1990, 1991a,b, Van der

Hammen T. and Troncoso 1992, Oyuela-Caycedo 1993, 1996, 1998. See Chapter two of this thesis). Other investigations carried out in Panama (Bartlett and Barghoorn 1973 quoted by Pearsall 1995: 120), Ecuador (Athens and Ward 1999) and Peru (Wright 1983, Hansen *et al.* 1984 quoted by Pearsall 1995: 120) have yielded information on vegetation reconstruction and its changes during the Quaternary.

In Colombia pollen analysis has been practised on sediments collected from many archaeological sites. These data have been mainly used to infer palaeocological conditions in the past but also to argue crop production, land use and the nature of subsistence systems (see Herrera 1985, Monsalve 1985, Herrera *et al.* 1988, 1989, 1992a,b,c, Salgado López 1989, Correal *et al.* 1990, Mora *et al.* 1991, Van der Hammen T. 1992, Salgado López and Stemper 1994, Romero 1995, Herrera and Berrio 1996, Gnecco and Mora 1997).

Limitations of pollen analyses in tropical areas relate to complexity of recovery, quantification and interpretation of fossil pollen and to the high plant diversity of the area. Besides these factors preservation of pollen grains in soils of archaeological sites is not always possible due to weathering processes to which open sites are usually exposed. In spite of these limitations, palynological studies carried out in open sites of the tropical lowlands have reported crop plants such as maize (*Zea mays*), manioc (*Manihot esculenta*), squash (*Cucurbita* spp.), and chilli pepper (*Capsicum* spp.). Palynological research from the middle Caquetá river in the Colombian Amazon region has allowed investigators to reconstruct the history of the human adaptation in the area for a period of time of about 4000 years (see below in this chapter).

4.1.2.2.2. Phytoliths

Phytolith analysis has been proven to be an appropriate technique when used in combination with other techniques for the archaeobotanical research in the New World. It has been particularly useful in tropical areas where preservation of organic materials by desiccation or under waterlogged conditions is relatively rare. However there are limitations to the interpretation of phytoliths when they are the only source of data in a particular site or region (Pearsall 1993, 1995: 123).

Phytoliths have been used to identify edible plants from which macro-remains are not clearly identifiable or are not produced at all. In some cases tree phytoliths can be detected in sediments from archaeological sites, and therefore phytoliths can help in identification of unknown charred fragments of woods and seeds from the same sites (Pearsall 1995: 125). On the other hand, not all plants which produce phytoliths have taxonomically useful shapes. However important plants for human subsistence, such as maize and squash, produce discrete identifiable phytoliths (see Piperno 1984 for morphological studies of maize phytoliths).

However there are important crop roots in the New World which do not produce phytoliths or whose phytoliths have non-diagnostic shapes, such as manioc (*Manihot esculenta*), camote *(Ipomoea batatas*), american yams (*Dioscorea* spp.), ulluco (*Ullucus tuberosus*), ibia (*Oxalis tuberosa*), jicama (*Pachyrrhizus* spp.) and oto (*Xanthossoma* sp.). This, besides the fact that many tubers produce little pollen, makes the identification of tubers from archaeological or associated contexts difficult. A cultigen whose phytoliths have been identified is the sagú or araruta (*Maranta arundinacea*). Phytoliths of *Maranta* plants found in layers dated at early Holocene age at several archaeological sites in Panama are used by Piperno (1989a,b) to argue that tuber cultivation preceeded seed cultivation in that region (Cooke 1992: 44).

Piperno (1985b) compared phytolith and pollen data from deep core sediments taken at the Gatun Lake in eastern Panama. Her study showed that phytolith analysis is useful in the tropics to reconstruct broad-scale vegetation formations (e.g. mature tropical forest, marine swamp, freshwater swamp and disturbed forest) and is particularly useful in the study of human vegetation disturbance. Pollen and phytolith analyses are complementary techniques. In the Gatun Lake phytolith sequence evidence of agriculture and forest clearance is shown at about 1000 (4850 BP) years earlier than in the pollen sequence (4000 BP). Piperno points out that the phytolith data represent smaller clearings of the forest that did not affect the pollen sequences. However detailed information on the species composition will be reached from pollen sequences because many plants do not produce phytoliths.

Phytoliths are also preserved on the surfaces of lithic and ceramic artefacts as well as on teeth. Their analysis can be used as evidence of dietary patterns, stone and ceramic tool functions and for ecological reconstruction (Piperno 1995: 136).

In Colombia phytolith analysis has been practised on very few samples taken in the high and middle altitude Andean areas of southwestern Colombia, at the archeaological sites of San Isidro and several other sites from the Calima valley area (Piperno 1985a), and from samples taken at the archaeological site of Peña Roja in the middle Caquetá river (Piperno 1999. See Figure 4.1 for the geographical location of the above sites and Chapter four, sub-heading 5.5.3 for the results of phytolith analysis from Peña Roja). There is no systematic phytolith research on any crop from prehistoric times and phytolith analysis has not been practised to reconstruct palaeoenvironmental conditions from any area in the country.

4.1.2.2.3. Residues. Starch grains

Starch grain analysis in the tropics of America has started to be practised recently. Starch grains have been recovered from grinding artefacts such as grinding stones and grinding bases (see Piperno and Pearsall 1998: 35). This technique could be of particular importance in searching for direct evidence of processing of plants.

As Piperno and Pearsall have said (1998:2 86), starch grain analyses would help in resolving problems about subsistence in many areas of the Neotropics where pollen, phytolith and macro - remains of plants preservation and/or recovery have been unsuccessful.

Wood residues can also be found on artefact surfaces. *Podocarpus* from the Andean area of Colombia, was reported on the surface of a lithic artefact from the San Isidro archaeological site in the southwestern highlands (See map in Figure 4.1 of this thesis for the location of the site. Nieuwenhuis 1996, Gnecco and Mora 1997).

4.1.3. Recovery techniques applied

Recent implementation and improvement in the recovery techniques applied in the archaeological survey and excavation programs in the region have produced remarkable results both in archaeobotany and zooarchaeological research. Particularly important has been flotation to recover charred plant and animal macro-remains, and small artefacts.

Modern recovery techniques such as flotation and sampling strategies were introduced during the 1980's to the field and laboratory archaeological projects in Colombia. Before that identifications of some plant but mainly animal remains big enough to be recovered by hand during excavations were practised. Since 1986 a team of archaeologists from the Erigaie Foundation have carried out plant macro-remain studies on materials recovered by flotation and water screening in archaeological sites from the middle Caquetá river (Mora *et al.* 1991, Herrera *et al.* 1992a, Cavelier *et al.* 1995).

4.1.4. Quantitative analyses

In Colombia, quantitative analysis of archaeobotanical remains has been applied to the plant remains from San Jacinto 1 site, in the Caribbean lowlands; and to the seeds recovered at Peña Roja site in the middle Caquetá river. At San Jacinto 1, the analysis allowed discussion of the seasonal occupation of the site (see Bonzani 1997, 1998). At Peña Roja, the analysis allowed researchers to suggest ancient patterns of tree fruits consumption (see Morcote 1994a, Cavelier *et al.* 1995, Morcote *et al.* 1996, 1998, Herrera and Cavelier 1999).

Sampling of plant remains from archaeological sites is difficult to carry out because of the skewed distribution of these remains. Their distribution is skewed because of different natural and cultural factors. The cultural factors affecting plant remains are the types of human behaviour that result in the production, distribution and modification of plant remains in an archaeological site. The natural factors include postdepositional processes affecting preservation, mixing, transport and redeposition of plant remains (Shay and Shay 1978: 48, 50).

Quantitative measurements, either involving number of fragments or weight of fragments have been adopted by archaeobotanists working with charcoals. However, there is no consensus on the ideal index of abundance of archaeological charcoals within an assemblage. Part of the problem lies in the fact that preservation of the charcoals as well as the taxonomic composition of each assemblage can affect the reliability of both fragment counts and weight. If a particular taxon produces very fragile charcoal fragments, their sizes (or even their presence) might not be related to the relative importance of that particular taxon within an assemblage. Comparisons between charcoal data from different samples and sites may be based on ubiquity scores which record each taxon in an assemblage as a percentage of the total number of samples analysed (Thompson 1994: 17).

Ubiquity scores do not attempt to answer the question of how much wood was burnt. It only indicates which taxa are present (Willcox 1974, Smart and Hoffman 1988: 190), In this sense, ubiquity analysis avoids the problems related to fragmentation and different density. Ubiquity analysis is intrinsically comparative and not absolute, so that comparisons are possible between presence values within taxa but these values are not useful to compare the absolute importance of each taxon (Hubbard 1980). Ubiquity analysis assumes that all samples are independent. Popper cautions that when mistakes in sampling and recording occur it would be difficult to assess differences between contexts or the homogeneity of deposits (Popper 1988: 61).

The contexts and sampling strategies are taking into account for ubiquity analysis. Samples from which the remains are analysed must be of comparable size and from the same type of contexts. In addition, groups containing the same number of samples are necessary to avoid skew of frequency scores. Ubiquity analysis is useful in showing general trends. The results of this analysis are dependent on the number and grouping of samples (Popper 1988: 64).

Quantification studies of wood charcoals from archaeological sites depend on the research aims, site chronology, amount of remains studied and other environmental material. Methods include presence/absence notation, expression of relative frequencies as percentages by weight or expressions of relative percentages according to volume of a standard sample. Counting of charcoal fragments for calculating relative percentages of different taxa has disadvantages because of the high number of factors affecting the charcoal fragmentation rate. These factors include charring, deposition, and post-deposition, flotation, sorting, packing and examining processes. Some investigators use relative proportions of taxa expressed as percentage by weight to compare inter-site assemblages. However, it has to be taken into account that each site has its own taphonomic processes affecting charcoal preservation (Cartwright and Parkington 1997: 65. See Chapter five sub-heading 5.5.4.1 of this thesis).

In the case of Peña Roja, there are no particular studies on differential fragmentation patterns between charcoals from different woody taxa. Counts of fragments have to be taken with caution taking into account that counting fragments simply gives an index of fragmentation (Cartwright and Parkington 1997: 65). Weights of fragments can be biased by the specific gravity of wood and charcoal. Specific gravity in both woods and charcoals can be highly variable between taxa. Particular studies on the range of specific gravities for wood and charcoals, as well as experiments on fragmentation patterns are necessary when a new charcoal assemblage is studied (Thompson 1994: 17).

4.2. Studies on tropical food production

4.2.1. Theories on the origin of agriculture

Theories used to explain the origins of agriculture in the New World have seen the phenomenon as the result of one of several circumstances: demographic pressure, environmental changes, socio-cultural factors, evolutionary processes occurring in human and plant associations and interactions through time.

Models developed to explain the evolution of agriculture are of two types: cause-and-effect and equilibrium models. The first type assigns cause of change in the food procurement system to one variable in the environment, generally climatic fluctuation or population pressure. The second type applies concepts from systems theory. In equilibrium models the evolution is taken as a permanently changing adaptation between the organism and its environment. This adaptation involves the whole history of the relationship between the elements of the system. Any change occurring in one of the components of the system such as physical environment, technology, food procurement or social organisation lead to correlated changes in all the other components of the system. Because all the components are interdependent and in permanent state of flux there no can be a single cause of change (Bray 1976: 78).

Bray compared the sequences of the emergence of food procurement systems in Mexico and Peru and explains the general conclusions that any model of agricultural development must include: (1) agriculture was adopted gradually and hunting-and-gathering way of life was not completely abandoned; (2) the importance of cultivated foods for the diet may relate to the emergence of more productive varieties of plants that became staples, and to the adoption of techniques of intensive agriculture; (3) the changes in subsistence patterns occurred against a background of climatic changes, although these changes were never extreme enough to force to the invention of agriculture; (4) population growth accompanied agriculture, and (5) larger populations and effective agriculture may be co-related with larger and more stable communities, the development of political institutions and the emergence of states and civilisation (Bray 1976: 77-78), Bray 1977: 234).

The Amazon lowlands were thought to be one of the main centres for the early domestication of root crops in South America however, no clear evidence for this hypothesis has been found at present (Smith 1995: 170). Unfortunately, studies on wild relatives of most of the crops found at archaeological sites have not been yet initiated or gives ambiguous results. Therefore study on the origins of domestication and origins and spread of agriculture is just beginning.

Harris (1996: 5-7) explains the importance of the concept of centres of origins of domesticated plants. He points out that this concept raises the question of the relative importance or frequency of single or multiple domestications of the same or related taxa. This difficult question only may be answered if the wild progenitors are known as well as their distribution at the time or times when their domestication is postulated (Harris 1996: 6). A potential methodology to be use in the study of the origin and spread of agriculture is the biomolecular composition of crops, particularly DNA analysis (Jones *et al.* 1996).

As Bray (1976) points out there are several problems related to the investigation of the food procurement systems in prehistory. The first problem is the lack of agreement among botanists on the particular status of different plants. Some vegetative propagated plants show cultivated forms very similar to their wild prototypes and the earliest generations of domesticated plants would not appear very different to the cultivated plants. In addition, it is possible that there is no visible change between early wild and domesticated plants caused by human manipulation (Smith 1967, Higgs and Jarman 1972 quoted by Bray 1976: 77). These problems are exemplified in Peña Roja site where abundant charred palm seeds have been recovered and identified. These palms could be wild but they were "manipulated" by humans (see Morcote *et al.* 1998 and sub-section 5.4.2 in Chapter five of this thesis). Whether we can call this human management "horticulture" or "cultivation" might be a question of controversy and is related to the meaning of those terms. Another problem is differential preservation of plant remains that may prevent the recovery and identification of plants in the archaeological assemblages.

Some interesting statements on the domestication of early staples are presented by Spriggs (1996). He says that domestication may not be as significant for the origins of agriculture as is often assumed. Spriggs also points out that neither evidence of domestication nor of cultivation is enough to explain the origins of agriculture. Human subsistence patterns may adopt both cultivation and domestication but it not necessarily conduct to the direction of agriculture.

Poor preservation of plant macroremains in the tropics of America might be one of the causes for the lack of information on the history of the evolution of food procurement systems. (Bray 1976: 78). As it will be shown later the current archaeobotanical evidence (phytolith, pollen and charred seeds) has contributed to the idea that there is a long history of management of plants in the tropical South American lowlands.

The Amazon and Orinoco areas must be considered as places of early sedentism and population growth. The main cultivated crops in these areas are starchy tubers but they are complemented by protein from palm fruits, fish, reptiles and aquatic mammals provided year-round in these regions. Once the agriculture was developed the tendency to settle and for large populations to arise would be reinforced. Manioc can be planted and harvested throughout the year and may be stored in the ground until needed. Soils in the flood plains of the main rivers are rejuvenated every year by silt-laden waters. This circumstance allows root crop cultivation for 15 or 20 years and for villages to stay in one place (Bray 1976: 85).

In tropical areas the ideas of three scholars have been of paramount importance in searching of explanations of the origins of agriculture: Carl O. Sauer, David Harris and Donald Lathrap (Piperno and Pearsall 1998: 10-26). Sauer hypothesised that agriculture had its origins in the riverine areas of the tropics where sedentary people had enough available food resources to exploit. They could then spend time in plant experimentation. Tropical areas offered a high diversity of flora, adequate temperature, soils and rainfall, all favourable factors for food production. He noted that felling trees was not necessary to clear wooded areas because appropriate places could be available by ringing trees, in that manner, sunlight would have reached soils. Sauer also thought that early cultivators worked with different classes of plants to achieve starch food, poisons, materials for fish nets and lines and many other daily use artefacts (Sauer, 1952 quoted by Piperno and Pearsall, 1998: 19).

Like Sauer, Harris thought that the development of agriculture must have occurred not in the evergreen forest but in the zone of seasonal forest where dry seasons had a length of 3 to 7 months (Piperno and Pearsall 1998: 22). Harris (1969: 10) points out that the common ecological characteristic of root crops is that they store starch and because of it they are well adapted to survive long dry or cold seasons, they mature quickly when the rain begins. He assumed that the wild ancestors of tuberous crops must have lived in environments with seasonal climates and he thought that their cultivation must occurred in such environments (Hather 1996: 538).

The links between seasonal environments and the origins of the cultivation of tuberous crops is re-examined by Hather (1996: 545) with particular emphasis on the evidence from the Indo–Pacific. He points out that corms, tubers and rhizomes grow naturally and propagate in the non-seasonal tropics where their morphology (perennating organs) does not restrict them to be part of agrarian systems in seasonal forests. Hather suggests that the earliest cultivation of rhizomes of the Zingiberaceae, the corms of the Araceae, the tubers of the Dioscoreaceae and the vegetative structures of the Taccaceae, Caccaceae, Marantaceae and similar structures of the Musaceae took place where their wild ancestors are distributed. In contrast to the postulates of Harris (1969), Hather argues that this earlier cultivation occurred in the humid rather than in the seasonally dry tropics.

However other plants such as tubers of *Solanum tuberosum* (Solanaceae) and *Ipomoea batatas* (Convolvulaceae) and the root of *Manihot esculenta* (Euphorbiaceae) may have originated in seasonally dry or cold environments and their tuberous organs being perennial.

Harris (1969) believed that agriculture in the tropics had developed in the house gardens close to human dwellings. He argues that a house garden constitutes a generalised ecosystem that includes many species of cultivated trees, shrubs, climbers, root crops and herbs; each one represented by few individuals. A house garden is a system productive and stable, similar in structure, functional dynamics and equilibrium to the natural forest. A house garden does not imply a large-scale transformation of the landscape. Harris thought that with improved varieties of plants and more sophisticated agricultural technology a house garden could evolve into a specialised system which focus on few productive plants (Harris 1969, 1989, Bray 1977). The advantage of having many of the required plants at hand is evident in house gardens.

Harris (1969, 1972, 1977a,b) distinguishes between systems based on the cultivation of seeds and those based mostly on roots and tubers ("vegeculture"). He noted that when the two production systems are compared, the one based on seed cultivation required soils rich in nutrients and involved fewer kinds of plants and demand more frequent shifts of the cultivation areas than the vegeculture systems. The later, duplicating the natural ecosystem, has a larger number of cultivated plants within the same garden, and fewer soil nutrient requirements.

Herrera and Cavelier (1999) argue that Sauer and Harris's theoretical proposals about the conditions for early food production are exemplified in the Peña Roja site where an initial stage of high use of forest of resources was replaced by cultivation of plants (see below in this Chapter).

Donald Lathrap was one of the first scholars who considered that crops other than seeds could have been cultivated early in human history. He thought that bitter manioc was one of these crops, the domestication of which was achieved somewhere in the alluvial floodplains of northwester South America and in the Amazon region (Piperno and Pearsall 1998). The difference between bitter a sweet manioc is a matter of controversy. A myth suggests that the bitter variety was first used as fish poison and only incidentally discovered as edible. It is also believed that because processing of sweet manioc requires less effort than bitter manioc, the first one could be adopted and removed from its wild ancestor. The importance of bitter manioc is based on its higher content and crystalline structure of its starch. Bitter manioc is a better basis for the manufacture of bread and flour (Lathrap 1973: 174) McKey and Beckerman (1993) present a complete evaluation of the debate on the advantages of bitter manioc. The relationship between bitter and sweet manioc varieties is not understood in botanical terms. It is unknown which variety was first domesticated and if one of the varieties is derived from the other.

Lathrap (1970, 1977) also thought that the house gardens were the most appropriate habitats to carry out cultivation and domestication. In these places semi-sedentary forager people could have been experimenting with and propagating plants. The house gardens may contain between 50 and 100 useful plants including food, fibres, dyes, containers, coca, fish poisons, hallucinogenatory snuffs, perfumes and medicines, condiments etc. Experimentation with new species brought to the house garden from the forest or from other ethnic groups can be practised (Lathrap 1977). The majority of the plants in a house garden are morphologically wild. Then a house garden exhibits diversity and deliberate experimentation and transplantation of wild and cultigens occurred in these places (Bray 1977: 239).

Lathrap (1977) hypothesised a model according to which people practising agriculture, manufacturing of ceramics and living in dense settlements along the Middle Amazon river spread out to other South American low and highlands. By means of both historical and ecological approaches Lathrap used the linguistic information to build a model to hypothesise ancient population movements within the Amazon region. People moved out from Central Amazon and northern Colombia because they were looking for better agricultural lands. People moved because agriculture allowed them to increase production of food and population levels. Agriculture then spread to regions where it was a better option as a subsistence system. When the areas in which agriculture spread were not completely appropriate, or where agriculture was less adaptive, new plants were incorporated into the system which in turn allowed it to spread in new regions.

More recently, Piperno and Pearsall developed phytolith analysis that has been particularly important in understanding the status of maize and other cultivars and their wild relatives. They have studied phytoliths from sites where desiccated or charred macro-remains have not been found either because of the lack of appropriate preservation conditions or their absence within the archaeological record (Piperno 1985a, 1989, 1990, 1991, 1994, 1995, 1997, Piperno *et al.* 1985, Pearsall 1988a, 1989, 1992, 1994a,b, 1995, Pearsall and Piperno 1990, 1993, Piperno and Pearsall 1993, 1998).

According to the available evidence there were human populations practising horticulture in very different areas of the Neotropics during the early Holocene period. Piperno and Pearsall (1998: 6) use the term horticulture "to denote small-scale plantings or house gardens containing a range of plants from morphologically wild to clearly domesticated". Because of the existence of many gaps in the knowledge about geographical distribution of the ancestors of many crops, and also in the archaeological record, it is difficult to trace the history of the spread of these crops. Piperno and Pearsall think that agriculture started independently in several places in America (see papers in Stone 1984 for issues on distribution, migration and origins of plants from the South American lowlands)

Piperno and Pearsall's perspective on the origin of food production in the Neotropics is defined by themselves as one which "relies on modern ecological and evolutionary theory" (Piperno and Pearsall, 1998: 10). In contrast to the

Lathrap's interpretation, they do not consider the interior of the Amazon basin as the most probable area where plants became cultivated and domesticated. They cite two reasons as an explanation of their statement. First, the distribution of many wild progenitors of modern crops was not within the Amazon basin. Second, the major river valleys in the basin which receive seasonal alluvial supplies and are affected by water level fluctuations and lengthy floods "were probable not favoured by the low-density as socially simple earliest food producers, who were interested mainly in feeding their families" (Piperno and Pearsall 1998: 26).

Piperno and Pearsall (1998) argue that early humans in tropical America occupied the areas covered by deciduous and semi-evergreen vegetation (i.e. the Pacific coast of Central Panama and Ecuador, northern Venezuela, the Caribbean and northeastern Colombia lowlands, southern Guianas, southern Bolivia and the mouth of Tapajos and Xindú rivers in Brazil). These were also the habitats of wild ancestors of many crop plants and where plant husbandry occurred (see map in figure 2.1). According to this, the Middle Caquetá river studied in this investigation was not one of the favored regions to have been a center of early cultivation and domestication of plants. However in this area there is archaeological evidence of small horticulture practiced at about 9000 BP (Herrera and Cavelier 1999, Piperno 1999).

Another phenomena which is important to take into account according to Piperno and Pearsall is that of non-domestication cultivation. To them, the term cultivation refers to "activities surrounding the preparation of plots specified for plant propagation and repeated planting and harvesting in these plots" (1998: 6). In their opinion, cultivation could have been practised at the same time in different areas of the Neotropics since very early times. Present day molecular and botanical evidence shows that early domesticated forms of maize, beans, squash, manioc and cotton were developed in some localised areas, but processes such as hybridisation with relatives and/or experimentation which produced morphological changes in plants, occurred during prolonged periods of time (Piperno and Pearsall 1998: 30).

Some of the present major food crops of the Colombian Amazon region such as manioc (*Manihot esculenta*), peach palm (*Bactris gasipaes*) and chilli pepper (*Capsycum* sp.) do not have wild relatives in the area and must be introduced into the region from somewhere else. It is possible therefore that the pre-ceramic period at Peña Roja was one of small-scale manipulation of indigenous plants. The ceramic period has the staples such as maize (*Zea mays*), manioc, (*Manihot esculenta*), and several tree fruits which have been already introduced into the Colombian Amazon. The introduction of these new crops should represent a big change. It must be account probably for fertilisation and intensification

Piperno and Pearsall think that it is important to distinguish between the origins of food production and the origins of agriculture. The term agriculture is used by the authors "to denote large-scale field systems, in which domesticated plants are common and come to dominate as staple crops" (1998: 7). Food production was practiced in the tropical lowlands at least for 5000 years before the emergence of village life in the region. The richness and abundance of the wild food resources allowed it. This phenomenon happened in some coastal and riverine areas, where settled people were living on the exploitation of wild food resources. These societies became dependent on food production relatively late in the archaeological record (1998: 8).

At present the whole picture of the history of the prehispanic human occupation in the middle Caquetá river is unknown. According to the ideas about the areas where the tropical crops could be domesticated it is possible that the hunter and gatherer groups who lived in Peña Roja came to the region as small scale horticulturists. There is no evidence that suggests a local development of domestication of crops (see later this chapter for details of the archaeobotanical remains). Further research in the area must be carried out in order to locate more archaeological sites and to try to answer questions about early human subsistence economy in the region.

4.3. The archaeobotanical evidence

Several archaeological sites in the lowlands of lower Central America and northern South America have yielded abundant plant remains. Table 4.1 shows late Pleistocene and Holocene sites, their chronology and the plant remains so far identified. The lowland areas studied include the Central Pacific Panama (Ranere 1980a,b, Piperno *et al.* 1985, 1991b, 1992, Piperno 1988, 1995, Cooke and Ranere 1992a, Ranere and Cooke 1995, Piperno and Pearsall 1998), the middle Orinoco river (Roosevelt 1980), French Guiana (Vacher *et al.* 1998), the Ecuadorian Pacific area (Lippi *et al.* 1984, Pearsall 1988a, Pearsall 1994a, Pearsall 1995, Piperno and Pearsall 1998), the Brazilian Amazon (Roosevelt 1991, Cooke 1992, Roosevelt *et al.* 1996, Bush *et al.* 1997 quoted by Piperno and Pearsall 1998: 281), and the Ecuadorian Amazon (Bush *et al.* 1989, Pearsall 1994a,b, Pearsall 1995, Piperno and Pearsall 1998, Athens and Ward 1999) and the Bolivian Amazon (Erickson 1995).

Table 4.1 Plant remains reported from the tropical lowlands of lower Central America and northern South America. Key for type of plant remains: seeds (s); phytoliths (ph); pollen (p); starch grains (sg); wood charcoal (wch); roots & tubers (rt); bottle gourd rinds (bgr); maize cobs (mc); maize cupules (mcl). * Wood charcoal reported from archaeological sites in the Sinnamary area, French Guiana included more than 150 taxa (see Vacher *et al.* 1998). This table includes only the families identified.

	ARCHAEOLOGICAL SITES AND DATES																
	Panama							Ecuador Pacific			Ecuador-Amazon	Brazil			Venezuela	French Guiana*	Bolivia-Amazon
	Los Vampiros cave 8600 BP	Aguadulce rockshelter 7000-500 BP	Corona & Caribali rockshelters 8450-6500 BP	Los Ladrones cave ca 7000-6000 BP	Chiriqui rockshelters 6750-2450 BP	Monagrillo 5000-3000 BP	La Mula 2500 BP	OGSE-80 site 10,800-6600 BP	La Ponga 3150-2750 BP	Real Alto5500-2800 BP	Ayuchi 5300 BP	Pedra Pintada 11,200;10,500 BP	Rondonia area 14,700;8930 BP	Marajo Island AD 450-950	Parmana 4000; 3000; 2700 BP	Sinnamary basin sites 1660; 430; 240; 220 BP	El Villar (dates unknown)
Trees/shrubs																	
Anacardiaceae																wch	
Spondias sp. Anacardiaceae																	
Spondias lutea. Anacardiaceae														s			
Annonaceae																wch	
Apocynaceae																wch	
Ilex cf. guallusa Aquifoliaceae																	p
Araliaceae																wch	
Bignoniaceae																wch	
Tabeuia chysantha Bignoniaceae										wch							
Bixa cf. urucu Bixaceae																	p
Bombacaceae																wch	
Boraginaceae																wch	

Table 4.1 Continued.

	ARCHAEOLOGICAL SITES AND DATES															
	Panama							Ecuador Pacific			Ecuador-Amazon	Brazil			Venezuela	French Guiana*	Bolivia-Amazon
	Los Vampiros cave 8600 BP	Aguadulce rockshelter 7000-500 BP	Corona & Caribali rockshelters 8450-6500 BP	Los Ladrones cave ca 7000-6000 BP	Chiriqui rockshelters 6750-2450 BP	Monagrillo 5000-3000 BP	La Mula 2500 BP	OGSE-80 site 10,800-6600 BP	La Ponga 3150-2750 BP	Real Alto5500-2800 BP	Ayuchi 5300 BP	Pedra Pintada 11,200;10,500 BP	Rondonia area 14,700;8930 BP	Marajo Island AD 450-950	Parmana 4000; 3000; 2700 BP	Sinnamary basin sites 1660; 430; 240; 220 BP	El Villar (dates unknown)
Burseraceae																wch	
Caryocaracaceae																wch	
Celastraceae																wch	
Chrysobalanaceae																wch	
Clusiaceae																wch	
Combretaceae																wch	
Dichapetalaceae																wch	
Ebenaceae																wch	
Elaeocarpaceae																wch	
Muntingia calabura Elaeocarpaceae																	
Erythroxylaceae																wch	
Euphorbiaceae																wch	
Flacoutiaceae																wch	
Humiriaceae																wch	

Table 4.1 Continued.

	ARCHAEOLOGICAL SITES AND DATES																
	Panama							Ecuador Pacific			Ecuador-Amazon	Brazil			Venezuela	French Guiana*	Bolivia-Amazon
	Los Vampiros cave 8600 BP	Aguadulce rockshelter 7000-500 BP	Corona & Caribali rockshelters 8450-6500 BP	Los Ladrones cave ca 7000-6000 BP	Chiriqui rockshelters 6750-2450 BP	Monagrillo 5000-3000 BP	La Mula 2500 BP	OGSE-80 site 10,800-6600 BP	La Ponga 3150-2750 BP	Real Alto5500-2800 BP	Ayuchi 5300 BP	Pedra Pintada 11,200;10,500 BP	Rondonia area 14,700;8930 BP	Marajo Island AD 450-950	Parmana 4000; 3000; 2700 BP	Sinnamary basin sites 1660; 430; 240; 220 BP	El Villar (dates unknown)
Sacoglottis guianensis Humiriaceae												s					
Lamiaceae																	
Lauraceae																wch	
Lecythidaceae																wch	
Bertholetia excelsa Lecythidaceae												s					
Leguminosae																wch	
Acacia macracantha Leguminosae										wch							
Cassia sp. Leguminosae																	
Hymenaea spp. Leguminosae												wch					
Hymenaea courbant Leguminosae					s												
Inga sp. Leguminosae														s			
Prosopis juliflora Leguminosae										wch							
Pithecellobium dulce Leguminosae										wch							

Table 4.1 Continued.

	ARCHAEOLOGICAL SITES AND DATES																
	Panama							Ecuador Pacific			Ecuador-Amazon	Brazil			Venezuela	French Guiana*	Bolivia-Amazon
	Los Vampiros cave 8600 BP	Aguadulce rockshelter 7000-500 BP	Corona & Carihali rockshelters 8450-6500 BP	Los Ladrones cave ca 7000-6000 BP	Chiriqui rockshelters 6750-2450 BP	Monagrillo 5000-3000 BP	La Mula 2500 BP	OGSE-80 site 10,800-6600 BP	La Ponga 3150-2750 BP	Real Alto5500-2800 BP	Ayuchi 5300 BP	Pedra Pintada 11,200;10,500 BP	Rondonia area 14,700;8930 BP	Marajo Island AD 450-950	Parmana 4000; 3000; 2700 BP	Sinnamary basin sites 1660; 430; 240; 220 BP	El Villar (dates unknown)
Loganiaceae																wch	
Malpighiaceae																wch	
Byrsonima sp. Malpighiaceae		s			s												
Byrsonima crassifolia Malpighiaceae														s			
Byrsonima crispa Malpighiaceae												s					
Gossypium sp. Malvaceae										ph							
Melastomataceae																wch	
Meliaceae																wch	
Moraceae																wch	
Myristicaceae																wch	
Myrtaceae																wch	
Nyctaginaceae																wch	
Ochnaceae																wch	
Olacaceae																wch	
Proteaceae																wch	

Table 4.1 Continued.

	ARCHAEOLOGICAL SITES AND DATES																
	Panama							Ecuador Pacific			Ecuador-Amazon	Brazil			Venezuela	French Guiana*	Bolivia-Amazon
	Los Vampiros cave 8600 BP	Aguadulce rockshelter 7000-500 BP	Corona & Caribali rockshelters 8450-6500 BP	Los Ladrones cave ca 7000-6000 BP	Chiriqui rockshelters 6750-2450 BP	Monagrillo 5000-3000 BP	La Mula 2500 BP	OGSE-80 site 10,800-6600 BP	La Ponga 3150-2750 BP	Real Alto5500-2800 BP	Ayuchi 5300 BP	Pedra Pintada 11,200;10,500 BP	Rondonia area 14,700;8930 BP	Marajo Island AD 450-950	Parmana 4000; 3000; 2700 BP	Sinnamary basin sites 1660; 430; 240; 220 BP	El Villar (dates unknown)
Rubiaceae																wch	
Sapindaceae																wch	
Talisia esculenta Sapindaceae												s					
Sapotaceae			s							s						wch	
Pouteria cf. mammosa Sapotaceae						s											
Simaroubaceae																wch	
Simarouba glauca Simaroubaceae																	
Sterculiaceae																wch	
Sterculia corrugata Sterculiaceae										wch							
Styracaceae																wch	
Tiliaceae																wch	
Verbenaceae																wch	
Vitex cf. cymosa Verbenaceae												s				wch	
Violaceae																wch	
Vochysiaceae																wch	

Table 4.1 Continued.

	ARCHAEOLOGICAL SITES AND DATES																
	Panama							Ecuador Pacific			Ecuador-Amazon	Brazil			Venezuela	French Guiana*	Bolivia-Amazon
	Los Vampiros cave 8600 BP	Aguadulce rockshelter 7000-500 BP	Corona & Caribali rockshelters 8450-6500 BP	Los Ladrones cave ca 7000-6000 BP	Chiriqui rockshelters 6750-2450 BP	Monagrillo 5000-3000 BP	La Mula 2500 BP	OGSE-80 site 10,800-6600 BP	La Ponga 3150-2750 BP	Real Alto5500-2800 BP	Ayuchi 5300 BP	Pedra Pintada 11,200;10,500 BP	Rondonia area 14,700;8930 BP	Marajo Island AD 450-950	Parmana 4000; 3000; 2700 BP	Sinnamary basin sites 1660; 430; 240; 220 BP	El Villar (dates unknown)
Palms																	
Arecaceae																wch	
Acrocomia mexicana Arecaceae		s	s										s				
Acrocomia vivifera Arecaceae					s												
Astrocaryum vulgare Arecaceae												s		s			
Attalea macrocarpa Arecaceae												s					
Attalea spectabilis Arecaceae												s					
Elaeis sp. Arecaceae		s															
Euterpe oleracea Arecaceae														s			
Scheelia zonensis Arecaceae					s												
Corn																	
Zea mays Poaceae		ph; sg		ph; p	s	sg	sg		s; mcl	ph	ph; p	mc			s		
Legumes																	
Phaseolus vulgaris					s										s		
Canavalia sp.										s							

Table 4.1 Continued.

	ARCHAEOLOGICAL SITES AND DATES															
	Panama							Ecuador Pacific			Ecuador-Amazon	Brazil			Venezuela	French Guiana*	Bolivia-Amazon
	Los Vampiros cave 8600 BP	Aguadulce rockshelter 7000-500 BP	Corona & Caribali rockshelters 8450-6500 BP	Los Ladrones cave ca 7000-6000 BP	Chiriqui rockshelters 6750-2450 BP	Monagrillo 5000-3000 BP	La Mula 2500 BP	OGSE-80 site 10,800-6600 BP	La Ponga 3150-2750 BP	Real Alto5500-2800 BP	Ayuchi 5300 BP	Pedra Pintada 11,200;10,500 BP	Rondonia area 14,700;8930 BP	Marajo Island AD 450-950	Parmana 4000; 3000; 2700 BP	Sinnamary basin sites 1660; 430; 240; 220 BP	El Villar (dates unknown)
Bottle gourd rinds		bgr						ph				bgr					
Roots & tubers																	
Xanthosoma cf. guialusa Areceae																	p
Canna edulis Cannaceae										ph							
probably Ipomoea batata Convulvulaceae					rt												
Manihot esculenta Euphorbiaceae		sg				sg	sg										
Calathea allouia Marantaceae		ph					ph	ph									
Maranta arundinaceae Marantaceae	ph																
Vegetables																	
Cucurbita sp.								ph		ph							

4.3.1. Archaeobotany in Colombia

Unfortunately there are no complete archaeobotanical sequences for many regions of the country. This circumstance makes any attempt of correlation between archaeobotanical data, palaeoenvironmental reconstruction, cultural materials and chronology difficult. Therefore any model on past subsistence or on past human use of plants is difficult to test against field data. Although it has to be said that this fact must not prevent the formulation of explanatory models. These would have to be tested when enough archaeological evidence is available.

In Colombia, most of the ideas on gathering and/or food production during prehistoric times are based by cultural artefacts found at archaeological sites which are related to the consumption, processing or production of foods. For example, grinding stones or "metates", hand milling stones, baking ceramic plates are respectively associated with the consumption and/or production of maize and manioc. This association is based on the ethonohistorical and ethnographic data.

At present, archaeobotany in Colombia is in an incipient stage and detailed investigations on management, consumption and production of plants have to be carried out in the future. Most of the plant remains found at archaeological sites are charred remains. The use of flotation systems has increased the amount of plant remains recovered from archaeological sites. There is still a tendency to have plant taxa lists and when available information about present ecology and ethnobotany of the identified taxa as part of the Appendices in archaeological reports (e.g. Morcote 1994b,c, 1995). An effort has to be made to integrate archaeobotany within the design and development of the archaeological projects.

In this section archaeological sites located in the Colombian lowland regions where archaeobotanical evidence have been studied will be the focus of the discussion. Table 4.2 shows the sites, their chronology and taxa reported.

Table 4.2 Plant remains reported from the Colombian lowlands. Key for the type of plant remains: seeds (s); phytoliths (ph); pollen (p); starch grains (sg); wood charcoal (wch); roots & tubers (rt); bottle gourd rinds (bgr); maize cobs (mc); maize cupules (mcl).

	ARCHAEOLOGICAL SITES AND DATES				
	Caribbean lowlands		Pacific lowlands	Amazonian lowlands	
	San Jacinto 2120; 1750 BP	Carate 25 AD 1010; AD 1270; AD 1400	Ordoñez & Palestina 4000 BP-C17th	Peña Roja 9000-9300 BP; 8090 BP	Araracuara sites 4700BP - AD790
Trees/shrubs					
Anacardium occidentale sp. Anacadiaceae					p
Oxandra eneura Annonaceae				s	
Couma macrocarpa Apocynaceae			s		
Macoubea guianensis Apocynaceae				s	
Carica papaya Caricaceae			s		
Caryocar aff. Glabrum Caryocareceae				s	
Chrysobalanaceae				ph	
Licania pyrifolia Chrysobalanaceae				s	
Rheedia madruño Clusiaceae			s		
Humiriastrum sp. Humiriaceae				s	
Humiriastrum procerum Humiriaceae			s		
Sacoglottis sp. Humiriaceae				s	
Vantanea peruviana Humiriaceae				s	
Beilschiedia brasilensis Lauraceae				s	
Inga sp. Leguminosae				s	
Parkia multijuga Leguminosae				s	
Marantaceae				ph	
Psidium sp.- Myrtaceae			s		
Theobroma bicolor Sterculiaceae					p
Arecaceae				ph	
Astrocaryum aculeatum Arecaceae				s	
Astrocaryum gynacanthum Arecaceae				s	
Astrocaryum javari Arecaceae				s	s
Astrocaryum sciophilum Arecaceae				s	p
Astrocaryum standleyanum Arecaceae			s		
Attalea sp. Arecaceae					p
Attalea insignis Arecaceae				s	
Attalea maripa Arecaceae				s	
Attalea racemosa Arecaceae				s	
Bactris barronis Arecaceae			s		
Bactris coloradonis Arecaceae			s		
Bactris gasipaes Arecaceae			s		p
Chanaedorea sp. Arecaceae					p
Euterpe sp. Arecaceae					p
Geonoma deversa Arecaceae			s		
Lepidocaryum tenue Arecaceae					p
Iriartea sp. Arecaceae					p
Oenocarpus bacaba Arecaceae				s	p; s
Oenocarpus bataua Arecaeae			s	s	p; s
Oenocarpus mapora Arecaeae			s	s	p; s
Orbignya cuatrecasana Arecaceae			s		
Mauritia flexuosa Arecaceae				s	p; s
Socratea exhorriza Arecaceae			s		
Syagrus sp.					p

Table 4.2 Continued.

	ARCHAEOLOGICAL SITES AND DATES				
	Caribbean lowlands		Pacific lowlands	Amazonian lowlands	
	San Jacinto 2120; 1750 BP	Carate 25 AD 1010; AD 1270; AD 1400	Ordoñez & Palestina 4000 BP-C17th	Peña Roja 9000-9300 BP; 8090 BP	Araracuara sites 4700BP - AD790
Grains					
Chenopodium sp. Chenopodiaceae	s				
Zea mays Poaceae		p			p
Grasses/Herbs					
Poaceae	s				
Malvastrum sp. Malvaceae	s				
Bottle gourd rinds					
Lagenaria sp. Cucurbitaceae				ph	
Roots & tubers					
Ipomoea sp. Convulvulaceae		p			
Ipomoea batatas Convulvulaceae					p
Manihot sp. Euphorbiaceae		p			
Manihot esculenta Euphorbiaceae					p
Calathea allouia Marantaceae				ph	
Vegetables					
Cucurbita sp. Cucurbitaceae				ph	
Cucurbita maxima Cucurbitaceae		p			
Cucurbita mixta Cucurbitaceae		p			
Capsicum sp. Solanaceae		p			
Capsicum chinensis sp. Solanaceae					p
Hallucinogenic					
Erythroxylon sp. Erythroxylaceae		p			
Fruits					
Passiflora sp. Passifloraceae		p			

4.3.1.1.The Caribbean lowlands

It has been argued that the lowlands of northern Colombia could have been one of the areas where domestication of crop plants such as tubers occurred (see Reichel-Dolmatoff G. 1986, Langebaek 1992). Evolutionary change between hunter-gatherer and farmer societies has also been postulated for the area (Reichel-Dolmatoff G. 1986). Evidence to support this consists of the presence of artefacts indirectly associated with the consumption and processing of certain plants such as maize and manioc (Archila 1991, 1993). The only systematic archaeobotanical study in the region was carried out in the San Jacinto 1 site (see Bonzani 1997, 1998), where no remains of crops such as manioc or maize were found.

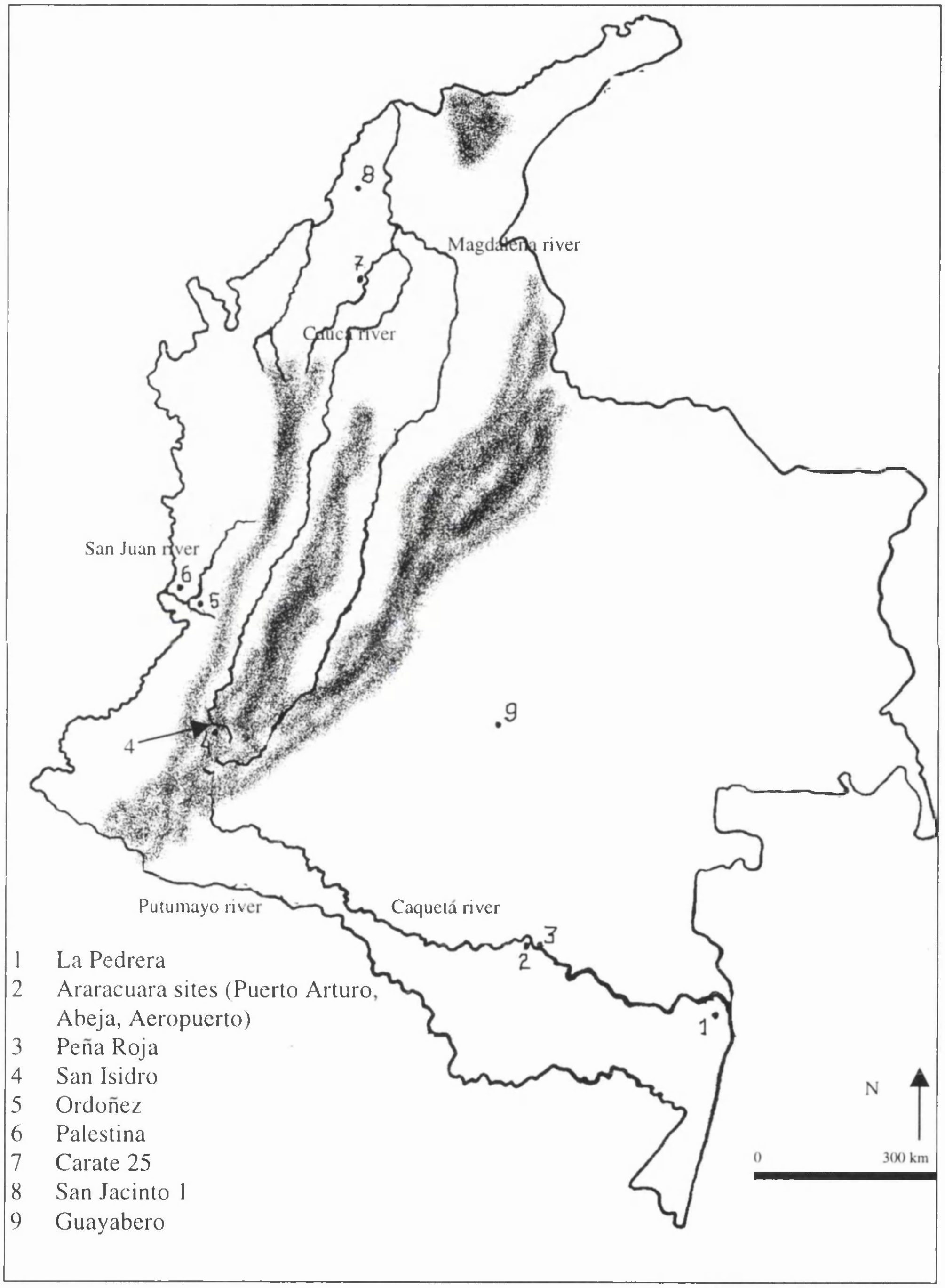
Several archaeological sites in the Colombian Caribbean lowlands have been located but unfortunately they were dug before modern recovery and analysis techniques of archaeobotany and zooarchaeology were developed and applied in

Colombia. As a result we have presence/absence records of different animal taxa as appendices in some archaeological reports. Most of the archaeology in the region concentrated in the formulation of a regional ceramic sequence and a series of indirect evidence within the archaeological records that suggest early cultivation of root crops and later cultivation of maize (Archila 1991, 1993).

Bonzani's (1998) archaeobotanical identifications of the macro-remains found at the site of "San Jacinto 1" (dated between 5940 and 5300 BP), revealed many grasses and some fruits. The site was seasonally occupied by people who collected wild grass seeds which were processed and cooked at the site. Stratum number 5 was dated between 2100 and 1700 BP (the laboratory numbers were not published). There is evidence of earth oven features used for cooking and a ground-stone lithic technology indicates that plant were processed at the site. There is also tentative evidence for the intensive human use of seed plants, such as grasses from the Poaceae family and *Malvastrum* seeds which seem to correspond to the natural background vegetation (Bonzani 1997: 1136, 1998).

A pollen sequence from Carate 25 site, in the Colombian Caribbean lowlands was studied by Herrera and Berrío (1996). The site is part of an ancient hydraulic system built to drain the area and to prepare land for agricultural purposes. According to the pollen record, squash (*Cucurbita maxima*), maize (*Zea mays*) and sweet potato (*Ipomoea* sp.) were cultivated at AD 1010. At AD 1270 that squash was replaced by *Cucurbita mixta* while maize, chilli pepper, sweet potato and manioc also appeared in the pollen sequence. At AD 1400 pollen of coca, squash, maize, sweet potato, manioc and *Passiflora* sp. fruit are reported from the sequence (Herrera and Berrío 1996).

Figure 4.1 Map of Colombia showing the archaeological sites of the lowlands from which plant remains have been studied. Adapted from The Times Atlas of the World. Concise edition (1995: 162-163).



4.3.1.2. The Pacific lowlands

Humanly modified black soils were recorded from the archaeological site of Palestina (dated between AD 900 and AD 1600) in the tropical rain forest of the Choco region, western Colombia (Figure 4.1). Pollen analysis and physical and chemical determination of the soil characteristics showed that people improved soil conditions by adding lime sediments, sand, algae (*Spirogira* and diatoms) from the swamps and river shores, and also by adding organic refuse from the adjacent dwelling sites (Salgado López and Stemper 1994: 188).

Research carried out in the alluvial plains of lower Calima (Ordoñez site), and San Juan (site Palestina) rivers (Figure 4.1), southwest Colombia, has led to the recontruction of the human diet during the period between *c.* 4000 BP and the 17th century AD. Plant remains from maize, palms and tree fruits were identified by Romero (1995). Palms seeds included *Astrocaryum standleyanum*, *Bactris barronis*, *B. coloradonis*, *B. gasipaes*, *Geonoma deversa*, *Oenocarpus bataua*, *O. mapora*, *Orbignya cuatrecasana* and *Socratea exhorriza*. Three of these palms are used at present as food (*Bactris gasipaes*, *Oenocarpus mapora* and *Orbignya cuatrecasana*) while two (*Geonoma deversa* and *Socratea exhorriza*) are used for building. Within the filling of a pit dated to the latest period, seeds of *Bactris* sp. and *Oenocarpus* sp. palms were found. The pit fill contained also seeds from several tree fruits: *Couma macrocarpa* (Apocynaceae), *Carica papaya* (Caricaceae), *Humiriastrum procerum* (Humiriaceae), *Rheedia madruno* (Clusiaceae) and *Psidium* sp. (Myrtaceae). At present all these fruits are valued as food (Romero 1995).

4.3.1.3. The Amazon lowlands. Middle Caquetá river settlements

4.3.1.3.1. Peña Roja site

4.3.1.3.1.1. Macro - remains. Charred seeds

Most of the identified seeds (68%) in the assemblage from Peña Roja were from palms (Morcote 1994a, 1998, Morcote *et al.* 1996,1998). They belong to eleven species from four genera: *Astrocaryum javari*, *A. aculeatum*, *A. gynacanthum* and *A. sciophilum*, *Oenocarpus bataua*, *O. bacaba*, *O. mapora*, *Mauritia flexuosa*, *Attalea maripa*, *A. insignis*, *A. racemosa* (Cavelier *et al.* 1995: 34, Herrera and Cavelier 1999. See Chapter five for details of the distribution throughout time of these remains and of their probable uses).

Tree fruits were also consumed by people from this period as is indicated by the identified seeds of 10 species from six families. These include nuts such as *Caryocar* aff. *glabrum* (Caryocaceae), *Vantanea peruviana* (Humiriaceae) and fruits which probably were eaten raw, such as *Macoubea guianensis* (Apocynaceae), *Beilschmiedia brasilensis* (Lauraceae), *Humiriastrum* sp., *Sacoglottis* sp. (Humiriaceae), *Oxandra eneura* (Annonaceae), *Licania pyrifolia* (Chrysobalanaceae), *Inga* sp. and *Parkia multijuga* (Leguminosae) (Herrera and Cavelier 1999: 5). Whole and fragmented charred palm seeds were recovered from the ceramic-levels of the Peña Roja archaeological site. The species identified are the same as those found in the pre-ceramic levels of the site, with the exception of *Mauritia flexuosa*, which was only found in the pre-ceramic levels (see sub-heading 4.2.4.2.1.2). In general the frequencies of each one is lower in the ceramic period than to the pre-ceramic one. The species include *Astrocaryum aculeatum*, *A. javari*, *A. sciophilum*, *Maximiliana maripa*, *Oenocarpus bataua* and *O. mapora* (Morcote 1994a).

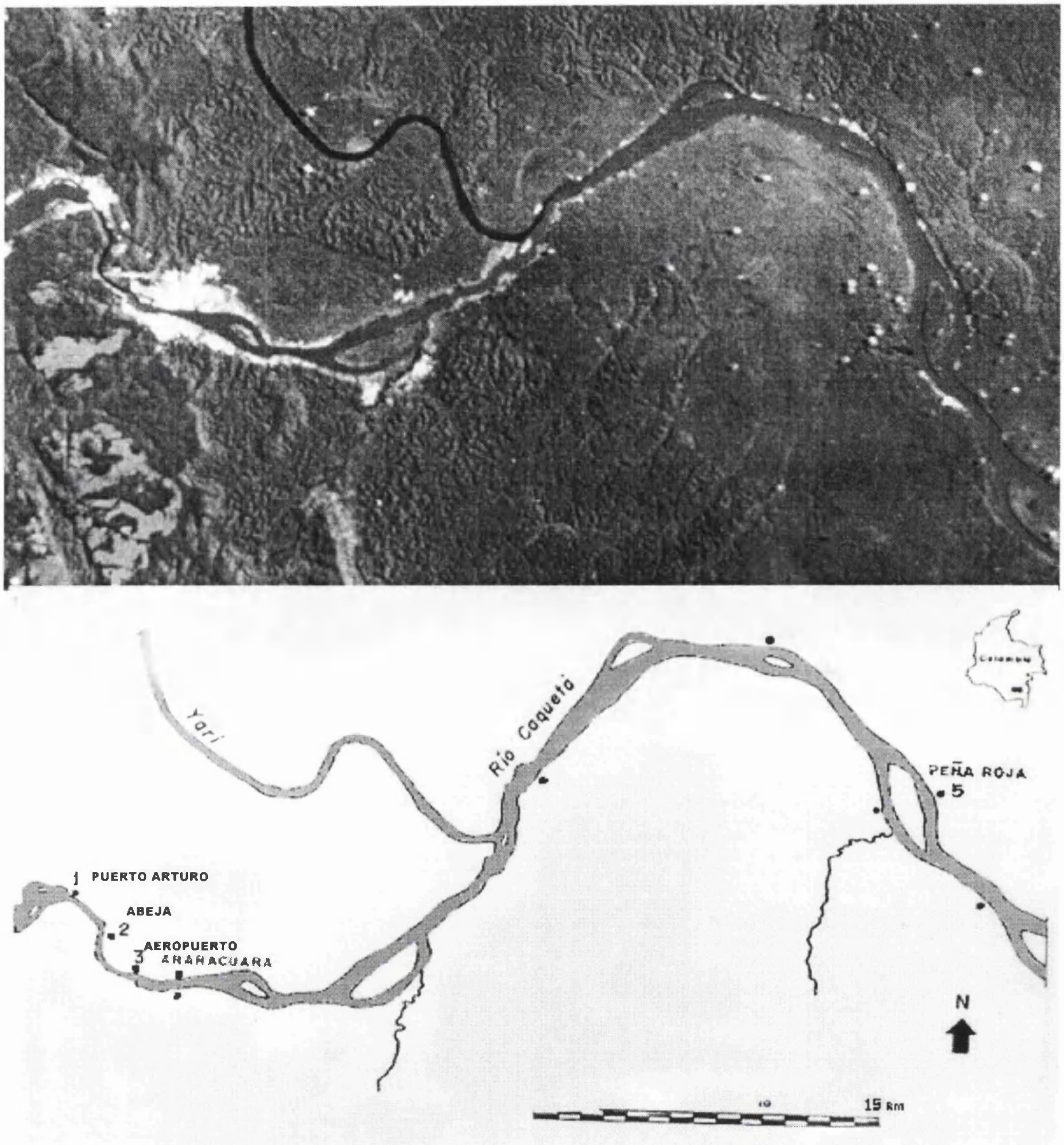


Figure 4.2 Radar-photograph (Instituto Geográfico Agustín Codazzi, IGAC and Centro Iberoamericano de Foto-interpretación, CIAF. October 1992) and map (After Herrera *et al.* 1992c) of the middle Caquetá river showing different archaeological sites. The unlabeled spots indicate other sites not mentioned in the text.

4.3.1.3.1.2. Micro-remains. Phytoliths

Phytoliths from squash (*Cucurbita* sp.), leren tuber (*Calathea allouia*) and bottle gourd (*Lagenaria* sp.) have been found by Piperno, in sediments taken at Peña Roja. A direct radiocarbon date of 8090 ± 60 BP (Lab. No. UCR 3419, CAMS-27728), was obtained from this phytolith assemblage (Piperno 1999). *Cucurbita* phytolith sizes were measured and it was found that the upper size limit of them is greater than that limit in modern wild specimens. This fact and the low probability of finding a wild *Cucurbita* species in this low wet tropical forests, makes it likely that the phytoliths from Peña Roja site belong to a cultivated species (Piperno and Pearsall 1998: 205).

The presence of phytoliths from squash (*Cucurbita* sp.), bottle gourd (*Lagenaria* sp.) and leren tuber (*Calathea allouia*) in the samples Peña Roja is taken by Piperno (1999) as evidence of the practice of small scale horticulture in the site. Piperno also argues that the fact that phytoliths from trees and shrubs were dominant in all the analysed samples together with the fact that very few grass phytoliths were observed suggest that the horticultural systems were small-scale, e.g. practised in house gardens and did not involve clearing of large forest areas for agricultural fields (see sub-section 4.2.1 in Chapter four of this thesis).

Phytoliths of *Calathea allouia* are derived from seeds of the plant (Piperno and Pearsall 1998: 206). At Peña Roja site *Calathea* phytoliths were only found at pre-ceramic levels and it suggests that the plant lost its ability to set seed under domestication or that the plant was harvested before seeds were set. Tree phytoliths include Chrysobalaneceae (e.g. *Chrysobalanus*, *Licania*), Arecaceae, Marantaceae and Zingiberaceae. Chrysobalanaceae phytoliths account for more than 70% (Piperno 1999).

4.3.1.3.2. Abeja and other Araracuara sites

4.3.1.3.2.1. Macro-remains. Charred seeds

Seed remains from three species of *Oenocarpus*, *Astrocaryum javari* and *Astrocaryum* cf. *aculeatum/sciophilum* and *Mauritia flexuosa* palms were identified. Fruits of these palms could have been consumed by the prehistoric inhabitants of the area (Herrera and Cavelier 1999: 8).

4.3.1.3.2.2. Micro-remains. Pollen analysis

A complete edaphic, palynological and chronological record was obtained from Abeja (2 in Figure 4.3) and Aeropuerto (3 in Figure 4.3) sites (see Figures 4.3 and 4.4). Human interference caused slight disturbance of the forest at 4645±40 BP in Abeja site (Mora *et al.* 1991: 26). Pollen of grasses and *Attalea* palms were reported along with maize pollen. Herrera and Cavelier (1999) interpret this as the first cultivated plot in the Araracuara area. They think that plots were small taking into account that no substantial accumulation of organic matter or other cultural remains were found in these soils. Humanly modified soils covering an area of 6 ha in Abeja site were dated to 1565 ± 35 BP (GrN 16970) and 775 ± 25 (GrN 16968). Manioc (*Manihot esculenta*), maize (*Zea mays*), chilli peppers (*Capsicum chinensis*) and maraca fruit (*Theobroma bicolor* from Sterculiaceae family) were cultivated in these fields according to the pollen record (Mora *et al.* 1991). Palm pollen of 11 species included *Oenocarpus bataua*, *O. bacaba*, *O. mapora*, *Lepidocaryum tenue*, *Attalea* sp., *Mauritia flexuosa*, *Syagrus* sp., *Astrocaryum sciophilum*, *Euterpe* sp., *Iriartea* sp., *Bactris gasipares* and *Chanaedorea* sp. (Herrera and Cavelier 1999).

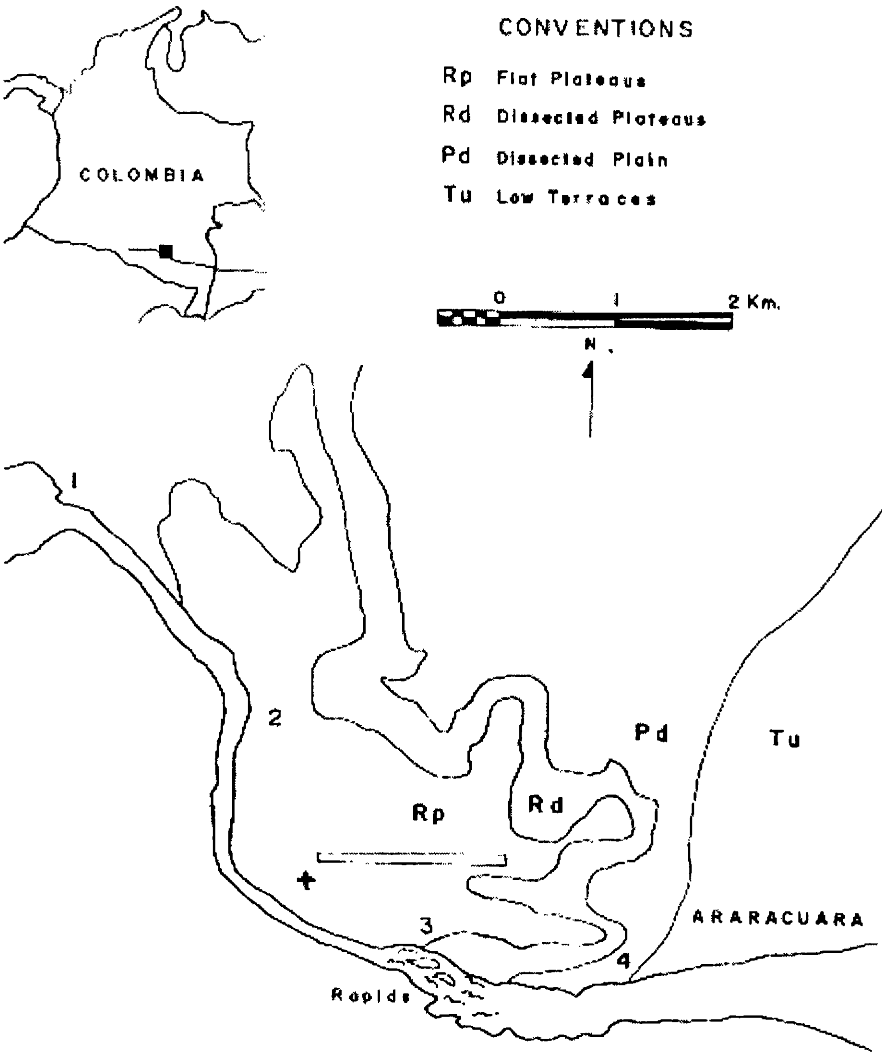


Figure 4.3 Map showing the location of archaeological sites of the Araracuara plateau: (1) Puerto Arturo; (2) Abeja; (3) Aeropuerto; (4) Araracuara. After Herrera *et al.* 1992a: 101

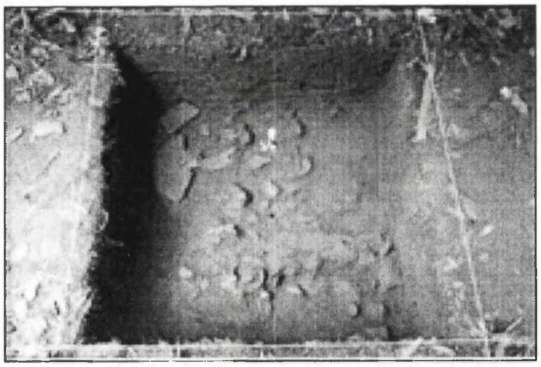


Figure 4.4 Photograph of the excavation in Abeja site at Araracuara.

Humanly modified soils at Aeropuerto site were formed by the addition of organic matter; palynological analysis shows that at about the 8th Century there was a change in the agricultural system practised by ancient inhabitants of the area (see Figure 4.5). Alluvial silt addition to the soil is inferred from the appearance of humidity indicators in the pollen sequence such as algae whose habitats are permanently flooded areas. At the same time a diversification in the cultivated plants is recorded from the pollen sequence. The new group of plants include sweet potato (*Ipomoea batatas*), two types of manioc (*Manihot esculenta*), four types of maize (*Zea mays*), and cashew nut (*Anacardium occidentale*) (Herrera *et al.* 1992a: 102).

Figure 4.5. Photograph of black soil in site 3, Araracuara plateau.

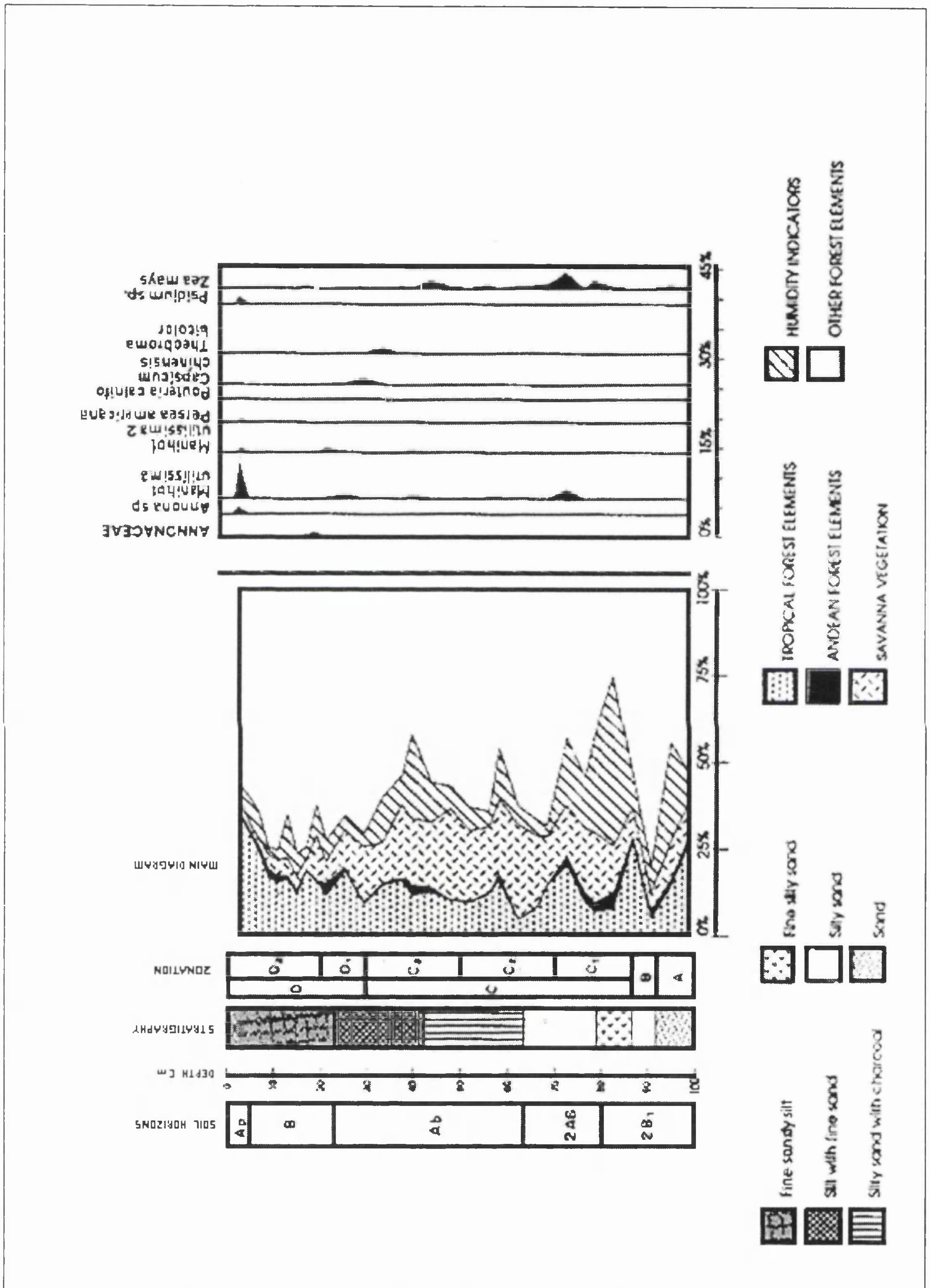


Figure 4.6 Diagram of pollen from a core taken at Abeja site, showing cultivated plants. After Mora *et al.* (1991: 29).

4.4. Discussion on roots/tubers vs. seed cultivation

Root crops have been traditionally considered as the staples for the Amazon region. It has been said that their cultivation was complemented by protein obtained from fishing and hunting (e.g. Denevan 1966, Lathrap 1970, Meggers 1971). However maize was also cultivated by societies inhabiting floodplain areas in the Amazon region during the later prehistoric times, c. 2000 years BP (Roosevelt 1991: 126. See sub-heading 3.3 in Chapter three of this thesis). Maize pollen was also reported in samples taken at Abeja (dated to 4645 ± 40 BP. GrN 14987) and Aeropuerto sites (dated to AD 790), in the Colombian Amazon (Mora *et al.* 1991: 12). Phytoliths and pollen of maize (dated to 5300 BP and 2400 BP) were found in cores taken at the Ayauchi' lake in the Ecuadorian Amazon (Bush *et al.* 1989, Pearsall 1994a: 122, Piperno and Pearsall 1998: 258-259).

Maize cultivation has been discussed as a prime factor to the appearance of chiefdoms in the Brazilian Amazon region (Roosevelt 1980, 1991, 1994). In the archaeological literature of the lower Central America and northern South America it is commonly pointed out that maize production allowed surplus and storage, and in turn denser populations on which chiefly activities depend (see for example Reichel-Dolmatoff 1986b, Langebaek 1992). In chiefdom societies chiefs have been seen as manipulators of the surplus. It is believed that a society with a subsistence economy based on maize cultivation was more likely to evolve into a chiefdom than a society practising highly diversified agriculture. The later usually is based on the cultivation of manioc or other starchy tubers, and includes wild or partially domesticated species (Drennan 1995: 306). Manioc is also suitable for being stored as cassava bread or as manioc flour but its storage requires long time-consuming processes (see e.g. Van der Hammen M. C. 1992).

The dichotomy between producers of maize and non-producers of maize as a condition of complexity has been mentioned by some authors (eg. Denevan 1966, Roosevelt 1991). The level of social complexity of the earliest people who cultivated maize in the Amazon region (in the Colombian and/or Ecuadorian Amazon) is unknown. What the current evidence shows is that there was an ancient agricultural tradition in the Amazon basin which involved maize cultivation at *c.* 5000 BP and squash, bottle gourd and leren tuber as early as 9000 BP. Manioc and maize were cultivated in the same plots at least since 1500 BP in the Colombian Amazon. This contradicts Roosevelt's hypothesis on the late introduction of maize in the lower Amazon region (see Bush *et al.* 1989). Social complexity is postulated by Mora *et al.* (1991) in the Colombian Amazon at 1150 BP when an intensification of the agriculture systems occurred.

The practice of tuber cultivation before seed cultivation has been postulated for the American tropical lowlands (the Central Pacific Panama, the Colombian Caribbean lowlands, the Venezuelan Caribbean and eastern savannah lowlands). In the Colombian and Venezuelan lowlands evidence to support this consists of artefacts related to the processing of seeds and/or tubers (Reichel-Dolmatoff 1986b, Roosevelt 1980). Direct archaeobotanical evidence found in Panama included phytoliths of the tuber *Marantha* sp. which were dated to early Holocene times. This evidence has been used to argue root earlier cultivation (Cooke 1992: 44, Piperno and Pearsall 1998).

As it has been said above (see sub-heading 4.1.2.2.2. of this Chapter), many tubers produce little pollen, do not produce phytoliths or they do not have diagnostic shapes. Charred tubers or fragmented tuber remains have not been reported from archaeological sites of the tropical lowlands. These preservation or identification limitations make difficult the reconstruction of the history of root/tubers management in the area. Other lines of evidence such as starch grain analysis and identification of wood fragments of small trees and shrubs from which roots and tubers are derived, might be explored in the future.

The early presence of maize macro-remains and micro-remains has been the focus of controversy. Some authors such as Smith (1995) do not agree with Pearsall and

Piperno's statements on early maize presence in northern South America. His evaluation of the phytolith evidence suggests that it is not very strong. He also mentions that phytoliths can be easily removed from their original places of deposition as a result of post-depositional processes. He also argues that the association of the very small remains with radiocarbon dates from the same levels is not very sure due to probable taphonomic problems.

In my opinion, the current evidence from phytoliths and pollen of maize as early as 5000 BP for different sites of tropical America, does not support the assumption that maize cultivation spread from Mexico and reached South America as late as 3200 BP (see for example Smith 1995: 159). On present evidence from the Pacific coast and Amazon regions in Ecuador, the Amazon region, high and middle altitude Andean zones of Colombia and the Central Pacific lowlands in Panama maize in South America was present by *c.* 5000 BP. This means in principle that maize was available to be introduced into the Amazon region any time after *c.* 5000 BP. It is interesting that maize was present in the pollen core from Abeja site in the Araracuara region at 4645±40 (GrN 14987) years BP.

4.5. Summary

Direct evidence of plant domestication and cultivation are relatively scarce in the lowlands of lower Central America and northern South America (*c.* 0 to 1000 m. above sea level). In part this is due to the fact that organic remains are better preserved in dry desert or cave environments rather than in lowland tropical areas. However the recent implementation of modern recovery and analytical techniques, for plant remains, has allowed us to improve and amplify our knowledge of human plant interactions during the past.

Tables 4.1 and 4.2 show that archaeological charcoals have been studied and identified only in the Pacific Ecuadorian lowlands, the Brazilian Amazon and French Guiana. Charred wood fragment identifications have not been carried out in archaeological samples from the Colombian lowlands or highlands before this thesis. In Chapter seven identified woody taxa are presented and their archaeological contexts are discussed in Chapter eight. Most of the archaeological plant remains identified from the lowlands consist of palm and tree seeds. Pollen analyses have been carried out in all the tropical American lowlands where archaeology has been practised. Starch grains and phytolith analyses have provided information on the presence of cultivated plants such as squash, leren tuber and maize, despite the level of macroscopic remains of these. There is a lack of local and particular studies on the exploitation of woods for firewood and other purposes.

According to the current archaeobotanical evidence between 7000 and 4500 years BP, the tropical lowlands of America were inhabited by people living in simple hamlets who moved their settlements occasionally and probably practised slash and burn agriculture. They had fully domesticated plants such as maize. Remains of these earlier Holocene settlements have been reported from the Ecuadorian and Panamanian Pacific lowlands, and the Ecuadorian Amazon area, as well as, from the Colombian Amazon region, the site of Peña Roja (see Tables 4.1, 4.2 and 4.3).

Archaeobotanical data from Peña Roja site in the middle Caquetá region showed that about 9000 years BP small-scale horticulture was practised probably in domestic gardens. Plants cultivated include squash, bottle gourd and leren tuber (see Piperno 1999, Herrera and Cavelier 1999). At 4645±40 BP (GrN 14987) in the Araracuara area there were people cultivating maize in plots which caused slight disturbance to the forest. At 1565 BP, 775±25 BP (GrN 16968) and 1150 BP they cleared large areas in the forest, modified soils and cultivated maize, manioc, chilli peppers and sweet potatoes (see Cavelier *et al.* 1990, Mora *et al.* 1991, Herrera *et al.* 1992a,b and Herrera and Cavelier 1999).

It is common to find in the archaeological literature from the studied area an association between ceramic manufacture and the emergence of plant cultivation and/or settled life. Archaeological evidence from the tropical lowlands of lower

Central America and northern South America shows that in Panama and the Colombian Amazon, the emergence of ceramic manufacture occurred several centuries later in comparison with cultivation. On the other hand, it is interesting to note that there is also archaeological evidence from the Caribbean lowlands of Colombia, which shows a settlement seasonally occupied by early foragers who manufactured ceramics (San Jacinto 1 site). Although this hypothesis has been dominant for some time, it is clear from the archaeological evidence emerging at present, that there is no correlation between the type of phenomena mentioned.

According to the available evidence the first plants domesticated in Central and South America were not staples. Arrowroot, quinoa, leren tuber, squash, bottle gourd and several fruit trees are included in the plants present in the earliest pollen and phytolith assemblages from archaeological sites.

Archaeobotanical studies in the middle Caquetá river have mainly focused on charred seed remains and also on pollen analysis. Seed identifications have revealed that palm fruits were important to the ancient inhabitants of the area, particularly the earliest people who lived there at about 9000 years BP. According to the current ethnographic and ethnobotanical evidence from the Amazon region, palm fruits as well as many other parts of palms are still widely used by the indigenous populations (see Chapters seven and eight).

Archaeological data from the middle Caquetá river have led to a revision of several common assumptions found in the anthropological and archaeological literature regarding the lowlands of America. One of these suggested that the establishment of permanent human settlements in the evergreen Amazon forest as early as the beginning of the Holocene period was very improbable. Other assumptions dealt with the presence of well developed agricultural systems in late Holocene times due to several environmental factors such as poor soil conditions. Complex societies were not considered to be present in the Amazon region before the beginning of the Christian era. The Peña Roja and Araracuara sites in the Colombian Amazon region, as well as other sites from Central Panama show that human occupation of these areas occurred and lasted during long periods of time. However there are still many gaps in the archaeological information from this and other areas that allow us to have a complete picture of the history of the ancient human occupation of the region.

5. PEÑA ROJA ARCHAEOLOGICAL SITE

5.1. Geographical information

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The archaeological site of Peña Roja is located on a lower terrace of the Caquetá river, 50 km to the east of Araracuara village (see Figure 4.2). The excavation of the site (trenches nine and ten, Pit 5 and other test pits) was carried out by the archaeologists of the Erigaie Foundation (see Cavelier *et al.* 1995). The author of this thesis was not involved in this excavation.

The terrace upon which Peña Roja sits is not subjected to flooding, as it is 10 to 15 metres above the river and 170 metres above sea level (see Figures 5.1, 5.2 and 5.3). The temperature of the area is between 24 and 28°C and the annual precipitation is 3500 mm. Present day vegetation is classified as tropical rain forest vegetation according to the Holdridge *et al.* (1971) system (see Morcote 1994a: 6, Cavelier *et al.* 1995: 27). The Peña Roja area is, at present, inhabited by the Nonuya people (see Figures 5.4 and 5.5).

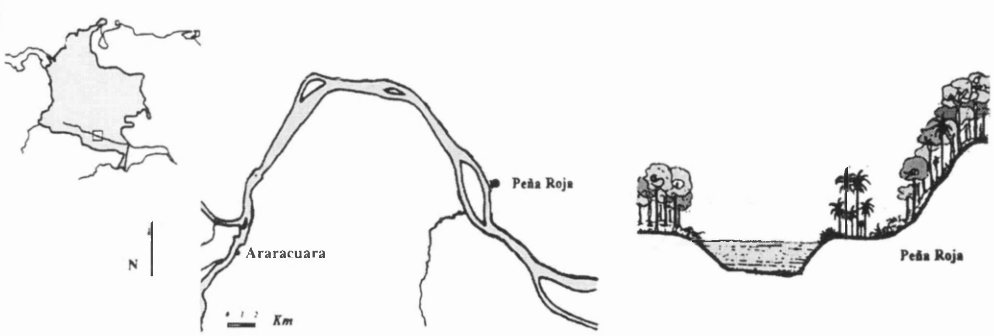


Figure 5.1 Diagram showing the location of the archaeological site of Peña Roja in a lower terrace from the Caquetá river. Adapted from Cavelier *et al.* 1995: 30.

Figure 5.2 Photograph of the archaeological site of Peña Roja (indicated by the arrow). The bank river forest is also shown.

Figure 5.3 Photograph of the archaeological site of Peña Roja. The "terra firme" forest can be appreciated in the foreground.

Figure 5.4 Photograph of the archaeological site of Peña Roja. One of the houses is inhabited by an indigenous family.

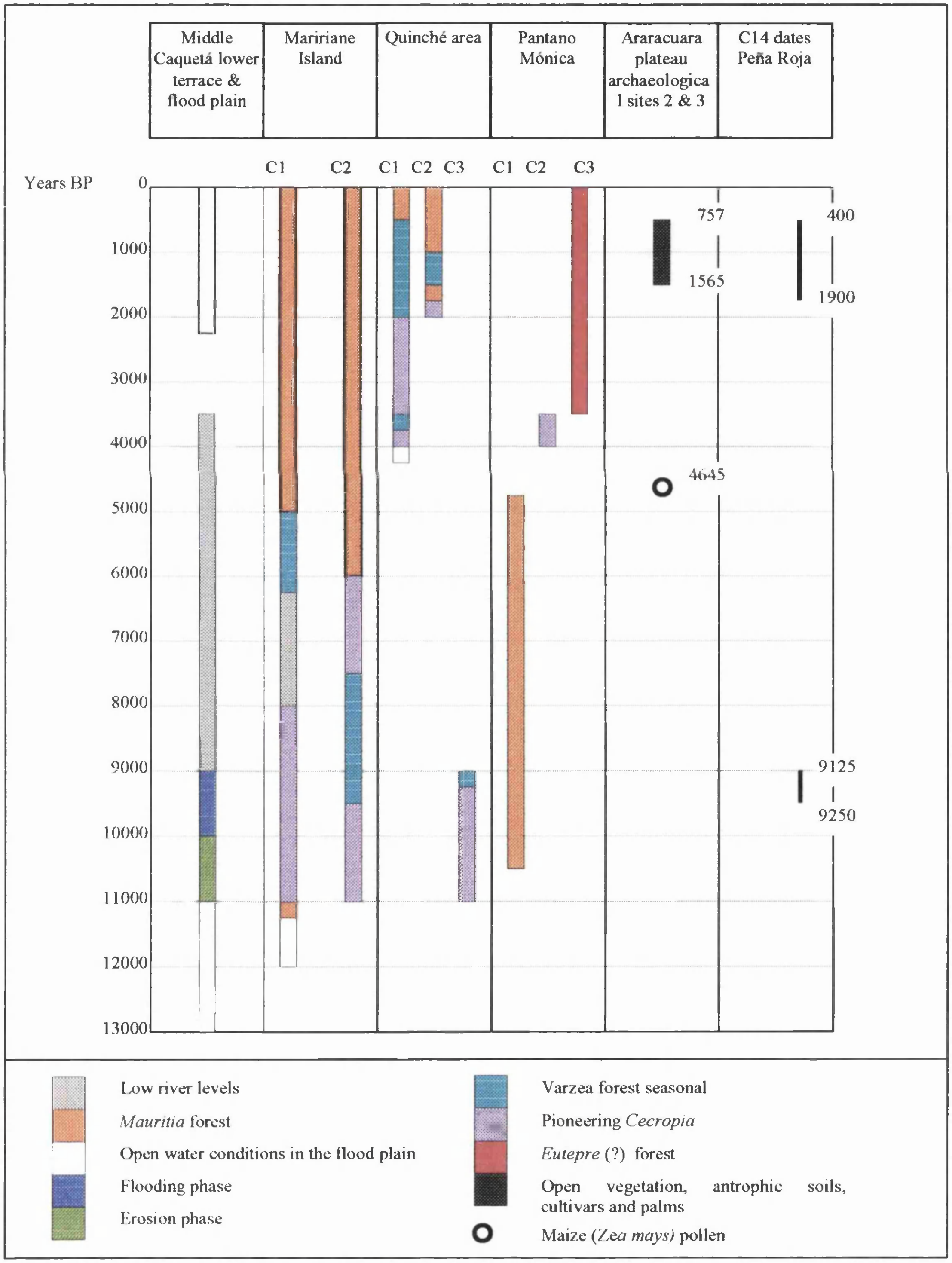
Figure 5.5 Photograph of the archaeological site of Peña Roja. The house of Eladio Moreno is shown.

5.1.1. Palaeoenvironmental information

Several pollen cores have been taken at different places located close to Peña Roja. Reconstruction of late Pleistocene and Holocene vegetation was made in three of these: Mariñame island, the Quinché area and Pantano de Monica. Sediments from 14 other sites were sampled in order to study the alluvial history of the flood plain and low terraces of the Caquetá river during the past 13,000 years. Pollen sequences from some of these sites were also studied (Van der Hammen *et al.* 1991a,b. See Figure 2.10 in this thesis). Mariñame island and Quiché area are located in the flood plain of Caquetá river and are frequently inundated. Their present vegetation consists of *Mauritia* palm forests. The Pantano de Mónica area is located approximately 10 km away from Peña Roja site, in a lower terrace of the Caquetá river and is not inundated.

Although environmental characteristics of the Amazonian tropical rain forest can be very different within a small area, these pollen cores are important in suggesting probable environmental conditions at Peña Roja site during prehistoric times. Soil samples for pollen analysis taken at the Peña Roja site did not contain enough pollen grains to be counted. Therefore it is necessary to use the information from the other pollen sequences studied in the area. Figure 5.6 summarises current palaeoenvironmental information.

Figure 5.6 Summary diagram of the palaeoecological information available from the Middle Caquetá river. Water levels of the river and general conditions suggested by the sediment sequences and the main forest compositions are illustrated. References: Mora *et al.* 1991, Van der Hammen *et al.* 1991a,b, Herrera *et al.* 1992a, Cavelier *et al.* 1995, Urrego, 1997, Behling *et al.* 1999.



According to the analysis of pollen cores taken at the Pantano de Mónica area, between 11,500 and 4750 years BP, the site was covered by *Mauritia* swamp forest. High amounts of other different forest pollen taxa suggest that the forest was closer to the swamp than it is today, and therefore the swamp was smaller. This evidence is used by the authors (Behling *et al.* 1999: 201) to argue that the lower terraces of the Caquetá river in the area were better drained during that period either due to a drier climate or a better drainage system.

Cores number two and three from the Pantano de Mónica swamps illustrate the forest history between 4000 years BP and the present day. According to these sequences the vegetation composition was more similar to that covering the area today. Around 3000 years BP the site experienced forest disturbance as indicated by the presence of the pollen of *Cecropia* which is a coloniser plant. Pollen of *Psychotria* plants which include shrubs and small trees of primary forest indicates the recovery of the area; while pollen of *Protium* and *Caryocar* might be indicators of poor drainage in the lower terraces at that time. Pollen core number three taken in a forested area between the two swamps of cores one and two, reflects the history of the vegetation for the last 3260 years. An increase in the pollen of the palm *Euterpe* can be interpreted as a result of poor drainage conditions but also as the result of strong human impact in the area (Behling *et al.* 1999: 209).

Palm remains found in archaeological sites (pollen and seeds) and present day indigenous settlements (seeds) have been reported for several areas of the Amazon region (see Baleé 1989). In Colombia the consumption of palm fruits and the propagation of palm forests have been studied for the Nukak people (see Cabrera *et al.* 1994, Politis and Rodríguez 1994, Morcote *et al.* 1996, 1998, Politis 1996a,b, 1998). The pattern of palm fruit consumption of Nukak people has been compared with that suggested for early Holocene inhabitants from the archaeological site of the Peña Roja (see Morcote *et al.* 1996, 1998 and later in this Chapter section 5.5.2). Comparative studies between these two patterns are important as sources of hypotheses which explain archaeological findings from

Peña Roja site. Both are hunter-gatherer societies which inhabited the Colombian tropical rain forest. Nukak people live in the Guainia forest area, north of the Caquetá region (see Figure 2.11).

The ceramic occupation of the Peña Roja site has been dated between 1900 and 400 years BP. During this period of time farmers were practising agriculture in the terrace as is indicated by the presence of humanly modified soils ("terra petra" soils). Clearance of the area to cultivate plants could have affected local vegetation composition. It is interesting to note that pollen cores from Pantano de Monica show that there was probable human interference in the area after about 3000 years BP. Pollen cores from other sites in the Araracuara plateau also show human influence on the local vegetation probably due to the practice of agriculture in the area from at least 1500 years BP (see Figure 5.6).

The two pollen sequences reported from Mariñame island, located approximately 15 km south of Peña Roja site, and the three cores taken at the Quiché area some 40 km away from the Peña Roja site show that at about 9000 years BP there was a drier climate in the area, as suggested by the presence of *Cecropia* pioneer forest in one of the sequences. This type of forest includes at least 18 different taxa. Between 6500 and 4500 years BP the area became covered by forest várzea (typically with at least 25 taxa) which was seasonally inundated. After 4500 BP the sites on the island were more influenced by the river dynamics and a *Mauritia* palm swamp forest developed. *Mauritia* forest includes the taxa *Euterpe, Symphonia, Virola, Cynometra, Ceratopteris, Asolla and Spirogyra* (see Urrego 1997 and Figure 5.6 of this thesis).

Mauritia palm seeds were found mainly in the pre-ceramic levels of Peña Roja site (see figure 3 in Morcote *et al.* 1998: 61). People from that period could have been collecting these fruits in the swamps from the interior areas of the lower terraces of the Caquetá river such as those of Pantano de Mónica.

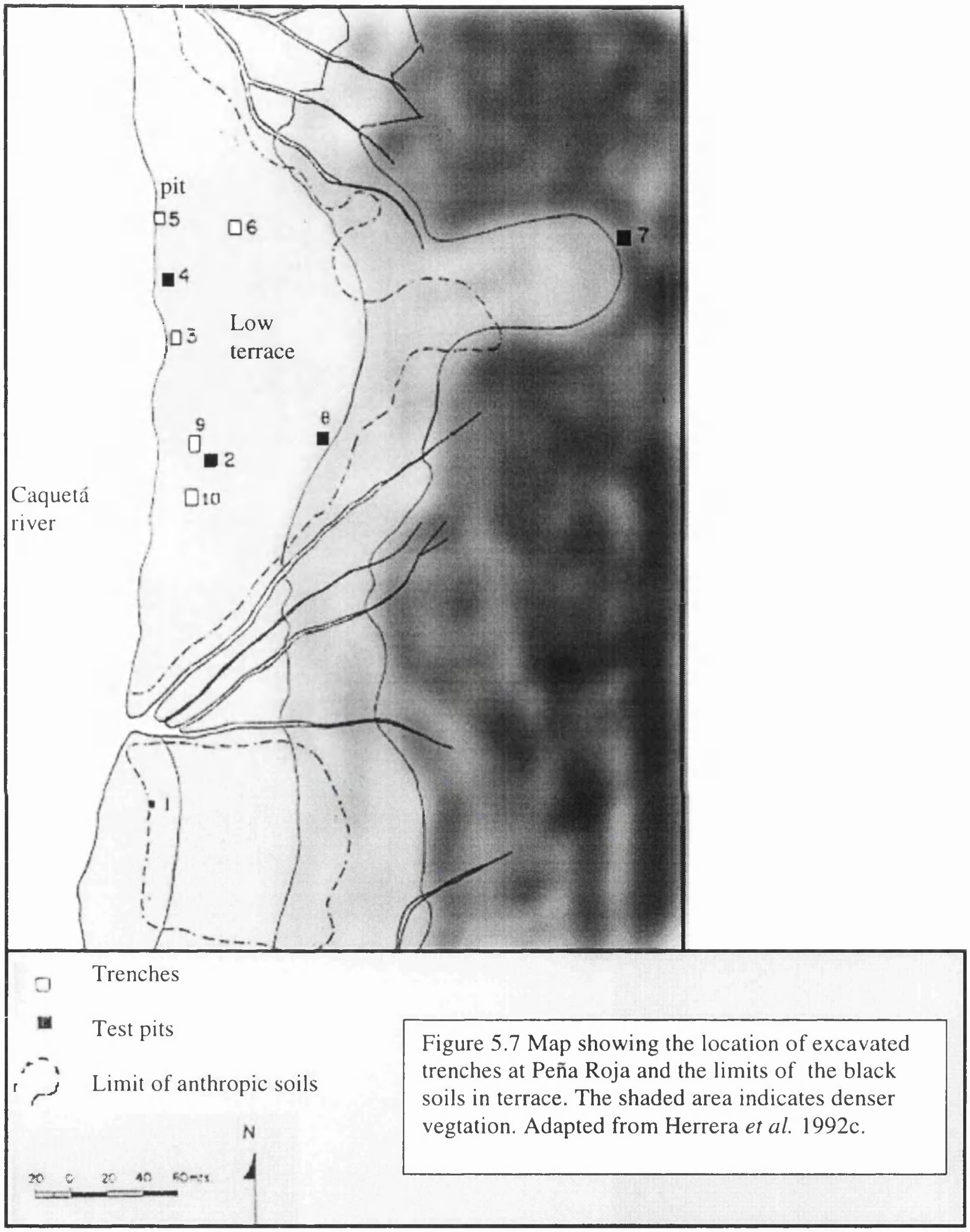


Figure 5.7 Map showing the location of excavated trenches at Peña Roja and the limits of the black soils in terrace. The shaded area indicates denser vegtation. Adapted from Herrera *et al.* 1992c.

To summarise, taking into account the available palaeoenvironmental and chronological information, at the beginning of the Holocene period, when earlier occupation of the Peña Roja archaeological site occurred (about 9000 years BP), it seems that there were well drained areas such as lower terraces which were not subjected to permanent inundation. The well drained lower terraces of the Caquetá river were suitable for the establishment of human camp sites.

Pollen sequences at the Pantano de Mónica area show vegetational disturbance between 4000 and 3080 years BP. At about 4645±40 (GrN 14987) years BP maize pollen is recorded in the pollen sequences of Abeja archaeological site (site 2), in the area of Araracuara village (see Chapter four). Although pollen from the area of Peña Roja has not been sufficient to allow local palaeoenvironmental and vegetation reconstruction, it is important to consider, nevertheless, that cultivation could have been practised in the tropical rain forest of Colombian Amazon since such early times. Probable strong human influence in the lower terraces of the area close to Peña Roja site is postulated for the past 3260 years. This is supported by the presence of palm pollen perhaps from the genus *Euterpe*. This pollen became prominent in the sequences from Pantano de Mónica, and could relate to either human influence or wetter climatic conditions.

5.2. Trenches 9 and 10

Trenches 9 and 10 were excavated by means of horizontal "décapage" technique, following arbitrary levels of about 4 cm depth, but stratigraphy was also taken into account. Location of the trenches is showed in Figure 5.7. In the centre of the terrace an auger survey was carried out in order to define the extent of the site. Sediment samples were taken for phytolith, macro-remains, soil and pollen analyses. Ten of these samples prepared for pollen contained too little material to justify counting (Cavelier *et al.* 1995, Gnecco and Mora 1997: 687).

Trenches 9 and 10 covered an area of 16 m^2. At trench 9, 24 artificial levels each approximately 4 cm thick, were dug, while at trench 10, 36 artificial levels of about the same thickness were dug. Levels 1 to 10 (= strata 2 and 3), correspond to the ceramic occupation of the site. In levels 10 to 13 (= stratum 4), cultural materials from ceramic and pre-ceramic levels were mixed. Pre-ceramic cultural materials were found in the deposit from level 14 downward (= strata 5 to 10) (see Figures 5.8, 5.9, 5.10, 5.11). Some disturbance of these strata was noticed as a result of animal activities and plant root growth. Soil analysis was undertaken for samples from each level. Several samples contained charred macro-remains including charred seeds and wood (Cavelier *et al.* 1995, Gnecco and Mora 1997). The contents of stratum 4 (ceramic and pre-ceramic mixed materials), and the disturbances of strata 5 to 10, suggest that the archaeological deposit was exposed to considerable mixing. This circumstance affects any archaeological interpretation of the cultural materials found in the site as well as the significance of the macro and micro plant remains recovered.

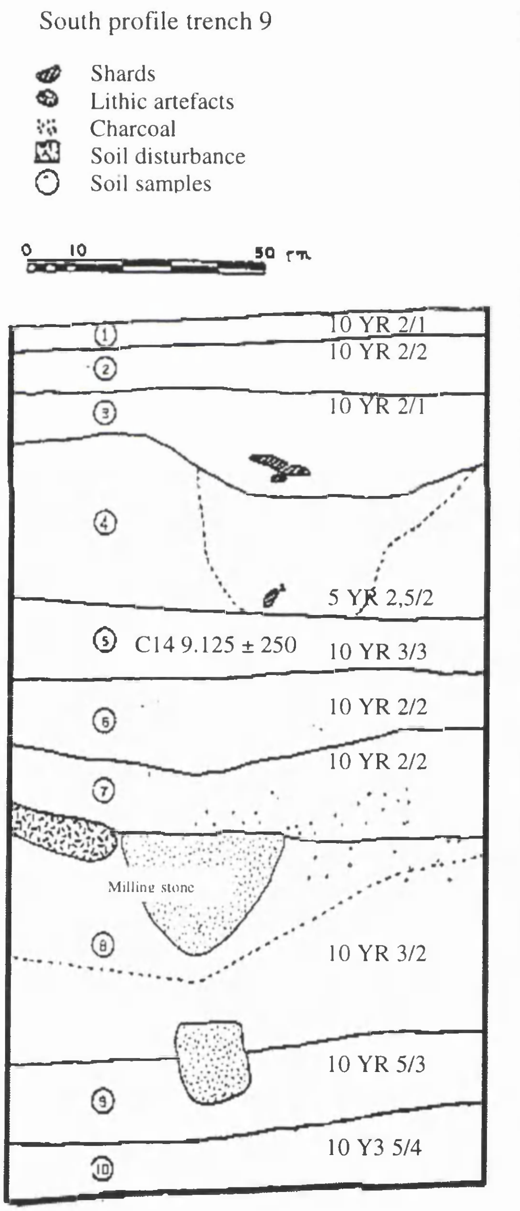


Figure 5.8 South profile of trench 9 at Peña Roja site. After Cavelier *et al.* 1995: 32

The first factor to be affected by the mixing of the deposit is the precision of the radiocarbon dates. In the case of Peña Roja, dates were obtained from the pre-ceramic levels only (strata 5 to 10). Post-depositional disturbance of the cultural materials and charred vegetal remains could have occurred. Disturbance might be caused by the activity of burrowing

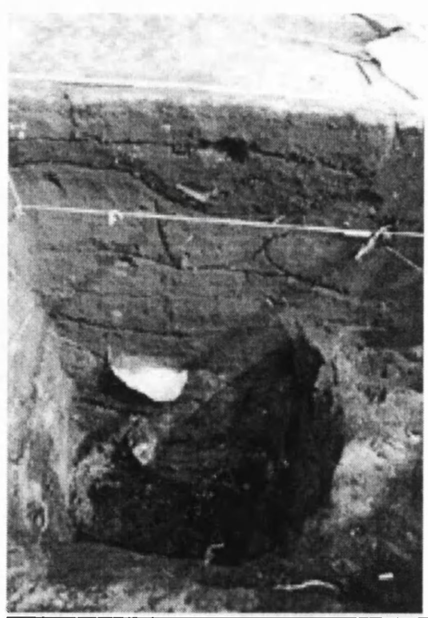


Figure 5.9 Photograph of one of the profiles of the excavation showing different strata

fauna that can remove or disperse charcoal and other vegetal remains into the deposit. A second problem affects the "continuity" of the deposit. The excavators (Cavelier *et al.* 1995) suggested that the concentration of the cultural remains through the strata and soil analysis indicate that the pre-ceramic occupation of the site was dense and continuous for at least 500 years. It is not clear from the published data if the radiocarbon dates from the pre-ceramic levels (9125±25, 9160±90 and 9250±140 BP) date a single event of occupation or a series of different events on the terrace. At present it is not possible to distinguish between continuous (year-round) occupation and repeated seasonal occupation of the terrace taking into account the available archaeological information.

The concept of continuity of occupation has to be evaluated according to numerous aspects that may affect site formation processes, the time span of the occupation and the taphonomy of the archaeological deposits in tropical areas. Soils from the tropical rain forests are exposed to the activity of a great variety of fauna and flora and also to physical factors such as percolation. These factors may alter soil morphology and composition. The extent to which an archaeological deposit has been affected by bioturbation processes is difficult to investigate. Recently, Grave and Kealhofer (1999) developed a methodology to study the role of bioturbation in interpreting palaeolandscapes in Thailand. This methodology combines soil morphology and phytolith analysis to measure the extent of vertical movement in a sediment column taken from the infill of a ditch. The analysis of soil morphology showed that there was intense insect activity and percolation at a scale that ranged from 200 μm to 500 μm. On the other hand, phytolith analysis showed that there was no significant alteration or mixing at a scale of 5 to 50 μm. When the results of these two scales of analysis are seen together it is clear that insect activity is highly localized and that it does not affect the general sequence of microbotanical remains. Therefore when the two techniques are used together it is possible to determine the scale at which the stratigraphy of an archaeological deposit is coherent (Grave and Kealhofer 1999: 1246).

In this chapter the data obtained at Peña Roja by Cavelier *et al.* (1995) is summarized. The assumption underlying these data is that the deposit represents two different prehistoric human occupations. However there are no data on the assessment of site formation process nor on its taphonomy. The current available information is not enough to allow an evaluation of these aspects. The study made in Thailand by Grave and Kealhofer (1999) is an example of how soil morphology and phytolith analysis can help in the assessment and sampling strategies in archaeological sites from the tropics.

5.2.1. Pre - ceramic occupation

An area of 350 square metres was defined as being the extent of the hunter-gatherer campsite in the central section of the terrace. The excavators do not think that the excavated area corresponds to a particular house floor but instead suggest that this area corresponds to a less defined human activity area relating to a campsite. (Cavelier *et al.* 1995, Gnecco and Mora 1997: 687, Herrera and Cavelier 1999).

Figure 5.10 Photograph of the terrace before the excavation of trench 9.

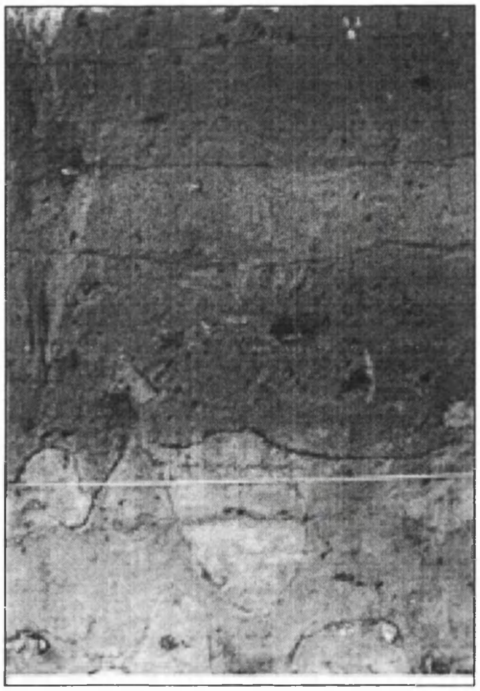


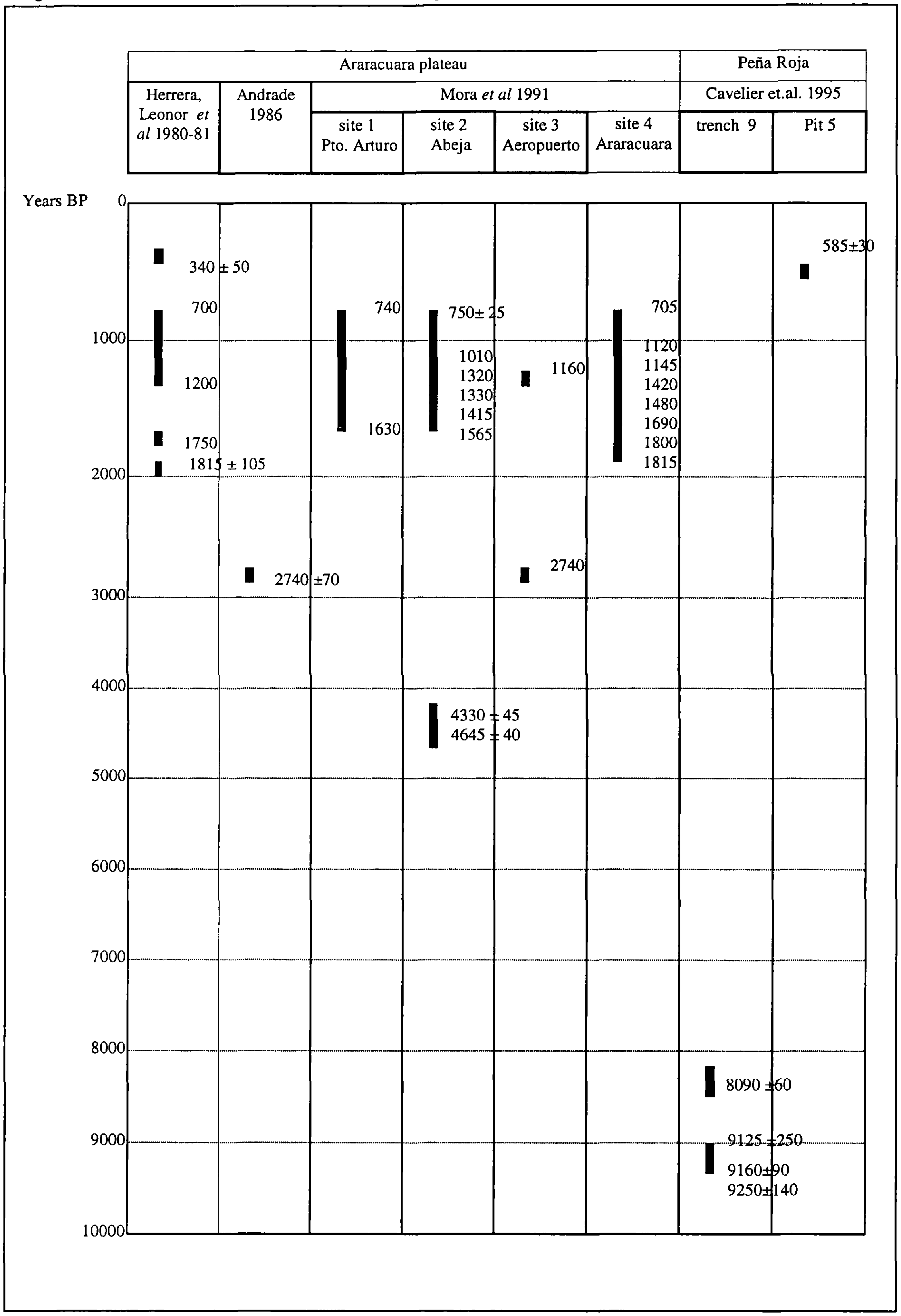
Figure 5.11 Photograph showing one of the profiles of the excavation at trench 10, Peña Roja.

A high amount of organic matter is reported for both the pre-ceramic and ceramic horizons, though this is lower for the transitional levels. Different activities carried out by people from the two occupations of the site were also noticeable in the different colours of the ceramic and pre-ceramic strata. The first are darker than the second and correspond to humanly modified soils (Cavelier *et al.* 1995: 42).

Soil analysis indicates that the pre-ceramic occupation was dense and continuous during the period of time that has been dated; that is, during at least 500 years. If only the evidence from the palm seeds is considered one could think that the site was occupied seasonally during the periods of fruit gathering. However 32% of the charred seeds recovered from trench 9 have yet to be analysed. On the other hand, roots and tubers might consumed although their remains have not been reported at present in the area (Cavelier *et al.* 1995: 43).

Pre-ceramic levels correspond to the most ancient human groups for this part of tropical rain forest registered in Colombia. These were dated between 9125±250 and 9250±140 years BP (9125 ± 250, GX-17395; 9160 ± 90, Beta-52963; 9250 ± 140, Beta-52964). Figure 5.12 shows the radiocarbon dates at present known to the archaeological sites of the middle Caquetá river.

Figure 5.12. Radiocarbon dates for the archaeological sites from the middle Caquetá region.



5.2.1.1. Cultural materials recovered

Pre-ceramic occupation of the site is represented by unifacial tools and there is evidence of human exploitation of vegetal resources from the forest, as indicated by grinding tools used for processing food resources (Gnecco and Mora 1997).

Analysis of the lithic artefacts recovered at the Peña Roja site includes the identification of raw materials and the manufacture techniques (Cavelier *et al.* 1995). Aspects such as size, used edges, retouched surfaces and weight of artefacts were studied. Raw material included chert and siliceous stones, clastic sedimentary, metamorphic and igneous rocks. All these materials may be found in the middle Caquetá geological formations. The concentration of lithic artefacts in the excavation was evident from 14 level downward. At level 22 a concentration of the lithic material represented 15% of the total material from the whole site. Artefacts were manufactured from small chert cobbles by means of simple percusion technique. Concave sharp flakes were the commonest type of artefact found at the site. Use wear along an acute edge was noticed in many of these artefacts. Concave scrapers, perforators, wide base wedges, flakes with notches (Figure 5.13), a fractured milling stone (Figure 5.14), grinding stones and flat mortars (Figure 5.15) were some of the artefacts described. Gnecco and Mora, following previous studies on functions of lithic artefacts (Ranere 1980b, Flannery 1986d, Alonso and Mansur 1990 quoted by Gnecco and Mora 1997: 688), suggest that the unretouched flakes and perforators from Peña Roja, could have been used for processing game and fish meat; wood could have been worked with the concave scrapers, notches and wedges found at the site. Nuts could have been processed by using the fractured milling stone, flat mortars and grinding stones which are also reported from the site (Gnecco and Mora 1997: 688). Two adzesm, probably hafted (Figure 5.16), were made of igneous stone and could have been used to dig up tubers (Cavelier *et al.* 1995: 33).

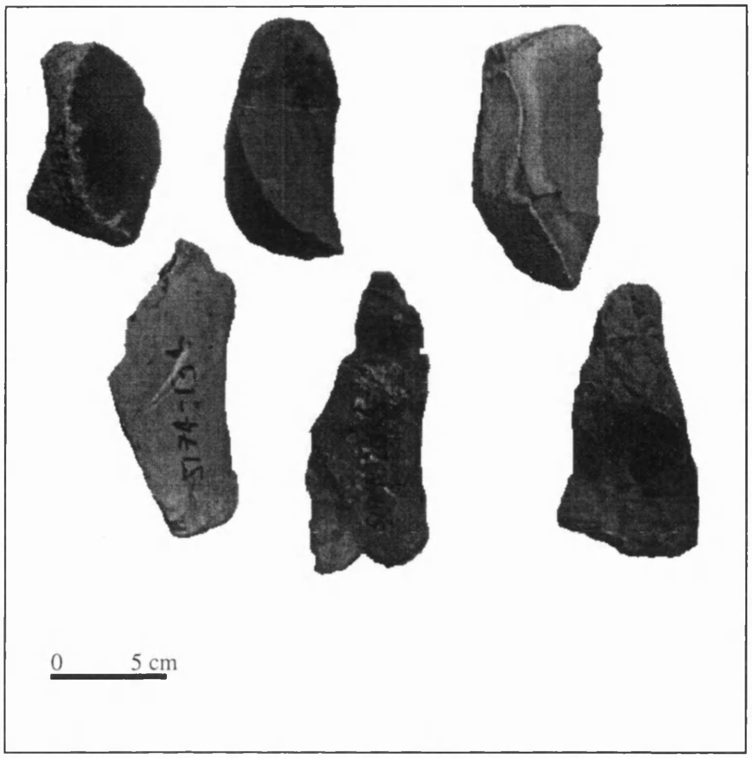


Figure 5.13 Photograph showing flakes from Pre-ceramic levels of Peña Roja.

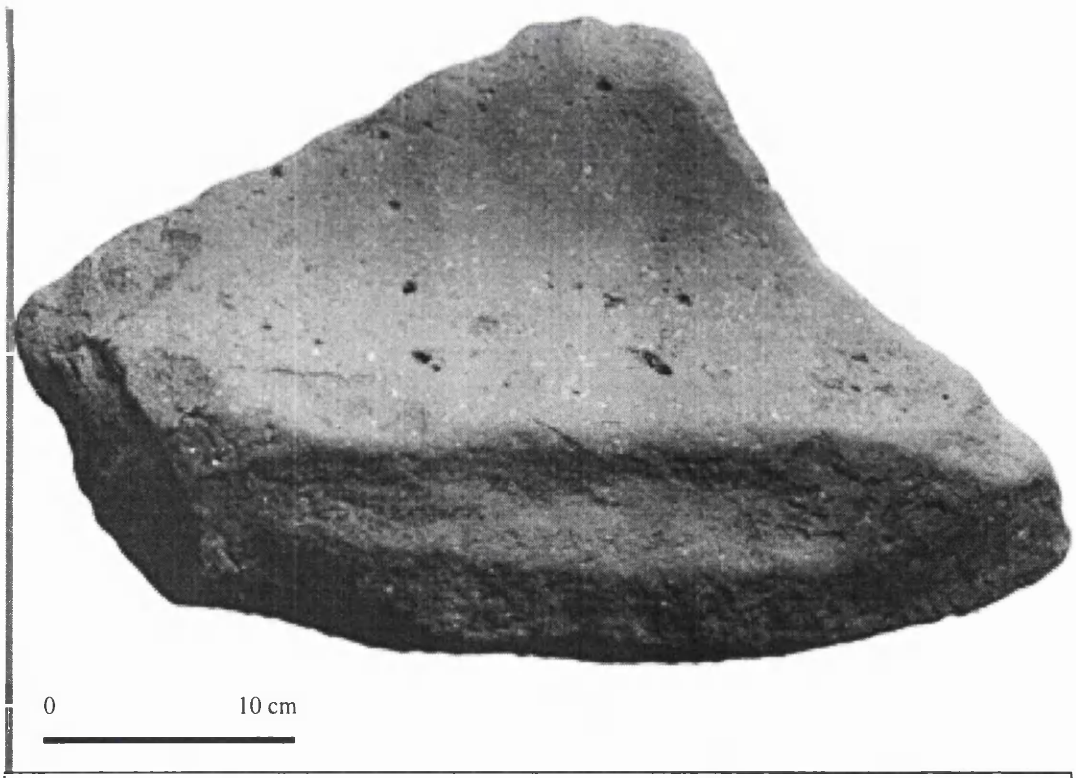


Figure 5.14 Photograph of a fragment of a milling stone from Peña Roja.

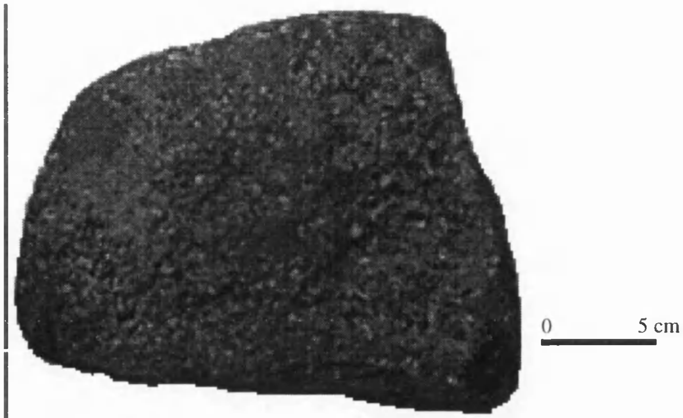


Figure 5.15 Photograph of a flat mortar from trench 9 at Peña Roja.

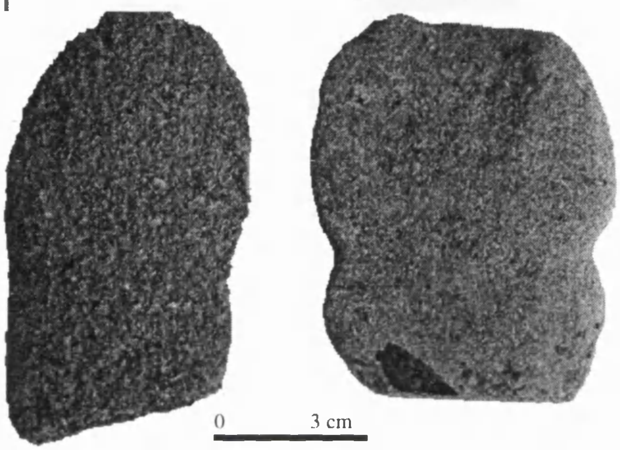


Figure 5.16 Photograph of adzes which were probably hafted, trench 9, Peña Roja.

Microwear analysis was carried out on 17 artefacts collected at trench 10 from the Peña Roja site. This seems to be a potential field of study for further research in the area. From the 17 artefacts analysed, six were used, nine probably used, three do not have traces and for two it is impossible to tell. Among the used artefacts three knives were used to cut soft material. From the four artefacts classified as wedges, two seem to have been used for wedging soft wood. One perforator was probably used to scrape hide. Three points were possibly used and hafted. There were no traces of use on an adze (Nieuwenhuis 1999).

5.2.2. Ceramic occupation

The strata two and three (0 to 22 cm in depth) from trenches nine and 10 contained the ceramic occupation of the site. In these first three strata a structure is present although it is absent in the rest of the strata from the site. This is taken as evidence for agricultural activities. In addition, phosphorus values are high in comparison to the Amazon soils. Their values are greater than 350 ppm and three events of intensive occupation can be detected when these values are considered

(Cavelier *et al.* 1995: 42). Humanly modified soils were observed at the terrace (see Figure 5.7). The ceramic levels correspond to the period of time between 1900 and 400 years BP according to the excavators who correlate this late occupation of Peña Roja with other dated archaeological sites from the middle Caquetá (see Cavelier *et al.* 1995: 29, Gnecco and Mora 1997, Herrera and Cavelier 1999).

5.2.2.1. Cultural materials recovered

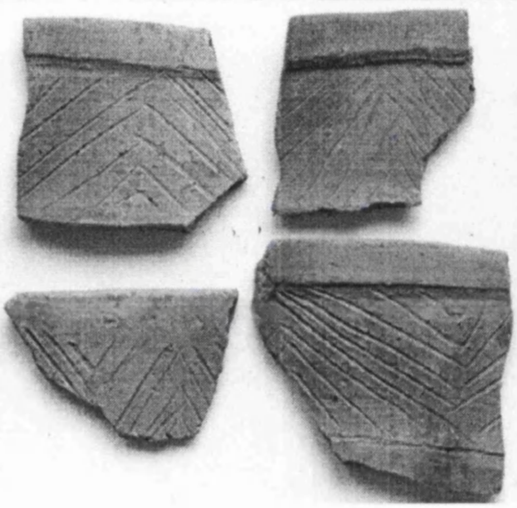


Figure 5.17 Photograph of pottery shards from archaeological sites of the Caquetá region.

Figure 5.18 Photograph of a fragment of pottery from Peña Roja.

Figures 5.17 and 5.18 illustrate some ceramic fragments from the middle Caquetá area. Detailed analysis of the ceramic remains found at trenches 9 and 10 from Peña Roja is still being carried out. To date, it appears that this material belong to the same groups of pottery characteristic of the Araracuara area (Inés Cavelier 1998 personal communication).

Ceramics from the lowlands of South America have been considered as very important elements in the discussion of several aspects of the cultural evolution of the prehistoric societies from the area. Discussion has been based on technological aspects, regional sequences and on the chronological data associated with the materials found at several sites from the northern Caribbean lowlands of Colombia and the Pacific coast of Ecuador (e.g. Meggers *et al.* 1965, Reichel-Dolmatoff 1986b, Oyuela-Caycedo 1993, 1995). Particularly in the Amazon lowlands early ceramic complexes have been defined based on the pottery found at archaeological sites in the Amazon river mouths as well as in the Marajó island (see Meggers, 1957a, 1987, Roosevelt, 1980, 1991, 1995).

Donald Lathrap (1970) attributed the "Tropical Forest Culture" to people living in the lowlands of South America at least since 5000 years BP. These groups were farmers who based their subsistence system on the cultivation of tubers, mainly manioc. Lathrap suggested that this way of life could have emerged in the northern lowlands of South America or in the flood plains of the Amazon region. Certain types of ceramic objects, particularly, the plates for baking manioc bread or large ceramic griddles ("budares"), have been used to suggest the practice of tuber agriculture in the lowlands of South America, and the presence of the tropical forest culture. This assumption is based on the ethnographic evidence of the present day use of "budares" within the indigenous groups from the Amazon lowlands.

The assumption that "budare" presence implies manioc cultivation, particularly cultivation of the bitter variety of manioc, does not take into account the many other plant species that people were utilising and possibly domesticating since very early times in the lowlands of South America (Herrera *et al.* 1989).

The history of ceramic manufacture development in the Amazon region has been studied from the perspective of a broad geographical context which implies the consideration of similar and contemporaneous technological developments in either the western cordilleras (e.g. Meggers 1954, 1957b, 1972, 1987, Evans and Meggers 1968, Meggers and Dannon 1988 quoted by Herrera *et al.* 1989: 187), or the eastern coastal areas (e.g. Roosevelt 1980). Meggers hypothesised that early ceramic-manufacturing people from the Amazon region had migrated from the western cordilleras area (Meggers 1987, Meggers and Dannon 1988 quoted by Herrera *et al.* 1989: 187). On the other hand recent archaeological investigations carried out by Roosevelt in the estuarine areas of the Amazon river in Brazil have showed that prehistoric inhabitants of the area were manufacturing pottery at least since 7000 years BP (Roosevelt 1995: 115). Radiocarbon dates associated with early pottery manufacture have been obtained from other archaeological contexts in eastern Ecuador at the site of Huasaga where dates of 4000 ± 75 and 4155 ± 90 BP are associated with the Pastaza A phase. However these dates should be carefully considered since the contexts where the dated materials came from were themselves problematic (Porras 1975, 1987 quoted by Herrera *et al.* 1989: 189).

In the Colombian Amazon region archaeological investigations have showed that in the Araracuara area societies who manufactured ceramics and practised agriculture had lived in the region since at least 4700 years BP (see Herrera *et al.* 1989, Cavelier *et al.* 1990, Mora *et al.* 1991, Herrera *et al.* 1992a). The archaeological study of Herrera, Bray and McEwan (1980-81) in the Araracuara region defined two occupations for the area based on the pottery classification and stratigraphy of the studied sites. The first occupation, called Camani, included a ceramic assemblage composed mainly of undecorated small vessels. The second occupation, called Nofurei, was characterised by a ceramic assemblage which included a major diversity of vessels which were profusely decorated by means of incised lines and white and red paint. The first group was related to the Japura site from the Brazilian Caquetá area and the second one to the Polychrome Tradition from the Amazon basin (see also Herrera 1981).

Camani pottery has been radiocarbon dated to AD 200. This ceramic style was replaced by the Nofurei style at about AD 700. The terminal date for the Nofurei style in the area is AD 1200. The two styles of ceramic could have belonged to two different groups of people (Herrera 1981). Both groups of pottery include "budares". Vegetal material was used as temper to make Nofurei ceramic. Indigenous people from the area still use this temper for manufacturing pottery (see later this chapter section 5.4.2). Nofurei vessels include globular vessels, bowls, fire-dogs or supports for "budares" while they are exposed to fire (Herrera 1981). The temper is locally called "cariapé" and consists of burned bark from

Curatella americana, Curatella sp. (Dilleniaceae), *Simmondsia chinensis* or *Euperua purpurea* (Mora *et al.* 1991: 69). The bark is burnt and crushed and then mixed up with the clay. Charcoal was also added as temper to this group of pottery (see discussion of this interpretation in sub-section 3.3.1 of this thesis).

The reference of the use of charcoal as temper is important here since it demonstrates a further use of wood in prehistoric times. However the charcoal particles observed by Herrera *et al.* (1980-1981, Herrera 1981), within the paste of shards from the Araracuara area, could have resulted from the burning of bark. This is a particular aspect of pottery manufacture that should be studied in detail in future research.

Angela Andrade (1986) described the pottery found at other archaeological sites from the Araracuara plateau as belonging to the same styles defined by Herrera and collaborators (1981-81). Andrade published a date for the Camani style of 2740 ± 70 years BP. Recent archaeological research carried out in the area showed that Nofurei style pottery was also used in the Araracuara area since 1900 BP (AD 50) but it was more common after 1150 BP. Differences in the frequencies of the two groups of pottery throughout time perhaps show development of more complex societies rather than the arrival into the area of different cultural groups (Herrera *et al.* 1988, Herrera *et al.* 1989, Cavelier *et al.* 1990, Mora *et al.* 1991, Herrera *et al.* 1992a).

A different group of pottery, Tubaboniba, found at archaeological sites in Araracuara plateau has been studied by Herrera *et al.* (1989). Radiocarbon dates covering the period of time between 4645 ± 40 (GrN 14987) and 4330 ± 45 (GrN 15733) years BP were obtained from organic materials associated with the ceramic assemblage. Vessel shapes associated with these dates were "budares", massive bases for "budares", semi-globular pots and pots with reinforced ribs. Charred bark was also used as temper in the manufacture of this pottery, but it was finer and more burnt than during later periods. Tree leaves were used as bases for "budares" whilst these were made (see later in this Chapter section 5.4.2 for details on ceramic manufacture technology). Another group of pottery studied by Herrera *et al.* belonged to the Camani-Nofurei style of pottery. This was the assemblage contained in Pit 5 at Peña Roja archaeological site and it will be described in the next section.

Taking into account the location of the different sites from where the analysed pottery samples came Herrera *et al.* (1989) suggest the probable catchment areas for raw materials used in pottery manufacture. Tubaboniba pottery is located on the Araracuara plateau and all the required resources for manufacturing pottery can be gatherered within a radius of 7 km. At Peña Roja, the cachtment area for resources for making Camani-Nofurei pottery covered 40 km along the Caquetá river (Herrera *et al.* 1989: 208).

Excavations at archaeological sites in the Araracuara plateau (such as Puerto Arturo, Abeja, Aeropuerto and Araracuara), allowed archaeologists to define two periods of occupation of the area. The earliest one was called Tubaboniba and the latest Meidote. The Tubaboniba period has been radiocarbon dated between 4645±40 (GrN 14987) and 4330±45 (GrN 15733) years BP at the site of Abeja, and corresponds to early farmers who were growing maize (*Zea mays*). The Meidote period was dated to between 1815 and 705 years BP and corresponds to farmers who produced a brown humanly modified soil covering approximately 6 ha at Abeja site. The pottery from the Meidote period includes several different vessel shapes for preparing, storing and cooking food, such as open bowls, ollas, and fire-dogs. Some of these vessels were decorated with appliqué or red paint. A very fine and charred temper is present in the paste of this pottery. Tempers were analysed macroscopically and included "caraipe" or burned bark mixed with ash, iron oxides and sometimes quartz (Mora *et al.* 1991).

5.3. Pit 5

Pit 5 is located in the same lower terrace of the Caquetá river where trenches 9 and 10 were excavated. It is approximately 120 m away from trenches 9 and 10, and consisted of a bell-shaped deposit containing mainly shards and charred plant macro-remains including wood fragments (see Figure 5.20). Some shards were found upright at the deposits while others were close to the borders of the deposit. Pit 5 was first observed on the bank of the river (Figure 5.19). During its excavation it was evident that the deposit was filled with organic matter and other refuse such as shards. Soil inside pit 5 was black in colour possibly because of high organic content (Figure 5.20).

A radiocarbon date, obtained from the analysis of organic material contained within the pit was 1365 ± 30 years AD (= 585±30 years BP GrN 14993). In the surrounding area of Araracuara village more than six deposits similar in both shape and content to Pit 5, were reported. Two of them were radiocarbon dated: 135 ± 105 AD (=1815±105 BP) which was located in the alluvial terrace of Araracuara and the other one was dated to 1610 ± 50 AD (=340±50 BP) and was located at the same alluvial terrace but in the opposite side of the river (Herrera *et al.* 1980-1981).

Figure 5.19 Photograph showing the profile of Pit 5 in the bank of the Caquetá river.

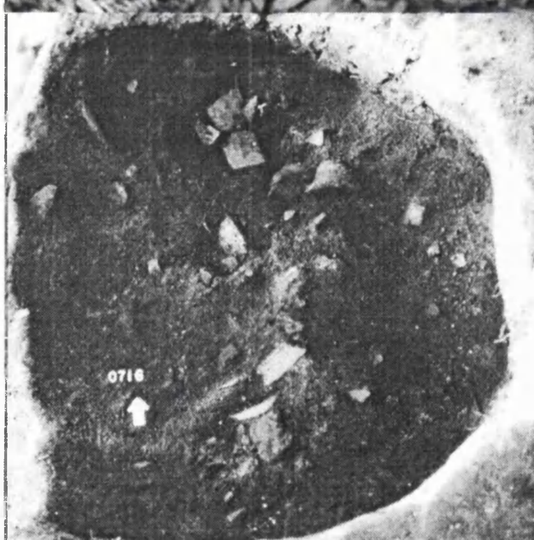


Figure 5.20 Photograph of Pit 5 excavation.

5.3.1. Cultural remains recovered

Pit 5 contained the raw materials and tools used for the manufacture of pottery along with fragments from 20 different vessels. Abundant charred wood fragments and ashes from a hearth made possibly to fire pottery vessels were deposited in a single event into the Pit 5. All this material was contained in a black soil matrix. Similar deposits have been reported in other places of the middle Caquetá area (Herrera *et al.* 1989:203).

A small excavation covering an area of 4 square metres was dug in order to investigate the deposit. Shards were found in an upright position and their distribution was following the shape of the deposit. Some of the ceramic fragments found in the bottom joined to some of the fragments found at the top of the deposit. They were not eroded. It is very probably that a camp site or house was close to the site of pit 5. However, no living floors were detected when trenches 9 and 10 and Pit 5 were excavated.

From the 20 vessels deposited in the pit, five were selected for petrographic and chemical analyses: a big griddle plate for making cassava (manioc bread), a pot with modelled decoration on the rib and red paint, a pot used for cooking, a bigger pot used also for cooking, and a fragment of a decorated pot with incised and white and red paint. Analysis of the clays used to manufacture the vessels was carried out by using X-Ray Diffraction (see figure 2 in Herrera *et al.* 1989: 200).

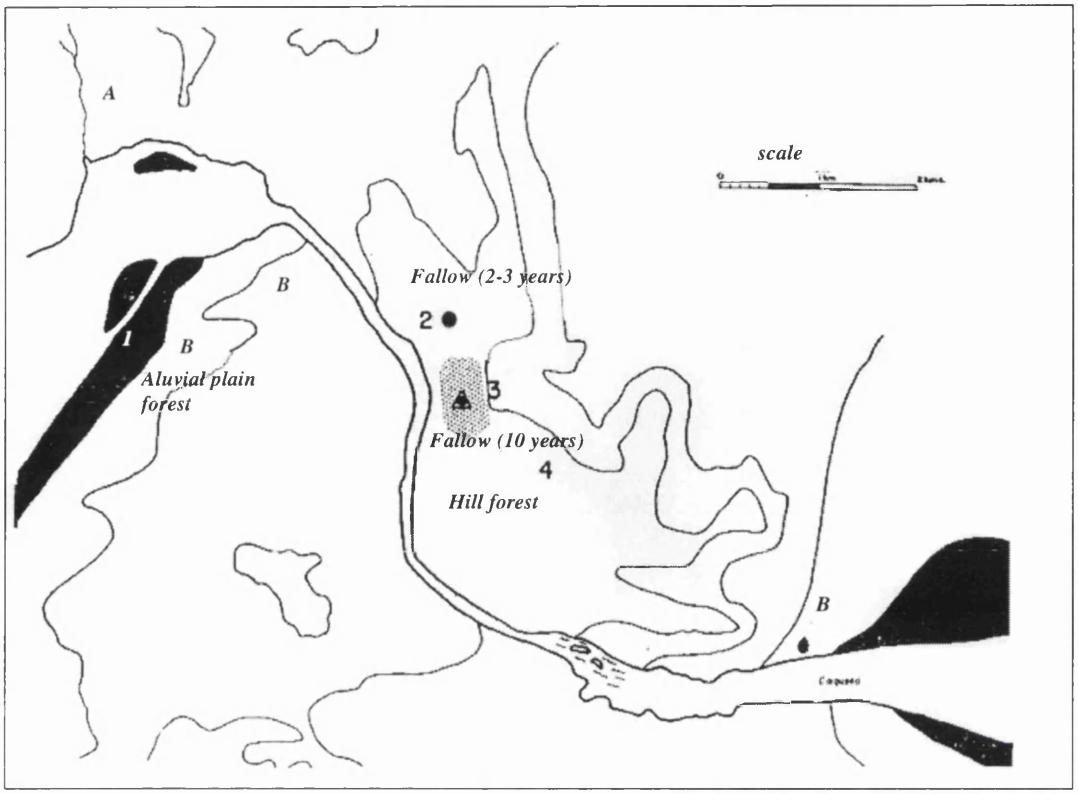
Vegetal fibres were used as temper in the manufacture of the vessels found in pit 5. Those vessels which were made to be continuously exposed to fire such as plates for baking cassava or manioc bread contained more vegetal fibres than others. In these plates two sizes of vegetal fibres were used: in the bases of plates the fibres used were bigger than those used in the interior surfaces of the plates. X-Ray Diffraction analysis of the ceramic samples from Pit 5 has shown that in all cases except in the "budare" plate, the clays used were kaolinite. The "budare" plate was made from montmorillonitic clay (Herrera *et al.* 1989: 203-204).

5.3.2. Ethnographic information on pottery manufacture

An ethnographic study on ceramic manufacture was carried out within Muinane people who live in Monochoa locality (close to Araracuara village), and in Villa Azul locality, sharing in the latter place their territory with Nonuya people. The study was carried out by Herrera *et al.* (1989) and the author of this thesis was not involved in this. One of the aims of this study was the collection of valuable information on pottery manufacture techniques in order to compare it with the archaeological data. Today ceramic manufacture is a rare activity carried out by a few of the Muinane women living in the Araracuara region. The study was made with the help of an indigenous woman, Clemencia Fiagama, who had learnt the knowledge of making pottery from her mother. A place close to the archaeological site called Abeja, on the structural plateau of Araracuara, was chosen to observe the manufacture of seven different vessels (Herrera *et al.* 1989: 190). Specially interesting and relevant to this research was the role played by organic tempering materials in this ethnographic ceramic manufacture.

The location where the ceramics were elaborated, by the time of the study, 1989, had been fallow for ten years. This was taken as the epicentre to register catchment areas for raw materials (see Figure 5.21). Clay sources are located in the mouths of stream. Cultural restrictions establish that not all people have access to the clay sources. An old woman is preferred to collect the clay. Clay collection was made during the summer season when the water levels of the stream are low and therefore clay sources are easily reached. Clay sources are scarce in the area, and in the case of the Monochoa area there is only one clay deposit known. It has restricted access. After collection of clay, it is stored dry for the rest of the year (Herrera *et al.* 1989: 192).

Three different vegetal products are used in the manufacture of pottery: bark, liana and latex. A liana fragment, of an unidentified taxon, of approximately 2 m long was macerated by beating it with a stick, then it was softened in water for two hours. After this it was removed and a viscous liquid is allowed to flow out. Latex



PLANTS
1 temper (bark)
2 Liana
3 *Heliconia biahi* (leaves)
3 Bark from different trees e.g. *Licania* sp.
3 *Heliconia* sp
4 *Couma macrocarpa* (latex)
4 *Lepidocarium gracile*
4 *Fusaea* sp. (bark)
4 Firewood

MINERALS

A Clay sources
B Chert pebbles to polish

Figure 5.21 Map showing catchment areas for resources used at present to manufacture pottery in the Araracuara region.

is extracted from the stem of "juansoco" tree (Couma macrocarpa Apocynaceae family), which is found in the secondary forest that covering the hills. To collect the latex several incisions are made on the bark and a leaf of the palm Lepidocaryum gracile is inserted into the bark to conduct the latex into a receptacle. This latex is added to the clay. Bark from two different trees is fragmented and burnt to obtain ash which, after being sieved, is added to the clay. Trees from the Chrysobalanaceae family are used, notably the genus Licania, with the species L. cf. octandra being one of the options. These trees are found in the forests covering the alluvial plain of the Caquetá river, both in lower and high terraces as well as in areas of the tertiary sedimentary planes (Herrera *et al.* 1989:194-195. See Figure 5.21 of this thesis).

Clay preparation is made in an area which is previously swept. In this place, leaves from "platanillo" (*Heliconia biahi.* Heliconiaceae family) are put below the base of the vessel. The vessel is shaped by using the coiled technique and then covered with more leaves of *Heliconia biahi* (Heliconiaceae). Once the clay is dry the vessel is smoothed and polished with pebbles. Time required to dry the vessel depends on its size and on the proximity to the hearth of the house. If the vessel to be manufactured is a manioc baking plate, fragments of bark from Fusaea sp. tree (Annonaceae family) are required to form a ring over the plate during the drying process to avoid distortion (Herrera *et al.* 1989: 196).

The firing of vessels is as follows: three trunks are put in the soil to support the vessel. Small kindling from porous and light wood and fragments of termite nests is put in the centre of the area formed by the points of the trunks. These materials produce a slow combustion without flame to smoke the vessel. The smoking process lasts for 15-20 minutes. After this, the vessel is covered and filled with kindling and termite nests, and twigs of porous wood are put in the base of the hearth. Then a flame is induced and this step lasts for 15 to 30 minutes. Vessels became red and then pale brown. The vessel is then put on to a "cold" leaf moving it with the help of long trunks (Herrera *et al.* 1989: 196-198).

In Chapter seven the identified wood species from pit 5 will be compared with the plants used during the process of ceramic manufacture by Muinane people as well as by other indigenous groups from the Amazon region.

5.4. Plant macro-remains

5.4.1. Recovery techniques

Four different macro-remains recovery techniques were used at the site:

1. Manual collection during excavation of both pre-ceramic and ceramic levels at trenches 9 and 10.
2. Water screening applied to sediments (5 litres per level of excavation) from trench 9 collected during excavation of both pre-ceramic and ceramic levels.
3. Water screening adding sodium silicate to break down the soil (5 litres per level of excavation) from Pit 5 context. Sediments were sieved through meshes of 2, 1 and 0.5 mm.
4. Flotation applied to sediments (5 litres per level of excavation) from trench 10 collected during excavation of both pre-ceramic and ceramic levels.

5.4.2. Charred seed remains

Seeds were sorted in the laboratory according to their preservation state in order to establish probable use and processing as well as any indication of alteration after deposition. Three groups were established: whole seeds, semi-whole seeds (i.e. when these were 50% of their whole size or greater), and fragmented seeds (i.e. when their size was less than 50% of their whole size) (Cavelier *et al.* 1995: 34).

Taxa represented by seeds included palms and other fruits. The total number of recovered seeds was 26,708 from which 16,024 belong to eleven palm species and four genera of the Arecaceae family; 9080 to several species of wild fruits; 1604 were unidentified. Wild fruits included *Anaueria brasilensis*, *Beilschmiedia brasilensis* (Lauraceae family), *Parkia multijuga* and *Inga* sp. (Leguminosae family), *Passiflora quadrangularis* (Passifloraceae family), *Caryocar* cf. *glabrum* (Caryocaraceae family), *Macoubea guianensis* (Apocynaceae family) and

Vantanea cf. *peruviana*, *Humiriastrum* sp., *Sacoglottis* sp. (Humiriaceae family) (Mocote *et al.* 1998: 60, Herrera and Cavelier 1999. See Table 4.2 of this thesis).

Miraña people ate the fruits of *Anaueria brasilensis* after grating and squeezing them. Tree trunks from this plant are used for manufacturing canoes. They also eat fruits of *Parkia multijuga*. Mauricio Sánchez Sáenz (1997) reports 54 different species from the genus *Inga* for the Middle Caquetá region. Fruits of the following *Inga* species are eaten by several of the indigenous groups from the Colombian Amazon: *I. brachystachya*, *I. ciliata*, *I. edulis*, *I. faleistipula*, *I. macropylla*, *I. nobilis*, *I. pruriens*, *I. punctata*, *I. ruziana*, *I. strigillosa*, *I. tessmanii* and *I. thilaidiana*. Andoque and Miraña people eat cooked seeds from *Inga edulis* and their roots are used for medicinal purposes by Huitoto people. Trunks from *Inga ciliata* are used to build houses by Huitoto people (Sánchez Sáenz 1997).

Fruits from *Passiflora quadrangularis* are eaten by Miraña people while Huitoto and Miraña people used fruits from *Caryocar glabrum* to poison fish, and they eat kernels from their seeds. Grated root from *Caryocar glabrum* is added to the "curare" or poison for hunting. Wood from *Vantanea peruviana* tree is used as fuel in hearths where food is cooked (Sánchez Sáenz 1997).

Within the genus *Oenocarpus*, the species *O. bacaba*, *O. bataua*, and *O. mapora*, were identified. *Oenocarpus* was the genus more frequently reported, 43% of the seeds from the excavations belonged to it. The species *O. bataua* was the most commonly represented. During the pre-ceramic period, *Oenocarpus* palms were dominant whilst during the ceramic period their presence decreases (Morcote *et al.* 1998: 62). The genus *Oenocarpus* includes solitary palms and its fruiting period is between March and June (Walschburger and Von Hildebrand 1991 quoted by Cavelier *et al.* 1995: 35). Today indigenous people from the Amazon region use the fruits from the *O. bataua*, *O. bataba*, and *O. mapora* to make a brew and to extract the oil. Leaves and trunks from the palm are used in construction, to manufacture tools and for medicinal purposes. The rachis and primary veins of the *O. mapora* palm are used to weave baskets. The large number of *O. bataua* seeds found in the excavations (whole, semi-whole and fragmented), suggested to the excavators that this palm was selected because of its high food value. Fruit flesh might have been processed by grinding fruits which is suggested by the abrasion presented by some of the seeds and also by the presence of lithic artefacts related to grinding processes. It might be also used as fuel because of the high content of oil from its endocarps (Cavelier *et al.* 1995: 36). However, we must remember that seeds were charred and we need to develop some kind of diagnostic criteria of the evidence produced by abrasion and those produced by charring.

Astrocaryum javari follows *Oenocarpus bataua* palm in abundance and it was also more often found in the pre-ceramic strata. At trench 9, seeds from the genus *Astrocaryum* were found, always in fragmented state. Within this genus the most common species found was *A. javari*, which represented 41.8% and was more frequently found in the pre-ceramic excavation levels from the site. This palm is a thorny plant and grows in river shores and swamp areas. Its fruiting period is between May and June (Galeano 1991). Its fruits are used as fish bait (Walschburger and Von Hildebrand 1991 quoted by Cavelier *et al.* 1995: 3). There is no ethnographic report for human consumption of *Astrocaryum javari* fruits in the Colombian Amazon region. However, its high percentage in the archaeological assemblage from Peña Roja suggests to Cavelier and collaborators, that the fruit could have been eaten during the past (Cavelier *et al.* 1995: 39). On the other hand, these fruits could have also been used as fish bait.

Today the palm *Astrocaryum aculeatum* ("cumare", "chambira" or "coco", see Figure 5.22) grows near indigenous houses where it is either cultivated or protected (Galeano 1991 quoted by Cavelier *et al.* 1995: 39). Both flesh and seeds are edible and empty shells are used as containers to store tobacco extract and "ambil" salt. Baskets, cloths, hammocks, bags and nets are manufactured from leaves of this palm (Galeano 1991 quoted by Cavelier *et al.* 1995: 39). The palm *Astrocaryum sciophilum* ("coco peludo" or "cumare de guara") grows in isolation but it can also be found forming big groups within the undergrowth. Their fruits are easy to collect because the palm has no stem. The seeds are rich in oil and they are edible after cracking the endocarp. It is possible that nuts from the palms of the *Astrocaryum* genus have been eaten after cracking the seeds as is suggested by the presence of anvils and choppers within the lithic assemblage from Peña Roja (Cavelier *et al.* 1995: 40).

Attalea insignis, *A. maripa*, *A. racemosa* and *Mauritia flexuosa* species were found less frequently than *Astrocaryum* and *Oenocarpus* palms; most of their remains were found in the pre-ceramic occupation strata (Morcote *et al.* 1998: 61). The palm *Mauritia flexuosa* ("canangucha" or "moriche". See Figure 5.23) was only reported for the pre-ceramic levels of Trench 9. This palm grows in permanently inundated areas; its fruiting period is between March and June. Indigenous people from the region eat the fruits raw or make a brew with them (Galeano 1991, Balick 1979 quoted by Cavelier *et al.* 1995: 37). They also make a flour after milling its seeds (Dugand 1972 quoted by Cavelier *et al.* 1995: 37). Leaves and trunks from this palm are used for different domestic purposes. Coleopteran larvae which are eaten, breed in fallen trunks of *Mauritia* palms (Galeano 1991, Balick 1979 quoted by Cavelier *et al.* 1995: 37).

Taking into account the present day importance of *Mauritia flexuosa* palm as food, Cavelier and collaborators suggest that this palm is under-represented in the archaeological record from Peña Roja site. Presence/absence records at trench 9 showed that whole seeds of *M. flexuosa* palm represented 3.2%, semi-whole seeds constituted 6.81% and fragmented seeds were 2.24% of the total of seeds reported. The excavators think that perhaps this under-representation is explained by the fact that seeds were ground to obtain flour and their preservation as charred seeds would be less probable. The latter statement is supported by the presence of lithic artefacts from the excavation associated with grinding as well as for the abrasion present in the few recovered seeds (Cavelier *et al.* 1995: 38).

The palm *Maximiliana maripa* ("palma real", "marija" or "inajá") was recovered in the excavation levels of both pre-ceramic and ceramic periods from the site.

Today both fresh fruit and nuts from the seeds are eaten. Ripe fruits are cooked in water and their flesh is mashed to make a brew very rich in oil. Sections of the raceme are baked on hearths to crack the endocarps and obtain the oil seeds (Balick 1979, Galeano 1991 quoted by Cavelier *et al.* 1995: 38). Salt is obtained after burning, cooking and/or filtering several parts of the plant (Simon 1953/1627, Gilij 1965/1780, Galeano 1991 quoted by Cavelier *et al.* 1995: 38). Whole seeds from this palm were not found at the excavations in Peña Roja, which suggests that they were cracked to consume their inner nuts. The fragmented seeds might be also the remains of the seeds used to obtain salt (Cavelier *et al.* 1995: 39).

A comparative study between past and present systems of palm management in the Colombian Amazon was made by Morcote and collaborators (1996, 1998). The comparison is based on data obtained during excavation of Peña Roja archaeological site and on ethnographic data collected among nomadic Nukak people, who inhabited the north eastern Guaviare province in the Colombian Amazon region (see Figure 2.11 of this thesis for geographical location of the Nukak territory. Morcote *et al.* 1998: 57).

According to this comparative study, people from both prehistoric and present times preferred to exploit terra firme forests and selected palms whose fruits were available during most of the year. In the Middle Caquetá region, terra firme forest presents the highest density of palms amongst which *Oenocarpus bataua* is very common. The concentration of cultural remains throughout the strata at Peña Roja site shows that the place was continuously occupied by people. This continuity could have been related to the permanent availability of palm fruit resources in the area (Morcote *et al.* 1998: 66. See discussion about the continuity of the occupation in Peña Roja in sub-section 5.2).

Nukak people use seven palm genera as sources of raw materials for construction, manufacture of musical instruments, weapons, baskets, containers, other domestic artefacts, and also for fuel. Fruits of most of these palms are used as food. Fruits from *Attalea maripa* are eaten raw or baked *in situ* or in the settlement. They are also cooked mashed and sieved to prepare a drink. Sometimes Nukak people eat the kernel from the seed or a larva which grows within it. Fruits of *Mauritia flexuosa*, *Astrocaryum acculeatum* and *Astrocaryum gynacanthum* are collected from the forest floor when they are ripen, at which point Nukak people eat them raw. Nuts from *Astrocaryum acculeatum* palms are also eaten and the juice of their green fruits is drunk. Oral tradition from Nukak people includes references to the cultivation of *Attalea maripa* and *Oenocarpus bataua* but nowdays they only cultivate *Bactris gasipae* palms ("chontaduro") (Morcote *et al.* 1998: 62-63).

The palms *Astrocaryum aculeatum*, *Attalea maripa*, *Mauritia flexuosa*, *Oenocarpus bataua*, *O. bacaba*, and *O. mapora*, are reported from both Nukak and the people from early Holocene period who inhabited the Peña Roja site. According to the available information *Oenocarpus bataua* is very important as a source of food. This species can be found in all ecological units from the area. It produces fruits most of the year and is used for several different purposes; it is very high in nutrient contents. Consequently the fruits are eaten by several animals which in turn are hunted by humans. Regeneration of this species in areas close to human dwellings is favoured by several factors. Processing of fruits which include cooking and maceration accelerates the germination period of the plants (Balick 1986b quoted by Morcote *et al.* 1998: 66); organic residues in the surrounding areas of dwellings constitute important sources of nutrients to plants; roof structures shadow seedlings and after their decay allow sunlight to reach the plants. These factors could result in high germination rates (Borgtoft-Pedersen and Balslev 1993 quoted by Morcote *et al.* 1998: 69). On the other hand, seed germination is not affected by mobility and/or re-occupation of campsites in the Nukak people's territory. A local group of Nukak people can have on average 68.5 campsites per year and from 101 campsites they only re-occupied 19 (Morcote *et al.* 1998: 69).

Figure 5.22 Photographs of the process of firing pottery, Araracuara region.

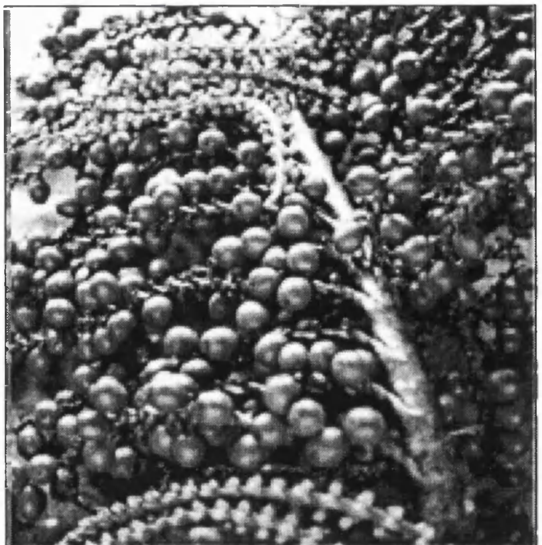


Figure 5.23 Photograph of *Mauritia flexurosa* fruits.

It is possible that the continuous human presence in the middle Caquetá area from the early Holocene period has contributed to the formation of the present day forest composition. Its prehistoric inhabitants were managing several palm species from different ecological units. Regeneration of some species in the abandoned campsites has influenced in the forest composition (Morcote *et al.* 1998: 72).

Nukak people do not eat *Astrocaryum javari* or *Astrocaryum sciophilum* reported for the pre-ceramic period at Peña Roja, but they eat fruits of other species of this genus, such as *Astrocaryum gynacanthum*. They also eat fruits from the *Bactris gasipaes* ("chontaduro") palm (Morcote *et al.* 1998: 66). *Bactris gasipaes* was not reported in Peña Roja site but it has been reported in pollen sequences from the Araracuara archaeological sites. This pollen sequence has been dated at 750 years BP, and belongs to the later period of prehistoric occupation of the area (Morcote *et al.* 1998: 66). It seems that the "chontaduro" palm was introduced into the Amazon region of Colombia in relatively recent times. Today this palm is a very important source of food for the indigenous population of the tropical rain forests of both Amazon and Chocó Colombian regions.

The state of preservation of the plant macro-remains found at Peña Roja site has been used by investigators to infer the uses and processing practices associated with them. Most of the *Oenocarpus bataua* seeds were found complete which suggests that flesh from fruits were eaten. *Oenocarpus bacaba* and *Oenocarpus mapora* palms are not commonly found today in the Araracuara region, and probably they were not commonly used as food during past times. *Attalea* and

Astrocaryum seeds were found fractured which suggests that seeds were cracked to extract their edible nuts. Low frequencies of *Astrocaryum acculeatum* and *Astrocaryum sciophilum* could be related with their consumption as occasional food. Low density of *Mauritia flexuosa* remains in the archaeological record from Peña Roja could be due to ecological or cultural factors. Firstly, at the beginning of the Holocene period the Caquetá river valley was subjected to massive flooding which could limit the "custom_cananguchales" areas, where *Mauritia* palms grow. But in certain areas from the lower terraces of the river, such as Pantano de Mónica area, there were *Mauritia* forest during the period between 11,000 and 4000 years BP. People inhabiting the middle Caquetá river at the beginning of the Holocene period could have moved between their camp sites and swamps areas such Pantano de Mónica which is less than 10 km away from the Peña Roja archaeological site. On the other hand, ethnographical data show that the fruits of *Mauritia flexuosa* are usually eaten *in situ* and therefore they are not often brought into dwelling places (Morcote *et al.* 1998: 66).

5.4.3. Phytoliths

A soil sample from trench 9 was taken for phytolith analysis. The study was carried out by Dolores Piperno who identified phytoliths from *Cucurbita, Calathea allouia* (leren tuber), and bottle gourd (*Lagenaria* sp.). Piperno suggests that people from the earlier occupation of the Peña Roja site were practising small scale horticulture perhaps in small domestic gardens (Piperno and Pearsall 1998, Piperno 1999, Herrera and Cavelier 1999. See Chapter four, sub-section 4.3.1.3.1.2 and 5.4.2.1 of this thesis).

It is interesting to note that the same group of phytoliths (*Cucurbita*, *Calathea* and bottle gourd), have been also reported in other archaeological sites from the lowlands of South America, such as the Aguadulce rockshelter in Central Panama and the site OGSE-80 in the Ecuadorian Pacific coast (Piperno and Pearsall 1998: 244, 287. See Chapter four of this thesis). These remains are from the early Holocene site, and date to ca 7000 for Aguadulce rockshelter and 10,800 to 6600 for the OGSE-80 site. However there is still a lack of local or specific studies on the history of human use and possible domestication of any of these plants within the lowlands of South America. What is available at present are the isolated data mentioned above. It is necessary to obtain more information on this particular group of plants. Their importance particularly *Cucurbita* and bottle gourd has been well emphasised by archaeologists from the area. The presence of arrowroot (*Calathea)* reminds us that there was a broad spectrum of available plants which prehistoric inhabitants from the area could have used. Phytolith analysis is one of the most promising fields in archaeobotanical studies for the tropical lowlands of America.

5.4.4. Charred wood

5.4.4.1. The test sample of charred wood fragments from Peña Roja

Taking into account the high flora diversity from the area of study as well as the lack of pilot studies on appropriate size of samples and sub-samples for charcoal assemblages from tropical lowlands of America, a test sub-sample of 200 charred wood fragments was chosen for identification. These were chosen within a group of fragments bigger than 2 mm mesh. Therefore the interpretation of data or any suggestions made from the results of this analysis have to be taken with caution, given the fact that large fragments from a sample bias the quantification and interpretation of a charcoal assemblage. Such a small sample does not allow any quantitative analysis such as diversity of taxa, and/or any palaeoenvironmental reconstruction of past conditions in the area, but, nevertheless, has provided a realistic point of introduction to the complexities of charcoal studies for the site and its surrounded region.

One of the goals of this thesis is to assess the applicability of current charcoal identification techniques to the material from tropical rain forest of Colombia. The test sample was chosen from samples collected by different recovery techniques and from three different contexts.

A random numbers table was used to choose the fragments. From Pit 5, 50 fragments from the coarse fraction (i.e. bigger than 2 mm) were taken for microscopic examination, description and identification. From the ceramic levels in trenches 9 and 10, 75 fragments were randomly selected from fragments bigger than 2 mm, and 75 fragments were selected in the same way from the pre-ceramic levels of the site. From the 75 fragments chosen from both the ceramic and pre-ceramic levels of the excavation, 25 were manually recovered, 25 were recovered by water screening and 25 by flotation. Tables 5.1 summarises the information about the test sample taken for microscopical examination. Tables 5.2, 5.3 and 5.4 show the weights of the fragments examined as well as total weight of charcoal fragments in each sample. Reference numbers in those tables correspond to the number of the square and level of excavation.

The size of archaeological charcoal samples varies according to the different aims of the particular projects and to the taxonomic diversity of the area of study. The small test sample from Peña Roja is not comparable with the sizes of samples taken from other sites. The major aim of this project was to create a model to characterise charcoal assemblages from archaeological sites in the Colombian Amazon and to assess current methods of charcoal identification for this region. Identification of charcoals is possible to the family and in very few cases to genus. Sample size affects the taxonomic composition of assemblages and therefore the interpretation of the charcoal assemblages. Therefore the suggestions about past uses of woods in Peña Roja have to be taken with caution. An estimation of the appropriate sample size for charcoal assemblages from the area will be carried out in future studies (see Chapter eight, sub-section 8.3.2).

Thompson (1998: 247), in her analysis of charcoals from Barrow Hills (Radley, Oxforshire, England), examined a sample of 2706 fragments. The objective of this study was to identify charcoals from well-defined and dated deposits. Vacher *et al.* (1998) examined 4431 fragments of charcoal which were used to reconstruct ancient fires and past vegetation in French Guyana whereas Cartwright and

Parkington (1997) examined over 6700 fragments of wood charcoal from Elands Bay Cave (South Africa) in order to reconstruct past vegetation change. Thompson (1994) studied charcoal assemblages from secondary deposits (probably redeposited refuse from fuels used in hearths) at Khok Phanon Di in Thailand where 775 charcoal fragments were selected for identification. Fifty fragments of charcoal were examined from each sample. Thompson points out that this sample size "reflected the abundance of research materials and the taxonomic diversity of the tropical forests. Samples sizes of twenty or thirty fragments are reported as acceptable elsewhere" (Thompson 1994: 18). Johannessen and Hastorf (1990) studied a number of 3670 charcoal fragments from 327 samples taken at the site of Pancán (located in a relatively tree-less high Andean valley in Perú) in order to analyse the prehistoric fuel use.

As the above examples show there is a huge variation in practice when the sample sizes of charcoal assemblages are decided. The area studied by Vacher *et al.* (1998) in French Guiana is similar to the middle Caquetá region in terms of the vegetation cover. Piperno and Pearsall (1998) say that the French Guiana area is at present covered by a combination of tropical evergreen, semi-evergreen and deciduous forests. The aims of the study carried out in Guiana were different from the aims of the present data. Vacher *et al.* (1998) do not mention if they calculate an appropriate sample size for the examination of charcoals.

The weight of the charcoal samples from Peña Roja has been used to calculate density of charcoals by strata at trenches 9 and 10 (see Figure 5.24). The density of charcoal is higher in the pre-ceramic strata. This could be due to the intensity of the occupation of the site, different or changing function of the site, or changes that occurred in the rate of deposition of the archaeological materials.

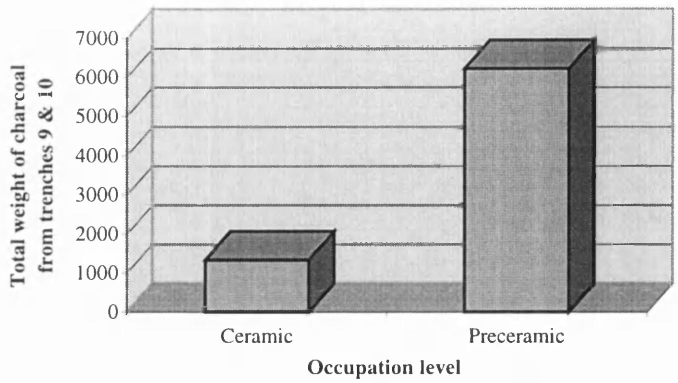


Figure 5.24 Diagram showing wood charcoal distribution in the Peña Roja trenches.

Table 5.1 Test sample of charred wood fragments from Peña Roja.

Sub-sample	**Recovery technique**	**Fragments larger than 0.5 cm^3**	**Weight (gr)**	**Randomly selected charcoal fragments**	**Weight (gr)**
1. Ceramic occupation levels	Manual collection	126	70,4841	25	12,2188
	Water screening	35	11,2968	25	7,8102
	Flotation	131	22,2757	25	4,9167
Subtotal		292	104,0566	75	24,9457
2. Pre-ceramic occupation levels	Manual collection	98	52,3178	25	12,2951
	Water screening	104	26,1370	25	5,7036
	Flotation	167	33,7477	25	4,7507
Subtotal		369	112,2025	75	22,7494
3. Pit 5	Water screening adding sodium silicate	1401	312,5018	50	9,4467
Total		2062	528,7609	200	56,1418

Table 5.2 Weights of fragments chosen for microscopical examination. Sub-sample 1: Ceramic occupation.

Manual collection		Water screening		Flotation	
square/level reference	**weight (gr)**	**square/level reference**	**weight (gr)**	**square/level reference**	**weight (gr)**
5572	0,3701	5096	0,1321	5514	0,1626
5532	0,2234	5050	0,5740	5522	0,1335
5545	0,3513	5050	1,1374	5531	0,1554
5522	0,9280	5040	0,0989	5533	0,0794
5533	0,4364	5096	0,0445	5566	0,3576
5581	0,2537	5096	0,1543	5518	0,5479
5560	0,3069	5040	0,2260	5553	0,0677
5101	0,7185	5050	0,2139	5565	0,0324
5530	0,5808	5050	0,3157	5563	0,1966
5576	0,6979	5080	0,0980	5529	0,1025
5093	0,1971	5050	0,2733	5568	0,0765
5506	0,3145	5096	0,0719	5576	0,2411
5037	0,3034	5024	0,1952	5573	0,4080
5099	0,2709	5050	0,3894	5587	0,1325
5096	0,2714	5072	0,0689	5558	0,1918
5537	0,0845	5040	0,1452	5551	0,1385
5551	0,9728	5040	0,1888	5556	0,1265
5586	1,7961	5050	0,4120	5561	0,1031
5535	0,8164	5024	0,3465	5503	0,1901
5088	0,2130	5080	0,1279	5571	0,1278
5526	0,2460	5050	1,4758	5544	0,6129
5527	0,3230	5050	0,2905	5554	0,2976
5547	0,1410	5050	0,3162	5534	0,2743
5074	0,4674	5080	0,0618	5516	0,0456
5544	0,9343	5050	0,4520	5585	0,1148
Total	12,2188	**Total**	7,8102	**Total**	4,9167

Table 5.3 Weights of fragments chosen for microscopical examination. Sub-sample 2:Pre-ceramic occupation

Manual collection		**Water screening**		**Flotation**	
square/level reference	**weight (gr)**	**square/level reference**	**weight (gr)**	**square/level reference**	**weight (gr)**
5634	0,3719	5142	0,2653	5656	0,2023
5678	0,4594	5117	0,1205	5593	0,0799
5121	0,3370	5134	0,1223	5757	0,3448
5603	0,8417	5193	0,1566	5637	0,2391
5636	0,7565	5152	0,0465	5676	0,1392
5637	0,7502	5174	0,1017	5671	0,1706
5149	0,3814	5148	0,1530	5629	0,1693
5752	0,6897	5169	0,0575	5675	0,1226
5654	0,7831	5154	0,1815	5604	0,2068
5755	0,1777	5157	0,6080	5651	0,2121
5609	0,4308	5158	0,1549	5679	0,2536
5593	0,2646	5126	0,3000	5647	0,1745
5631	0,6597	5137	0,2506	5773-5781	0,1083
5733	0,2390	5166	0,2868	5642	0,1899
5125	0,1407	5174	0,2369	5616	0,1050
5646	0,3264	5136	0,2458	5715	0,1560
5616	0,4575	5126	0,1535	5678	0,1437
5594	0,3428	5177	0,7161	5681	0,1534
5597	0,1856	5161	0,1626	5592	0,0844
5623	0,2146	5155	0,1931	5680	0,1625
5693	0,5873	5147	0,3254	5662	0,1323
5610	0,6699	5151	0,2050	5591	0,1990
5651	0,7912	5163	0,1501	5749	0,0573
5624	0,5756	5182	0,2194	5623	0,2073
5695	0,8608	5159	0,2905	5595	0,7368
Total	12,2951	**Total**	5,7036	**Total**	4,7507

Table 5.4 Weights of fragments chosen for microscopical examination. Sub-sample 3: Pit 5

Water screening adding sodium silicate			
excavation level & reference	**weight (gr)**	**excavation level & reference**	**weight (gr)**
705-1	0,1701	705-2	0,0239
706-1	0,3994	706-2	0,1782
707-1	0,0729	707-2	0,1886
708-1	0,0547	708-2	0,0908
709-1	0,1402	709-2	0,1032
710-1	0,0490	710-2	0,0821
711-1	0,1001	711-2	0,2688
712-1	0,1301	712-2	0,4025
713-1	0,0530	713-2	0,0006
714-1	0,0380	714-2	0,0209
715-1	0,0314	715-2	0,4005
716-1	0,0071	716-2	0,1703
717-1	0,0693	717-2	0,2113
718-1	0,3455	718-2	0,1330
719-1	0,1355	719-2	0,2135
720-1	0,1247	720-2	0,0883
721-1	0,2178	721-2	0,1477
722-1	0,2137	722-2	0,1606
723-1	0,3807	723-2	0,1747
724-1	0,4655	724-2	0,1992
725-1	0,1079	725-2	0,0416
726-1	0,1745	726-2	0,2204
727-1	0,4121	727-2	0,2629
728-1	0,1415	728-2	0,7282
729-1	0,5876	729-2	0,3126
Subtotal	4,6223	Subtotal	4,8244
Total: 9,4467			

5.5. Summary

The archaeological site of Peña Roja is located on a low terrace of the middle Caqueta river. Current palaeoenvironmental information for the area indicates that at the beginning of the Holocene period the low terraces of the middle Caquetá river were well drained areas not subject to regular floodings and therefore suitable for the establishment of human campsites.

Two prehistoric human occupations have been reported in the site. At present three radiocarbon dates are available for the earliest occupation period: 9125±250 BP (Gx 17395), 9160±90 BP (Beta 52963) and 9250±140 BP (Beta 52964). This occupation has been associated with hunter-gatherer groups who did not manufacture pottery. Their subsistence included gathering palm fruits and they were probably practising small scale horticulture. The latest occupation of Peña Roja has been related to people who practiced agriculture and manufactured pottery. Humanly modified soils ("terra petra" soils) have been reported from that period. This prehistoric occupation has been related to a period of time between 1900 and 400 years BP according to similar cultural remains found at other sites of the middle Caquetá river. A deposit (Pit 5) containing plant macro-remains, pottery and lithic artifacts was also excavated. This deposit is located on the same terrace and was radiocarbon dated to 585 ± 30 years BP (GrN 14993).

In order to collect information suitable for being compared with the archaeological data, an ethnographic study on present day Muinane ceramic manufacture techniques was carried out by Herrera *et al.* (1989). The study investigated the clay types available in the area and their provenance. Of particular interest for this thesis is the report of the vegetal resources used during the process of pottery manufacturing: bark, lianas, wood and latex from several trees.

Plant macro-remains and micro-remains were recovered from the archaeological excavations at Peña Roja site (trenches 9, 10 and Pit 5). Recovery techniques employed included manual collection, water screening and flotation. Charred seeds of palms (11 species belonging to four genera) and other tree fruits (10 genera from six families) recovered from both the pre-ceramic and the ceramic occupation levels at trenches 9 and 10 were identified.

A comparative study between the past and present palm human consumption patterns was carried out by Morcote *et al.* (1996, 1998). Past palm consumption information presented by Morcote and collaborators is based on data at Peña Roja site and present day consumption on data collected amongst the Nukak people. Nukak people are hunters and gatherers who inhabit the northeastern area of the Colombian Amazon region (see map in Figure 2.11). Both prehistoric inhabitants of Peña Roja and Nukak people selected palms whith fruits available during most of the year and which grow in the forest of "terra firme" areas. In addition to the consumption of palm fruits, at present, Nukak people use palms for different purposes which include: fuel, house building, manufacture of containers, musical instruments and hunting and fishing equipment such as blowpipes.

Phytolith analysis from a soil sample taken from the excavation of trench 9 at Peña Roja allowed Piperno (1998, 1999) to suggest the practice of small scale horticulture at the time of the earliest occupation of the site, i.e., around 9000 years BP. The phytoliths identified include squash (*Cucurbita* sp.), bottle gourd (*Lagenaria* sp.) and leren tuber (*Calathea alloua*).

The plant macro-remains from different excavations carried out at Peña Roja site included abundant charred wood fragments. A test sample of 200 charred wood fragments was chosen for identification.

6. METHODS

6.1. Production of a wood reference collection

6.1.1. Use of present ethnographic and ethnobotanic studies from the Colombian Amazon region

Ethnographic information has been used in this study to understand the present traditional use of woods in the region and so lead to a better understanding of the possible uses of wood in the past. Traditional subsistence practices of present-day indigenous societies in the zone can help in modelling hypotheses about past use of forest resources and the processes that precede deposition of archaeological remains. However this kind of information must be used cautiously to avoid erroneous conclusions which do not take into account the temporal gap between present and past people, more than 2000 years in the case of pre-ceramic people who lived at the Peña Roja site.

In spite of the fact that present indigenous communities belong to modern political and economic Colombian systems, data on the ethnobotany of these communities are used here to formulate hypotheses about wood exploitation during past times. This is because the traditional way of life and accumulated knowledge of forest resources of indigenous people are considered to be aspects closer to ancient customs than subsistence patterns of white or mestizo people who also inhabit some parts of this area today.

Taking into account the high diversity of the flora in the Amazon rain forest, particularly in woody taxa, ethnobotanical literature has been a very useful source for restricting the huge amount of information about wood to that concerning its traditional use. However, during fieldwork it was clear that most plants reported and chosen from ethnographic literature were not used at present by Muinane people, amongst whom the collection was made. The fieldtrip of three weeks duration was carried out during the month of September in 1994 mostly in the locality of Villa Azul where the Peña Roja site is located. At present a Muinane community inhabits this locality. The information concerning present wood uses amongst the Huitoto people was collected in the locality of Araracuara.

Ethnobotanical data collected within several indigenous groups inhabiting the present Amazon tropical rain forest in Colombia, the Andoque, Huitoto, Miraña, Tukuna Puinave and Muinane people (see Figure 2.11), and already published at the time of the fieldwork, in 1994 include: Glenboski 1983, La Rotta 1983, Triana 1985, La Rotta *et al.* 1989, Galeano 1991, Walschburger and Von Hildebrand 1991. These references were used to produce a preliminary list of 45 species to be obtained as part of the reference collection (Table 6.1). Criteria used to select these plants were based on present indigenous wood uses reported in the literature and supposition that these plants were used during the archaeological past in a similar way to today, as well as on the supposition that they could be preserved and recovered in the archaeological contexts under examination. Ethobotanical information used in Chapters seven and eight includes also the data published after 1994 (e.g. Politis and Rodríguez 1994, Herrera and Urrego 1996, Politis 1996a,b, Sánchez Sáenz 1997 and 1998). The botanic samples collected during the fieldtrip were sent to Bogotá to the botanist Mauricio Sánchez Sáenz who identified them at the "Corporación Araracuara" Herbarium (COAH. See sub-section 6.1.4).

Table 6.1. List of woody plants used in the Colombian Amazon by indigenous peoples. This list is based on the ethnographic data published by 1994 (Glenboski 1983, La Rotta 1983, Triana 1985, La Rotta *et al.* 1989, Galeano 1991, Walschburger and Von Hildebrand 1991).

	Family	**Species**	**Uses**				
			Firewood	Timber for house building	Domestic artefacts	Hunting & fishing artefacts	Canoe manufact.
1	Annonaceae	*Guatteria megalophylla*		X			
2	Annonaceae	*Unonopsis veneficiorum*		X			
3	Annonaceae	*Xylopia amazonica*	X	X			
4	Arecaceae	*Catoblastus drudei*				X	
5	Arecaceae	*Desmoncus horridus*		X			
6	Arecaceae	*Dictyocaryum ptariense*		X			
7	Arecaceae	*Euterpe catinga*		X			
8	Arecaceae	*Euterpe precatoria*		X			
9	Arecaceae	*Geonoma piscicauda*			X		
10	Arecaceae	*Iriartea deltoidea*		X			
11	Arecaceae	*Iriartella setigera*		X	X	X	
12	Arecaceae	*Mauritia flexuosa*		X			
13	Arecaceae	*Mauritiella aculeata*		X			
14	Arecaceae	*Maximiliana maripa*				X	
15	Arecaceae	*Oenocarpus bataua*		X			
16	Arecaceae	*Socratea exhorrhiza*		X			
17	Arecaceae	*Wettinia augusta*				X	
18	Bignoniaceae	*Scleronema micranthum*		X			
19	Bignoniaceae	*Scleronema praecox*		X			
20	Bombacaceae	*Ochroma pyramidale*			X		
21	Celastraceae	*Goupia glabra*	X				
22	Chrysobalanaceae	*Licania apetala*	X	X			
23	Euphorbiaceae	*Micrandra spruceana*	X	X	X		
24	Euphorbiaceae	*Sandwithia heterocalyx*	X				
25	Flacourtiaceae	*Lindackeria paludosa*		X			
26	Gramineae	*Gynerium sagittatum*				X	
27	Lauraceae	*Nectandra cuspidata*		X			
28	Lecythidaceae	*Eschweilera alata*		X			
29	Lecythidaceae	*Eschweilera itayensis*	X				
30	Lecythidaceae	*Eschweilera turbinata*		X			
31	Leguminosae	*Dipteryx micrantha*		X	X		
32	Miliaceae	*Carapa guianensis*		X			
33	Miliaceae	*Cedrela fissilis*		X	X		X
34	Moraceae	*Brosimum rubescens*		X	X		
35	Moraceae	*Naucleopsis ulei*			X		X
36	Myristicaceae	*Iryanthera tricornis*		X	X		
37	Myristicaceae	*Iryanthera ulei*	X	X	X		
38	Myristicaceae	*Virola calophylla*	X	X			
39	Myristicaceae	*Virola elongata*	X	X			
40	Olacaceae	*Minquartia guianensis*	X	X	X		
41	Rubiaceae	*Botryarrhena pendula*		X			
42	Sapotaceae	*Manilkara inundata*		X			
43	Simararoubaceae	*Simarouba amara*		X			
44	Violaceae	*Leonia cymosa*		X			
45	Vochysiaceae	*Vochysia vochysiaceae*		X			

6.1.2. Field trip to collect samples

A field trip to collect wood samples in order to build up a reference collection was carried out in 1994 by the author of this thesis. Wood samples and ethnographic data were collected from the Muinane and Huitoto indigenous people who live in the region, sometimes occupying the same places as did pre-Columbian people.

Collection of specimens was carried out in places corresponding to three types of landscape (physiographic units): the alluvial plain of the Caquetá river, the Tertiary sedimentary plain and the hardrock (sandstone) formation of the Araracuara plateau. Archaeological studies of sites located also on these landscapes have been published (Herrera *et al.* 1980-81, Herrera 1981, Andrade 1986, 1988, Herrera *et al.* 1988, 1989, 1992a,b; Cavelier *et al.* 1990, 1995, Mora 1991). Collection was made in the company of Elías Moreno, a Muinane man who is knowledgeable of the forest and his own traditions, but is not a botanical expert. Of the 45 species listed (Table 6.1) in ethnographical and ethnobotanical literature published up until 1994 (Glenboski 1983, La Rotta 1983, Triana 1985, La Rotta *et al.* 1989, Galeano 1991, Walschburger and Von Hildebrand 1991) only 12 were recorded (ten identified to species and two identified to genus) as being currently used and were therefore collected though these had not been recorded in this literature. The specific ethnographic and ecological information obtained during the field trip has been very useful during the following phases of this research.

6.1.3. Recording of data

An example of the Field Card designed to record the information is shown in Figure 6.1. In addition, some other observations on the wood and charcoal characteristics mentioned by the Muinane and Huitoto people in the field were also recorded. These included: burning properties (if wood produces oil when it burns), "charring" properties (when wood produces charcoal and if it is hard or soft), and combustion properties (when wood burns well, produces heat efficient live coal, extinguishes fast, lights easily and produces long lasting live charcoal). Oxidation at breakage was recorded for only one taxon. This character refers to the resulting colour change of the wood on contact with air and is caused by the oxidation of the sap in the wood. All the collected information is summarised in Table 6.2.

Exudation properties, when observed, were registered because of the importance of such properties in wood combustion. Although some of the registered data such as "burning properties, charring and combustion properties" do not correspond to a strict classification in terms of physical characteristics of wood, these were taken into account because indigenous people consider them in selecting wood for different purposes. These observations refer to physical and chemical properties of woods such as hardness, density and contents of resins. Detailed studies on the temperatures of domestic hearths and about the physical and chemical properties of firewood could carried out in the future.

It is important to mention, in the ethnographic information registered, the precise differentiation between woods made by present-day indigenous people. For example, this was specially noticed with taxa used for smoking meat and fish where woods which produce long lasting heat were selected.

Figure 6.1 Field Card designed to collect present-day information on woods.

Field collecting card			
Sample			
Collector		Date	
Species		Common name	
Indigenous group		Indigenous name	
Place			
Mature forest		Site	
Flooded forest		Secondary forest	
Domestic garden		Agricultural plot	
Fallow		Around house	
Riverine		Savannah	
Lake shore			
Present use			
Food		Medicinal	
Firewood		Building	
Domestic		Transportation	
Weapons			
Collected wood and number of specimens			
Twig wood		Branch wood	
Trunk wood		Bark	
Herbarium specimens: collected parts			
Leaf/leaves		Fruit(s) Root(s)	
Seed(s)		Flower(s)	
Notes			

Table 6.2 Wood samples collected for reference collection during the 1994 field trip.

Family/Species	Indigenous & Spanish names	Habitat	Botanical part collected	Oxidation at breakage	Exudation	Burning proprieties	Charring	Combustion Proprieties	Botanical part used	Use
Annonaceae Guatteria cf. ferruginea	K+ bo du ge ne e Carguero de rastrojo	Fallow	Young trunk/bark/ leaves		White		Does not produce charcoal	Burns well	Bark	Domestic artefacts: baskets for carrying manioc roots
									Branch wood	Firewood
Pseudoxandra cf. coriacea	Fat+ m+ ku fat+ bue Perfume guara	Mature forest	Young trunk/branch/ bark/leaves				Does not produce charcoal		Bark	Ornaments/ritual: fragance
									Trunk wood	Construction: ceiling joists
Xylopia sp.1	Sa r+ ma qo Carguero negro	Mature forest	Young trunk/branch/ leaves				Does not produce charcoal		Trunk wood	Firewood Construction: ceiling joists
Apocynaceae Aspidosperma cf. excelsum	ki k++ Popai de sapo	Mature forest	Young trunk/branch/ leaves		White		Produces hard charcoal	Burns well	Branch wood	Firewood to smoke tapir meat and to provide light
Arecaceae Iriartea deltoidea	Jállacu; Ja a ya o Bombona	Flooded forest	Mature trunk				Does not produce charcoal		Trunk wood	Construction: trunks are split to make floors and walls of houses
Iriartella setigera	Jallacu; Mómo-igaicu Bombona, pona, zanconcita, chonta, chontica	Mature forest	Young trunk/branch/ leaves/friuts						Leaves Trunks	Construction: huts in the forest Hunting equipment: to make blowpipes and darts
Mauritiella aculeata	Uree-inoho Canagucha espinosa, cananguchilla/o	Mature forest	Mature trunk				Does not produce charcoal		Trunk wood	Construction: trunks are split to make floors and walls of houses

Table 6.2. Continued.

Family/Species	Indigenous & Spanish names	Habitat	Botanical part collected	Oxidation at breakage	Exudation	Burning proprieties	Charring	Combustion Proprieties	Botanical part used	Use
Oenocarpus bataua	Cumee; Ta ga i o Milpeso, milpesillo	Mature forest	Young trunk				Does not produce charcoal		Trunk wood Sprouts, fruits	Rearing of Coleoptera larvae Construction: trunks are split to make floors and walls of houses Food: sprouts are eaten raw, fruits are consumed.
Oenocarpus cf. bacaba	Ka ga o ta ga i o Milpesillo de rebalse	Flooded forest	Mature trunk/leaves/ fruits/roots/ flowers						Petiole	Domestic artefacts: baskets to carry or store manioc, manioc starch, manioc flour or meat. Fish traps are weaved from petioles.
Socratea exorrhiza	Igaicu Zancona	Mature forest	Young trunk/leaves/ roots						Root Trunks	Domestic artefacts:graters Construction: to make the frame of thatch units
Cecropiaceae Cecropia ficifolia	Go mo Yarumo blanco	Fallow	Young trunk				Does not produce charcoal		Leaves	Ornaments/ritual
									Leaves	Domestic artefacts
Cecropia sp.1	U da go + mo, o Yarumo de ratón	Fallow	Young trunk/leaves				Does not produce charcoal		Branch wood Leaves	Firewood Magic-ritual: crushed leaves are mixed together with coca leaves Pottery manufacture: leaves are located under ceramic plates whilst they are made
Chrysobalanaceae Licania apetala	Caguijao; D+r+je; Jiobo-caguijao; gui fo ka gui ja o Cemento fino, palo de cemento	Mature forest	Young trunk/leaves				Does not produce charcoal		Bark	Pottery manufacture: crushed bark pieces are mixed with clay
Licania cf. longipedicellata	D+, +r o Palo/leña de manteca	Mature forest	Young trunk/branch/ bark/leaves			let out oil	Produces hard charcoal		Branch wood	Firewood

Table 6.2 Continued.

Family/Species	Indigenous & Spanish names	Habitat	Botanical part collected	Oxidation at breakage	Exudation	Burning proprieties	Charring	Combustion Proprieties	Botanical part used	Use
Licania octandra	Facum+ -caguijao Palo de cemento	Mature forest	Young trunk/branch/ bark/leaves				Does not produce charcoal		Bark	Pottery manufacture:crusehed bark pieces are mixed with clay
Clusiaceae Tovomita aff. spruceana	Ma nio	Mature forest	Young trunk/twig/ leaves		Yellow			Does not produce efficient live coal	Trunk wood	Firewood
Vismia macrophylla	Yi re e Lacre	Fallow	Branch/leaves				Produces charcoal		Branch wood	Firewood
Euphorbiaceae Senefeldera cf. karsteniana	Tu k, o Palo podrido	Mature forest	Young trunk/branch/ leaves				Produces hard charcoal	Burns well	Branch wood	Firewood
Lauraceae Licaria sp.1	+ ji i ga Hígado del diablo	Mature forest	Young trunk/branch/ leav				Produces hard charcoal		Trunk wood	Firewood Construction: trunks are used as support posts and rafters
Licaria sp2	Fa t+ ba Medio comino de guara	Mature forest	Young trunk/branch/ leaves				Produces soft charcoal		Branch wood	Firewood Construction: ceiling joists and planks
Ocotea aciphylla	Ga, nao; No ba o Medio comino, comino de achiote	Mature forest	Young trunk/branch/ leaves	Red			Produces hard charcoal	Does not produce efficient live coal/ Extinguishes fast	Trunk wood	Construction: ceiling joists and planks Canoe manufacture: trunks are hollowed out to make canoes

Table 6.2 Continued.

Family/Species	Indigenous & Spanish names	Habitat	Botanical part collected	Oxidation at breakage	Exudation	Burning proprieties	Charring	Combustion Proprieties	Botanical part used	Use
Ocotea sp1	Bu ru chi ku Medio comino	Mature forest	Young trunk/leaves				Produces hard charcoal		Trunk wood	Costruction: ceiling joists
Lecythidaceae Eschweilera tessmannii	Jec+m+-cugao; Ku gao Piña de danta, popai	Mature forest	Young trunk/leaves				Produces hard charcoal	Does not produce efficient live coal	Branch wood	Firewood and to provide light
Leguminosae Swartzia racemosa	Da gi j+ je +a je Paleta de perico	Flooded forest	Young trunk/branch/ leaves					Burns well	Branch wood	Firewood to cook food and cassava and to smoke meat
Melastomataceae Bellucia grossularioides	T+e ni m+o Cronilla, guayabilla, guacuri de danta	Fallow	Young trunk/leaves				Produces soft charcoal		Branch wood	Firewood
Miconia sp.1	Jogorai	Fallow	Young trunk/leaves/ flower						Seed Wood	Ornaments/ritual: a black dye is extracted to paint vegetable fibres Firewood to smoke fish
Mouriri cauliflora	G+ s+ r+ e Palo de hierro	Mature forest	Young trunk/branch/ leaves				Produces hard charcoal		Fruit Branch wood	Food: fruits are eaten raw Firewood
Moraceae Brosimum rubescens	Faibec+du Granadillo, árbol de corazón rojo	Mature forest	Twig/leaves		White		Produces hard charcoal		Trunk wood	Ornaments/ritual: mortars to crush coca leaves Domestic artefacts:mortars, long semi-cylindrical troghs to crush manioc Hunting equipment:clubs
Myristicaceae Iryanthera tricornis	Meu+ Cabo de hacha, palo de tabaco, mamita, sangretoro	Mature forest	Young trunk/leaves						Branch wood	Hunting equipment: blowpipes Firewood Domestic artefacts: axe handles

Table 6.2 Continued.

Family/Species	Indigenous & Spanish names	Habitat	Botanical part collected	Oxidation at breakage	Exudation	Burning proprieties	Charring	Combustion Proprieties	Botanical part used	Use
Virola calophylla	Jufaifim+o; Pirijao Palo de mentiroso, mamita, sangretoro		Young trunk/leaves				Does not produce charcoal		Trunk wood	Costruction: ceiling joists
Olacaceae Minquartia guianensis	Namogañoo; Namom+o Ahumando		Young trunk/branch/ leaves				Produces hard charcoal		Trunk wood	Construction: house rafters
Rubiaceae Duroia eriophila	Na mo ca t+ o Pintura de zorra	Mature forest	Young trunk/branch/ leaves				Produces hard charcoal	Lights easily, live coal long lasting	Leaves Wood Fruits	Ornaments/ritual: a paimt is extracted to decorate human bodies Firewood Food: fruits are eaten raw
Genipa sp.1	Ju be ub, a	Mature forest	Young trunk/branch/ leaves				Produces hard charcoal		Branch wood	Firewood
Simaroubaceae Picramnia cf. sellowii planchon spp spruceana	Nibigai cat+o Pintura de venado	Flooded forest	Young trunk/branch/ bark/leaves						Leaves Wood	Ornaments/ritual: a dye is extracted to paint vegetal fibres and crowns made from feathers Firewood

6.1.4. Botanical identification of collected samples

Leaves, flowers and wood were collected and were used, along with field notes by the botanist Mauricio Sánchez, to identify the collected samples. The samples were compared to the collection of the "Corporación de Araracuara " Herbarium at Bogotá (COAH). Specimens collected are from 18 different botanical families. The wood collected is a very small sample of woody taxa used by people in the Colombian Amazon region, and specimens from other reference collections were used during the identification process of archaeological samples. Some of the samples were not identified because not enough material was collected.

6.1.5. Problems and limitations to make a reference collection

The main problem was the huge number of woody taxa used by present indigenous societies in the Amazon tropical rain forest. Ethnographical information has proved to be very useful in starting this collection. However, this research did establish that the indigenous Muinane sometimes said that certain plants were not used by them in the same way it was reported in the literature for other indigenous groups from the Amazon region. This shows that occasionally uses are very specific for different groups.

Plant collection was limited by to the duration of the field trip and by the knowledge of Muinane and Huiototo informants.

6.2. Laboratory analyses of wood reference samples

6.2.1. Preparation of uncharred samples

Blocks of wood of about 3 cubic cm were cut from the reference collection samples. These pieces of wood were put in water for 10 to 30 days to soften them and then boiled until they sank. Thin sections (7-15 μm thick) for microscopical examination were cut from these pieces using a microtome. Then thin sections were put in distilled water until they were ready for staining.

Staining:

Sections were put into safranin for 20 to 30 minutes, then washed in distilled water. After washing, the sections were transferred to a series of petri dishes containing solutions of 20%, 50%, 80%, 95% and 100% ethanol. In order to take out the ethanol, the sections were immersed in xylene and then these were mounted by using Styrolite, which is a xylene-based mounting medium.

6.2.2. Description and recording of data from wood reference samples

Description of microscopic anatomical features of thin sections obtained from the woods collected was made following the IAWA list of microscopic features (IAWA Committee 1989). However, quantitative features recommended by the IAWA list were not included in the description because such features may be altered by the conditions of charring woods. Also the descriptions do not include other non-anatomical information such as specific gravity, heartwood colour, odour, heartwood fluorescence, water and ethanol extracts, froth test, and chrome azurol-S. Figure 6.2 shows a three-dimensional diagram of a cube of wood including the anatomical features seen in cross, tangential and radial sections. Data were recorded in Table 6.3 which includes the information from all the samples described.

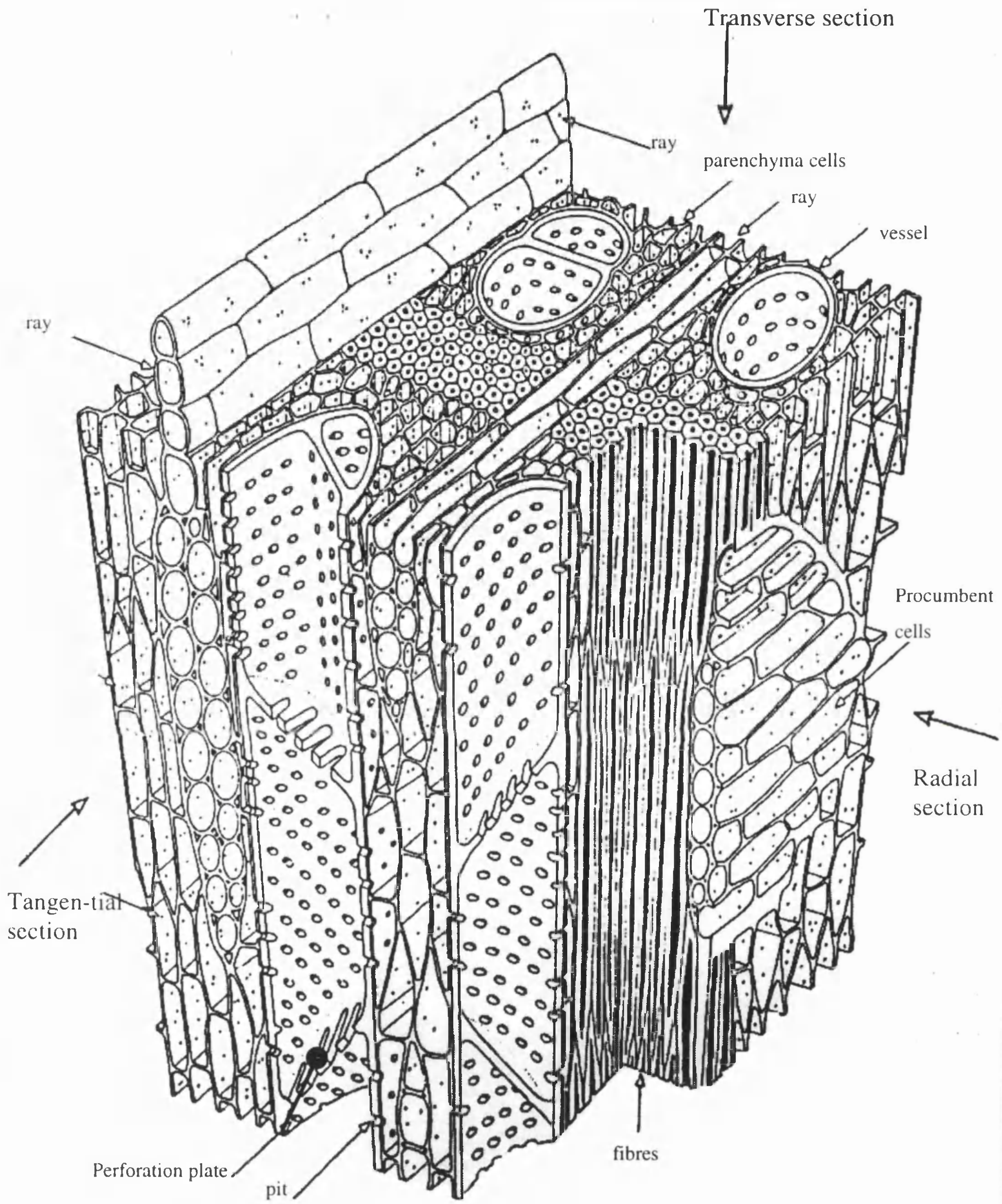


Figure 6.2 Three-dimensional diagram of a cube of wood showing micro-anatomical structure. After Couvert (1970: 44).

Table 6.3 Description of the microscopic anatomical features of wood reference samples.

A Goupia glabra; B Aspidosperma aff. excelsum; C Guatteria aff. Ferruginea; D Paseuxandra aff. coriacea; E Xylopia sp;*F Buchenavia aff. parvifolia; G Licania apetala; H Licania aff. longipedicellata; I Licania octandra; J Tovomita aff. spruceana; K Vismia macrophilla; L Licaria* sp.*1; M Ocotea* sp.*1; N Licaria sp.2; O Ocotea aciphylla; P Swartzia racemosa; Q Bellucia grossularioides; R Mouriri cauliphlora; S Miconia* sp.*1; T Brosimum rubescens; U Virola calophylla; V Iryanthera tricornis; W Minquartia guianensis; X Genipa* sp.*1and Y Duroia eriophilla.*

	Features	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**	**T**	**U**	**V**	**W**	**X**	**Y**
Growth rings	Growth ring boundaries distinct																									
	Growth ring boundaries indistinct	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Porosity	Wood ring porous																									
	Wood semi-ring porous																									
	Wood diffuse porous	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Vessel arrangement	In tangential bands								X																	
	In diag. &/or radial pattern	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	In dendritic pattern																									
Vessel grouping	Exclusively solitary	X	X				X		X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
	In radial groups of 4 or more																									
	vessel cluster common																									
Perforation plate	Simple perforate plate		X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X
	Scalariform perforate plates	X																					X			
	Scalariform >=10 bars																							X		
	Scalariform 10-20 bars																									
	Scalariform 20-40 bars																									
	Scalariform >=40 bars																									
	Reticulate, foraminate etc mult.																						X			
Intervessel pits arragment	Pits scalariform										X	X		X		X										
	Pits opposite	X							X	X		X	X			X					X	X	X			
	Alternate		X	X	X	X	X	X			X		X	X	X	X	X	X	X	X	X	X		X	X	X
	Shape of alt. pits polygonal						X																			
Vestured pits							X																			

Table 6.3 Continued.

	Features	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
Vessel ray pitting	similar to intervessel in size & shape	X	X	X			X		X				X		X		X			X	X				X	X
	apparen. simple round/ang.																									
	apparen. simple horz/scal. to vert.										X			X		X										
	2 diff. sizes in same ray cell									X								X	X			X	X			
	unilaterally compound and coarse																									
	restricted to marginal rows																									
Helical thickenings	Helical thickening in vessel																									
	Helical thick throughout body of vessel element.																									
	Hel. thick.only vessel. tails																									
	Hel. thick. only narrower vessel																									
Tyloses and deposits in vessel	Tyloses common	X	X						X			X	X	X	X	X			X	X	X					X
	Tyloses sclerotic																									
	Gums and other deposits																									
Vascular/vasicentric tracheids																										
Ground tissue fibres	Fibres with simple to minute pits	X																	X							
	Fibres with distinctly bord. pits																									
	Fibres comm in rad & tang walls																									
	Hel. thick. in ground tiss. fibr																									
Septate and parench. like fibr	Septate fibres present													X		X										
	Nonseptate fibres present																									
	Parency. like fibr. bands alternating																									

Table 6.3 Continued.

	Features	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
Fibre/wall thickness	Very thin walled			X	X	X							X	X	X	X	X	X		X		X	X			
	Thin to thick walled						X		X	X																
	Very thick walled	X	X	X						X									X					X	X	
Appotracheal parenchyma	Axial diffuse																									
	Axial diffuse in aggregates																					X		X	X	
Paratracheal axial parenchyma	Axial scanty paratracheal	X																								
	Axial vasicentric																									
	Axial aliform						X		X								X		X		X			X		X
	Axial lozenge/aliform																									
	Axial winged/aliform						X		X								X		X		X					X
	Axial confluent																X									X
	Axial unilateral paratracheal																									
Banded parenchyma	Axial < 3 cells wide		X										X		X	X		X		X				X		
	Axial narrow bands up to 3 cells																									
	Axial reticulate		X	X	X	X				X		X												X		
	Axial scalariform																									
	Axial marginal or seemingly marg. bands.							X			X			X									X			
Axial parench.cell type/strand l.	Fusiform parench. Cell	X	X	X		X					X		X	X		X	X			X	X			X	X	X
	2 cells per parench. Strand																									
	3-4 cells per parench. Strand																									

Table 6.3 Continued.

	Features	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
	5-8 cells per parench. Strand																									
	>8 cells per parench. Strand																									
Ray width	Ray exclusively 1-seriate	X	X				X		X	X		X	X					X		X			X	X		X
	Ray with 1-3 cells wide					X		X			X		X	X	X	X	X		X		X	X		X		
	Rays 4-10-seriate			X	X	X																			X	
	Rays >10-seriate																									
	Rays mult. As wide as unis. portion																									
Aggregate rays																										
Ray height > 1mm																										
Rays of 2 distinct sizes																										
Ray cell. Composition	All ray cells procumbent			X	X	X						X		X	X		X							X	X	
	All ray cells upright &/or sq.						X			X								X								
	Body cells proc. 1 row upright/sq. Marg.															X					X					
	Body cells with 2-4 row up/sq. Marg.								X		X		X							X		X	X	X		
	Body cells >4 up/sq marg.	X	X					X	X										X			X				
	Rays with proc, sq, upri, mixed																									
Sheath cells																										
Tile cells																										
Perforate ray cells																										
Disjunctive ray parench. Cell walls																										

Table 6.3 Continued.

	Features	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
Rays per mm	<=4/mm			X	X	X	X	X	X	X	X		X	X	X	X	X				X	X	X		X	
	4-12 /mm	X	X															X	X	X				X		
	>=12/mm											X														
Storied structure	All rays storied																									
	Low rays storied high nonstoried.																									
	Axial parench &/or vessel element storied																									
	Fibres storied																									
	Rays &/or axial element. irregularly storied																									
Oil &/or mucilage cells	Oil &/or mucilage cells assoc. ray par.																									
	Oil &/or mucilage cells assoc par.																									
	Oil &/or mucilage cells pres. among fibr.																									
Intercellular canals	Axial canals in long tangential lines																									
	Axial canals in short tang. lines																									
	Axial canals diffuse																									
	Radial canals																									
	Intercellular canals of traum. orig.																									
Lactiferous or taniniferous tubes																										
Cambial variants	Inclued phloem concentric																									
	Inclued phloem diffuse																									
Prismatic crystals	Prismatic cryst. present											X			X											
	Prismatic cryst. in up/sq ray cells									X																
	Prismatic cryst. in proc. ray cells																									
	Prismatic cryst. in align. proc. cells																									

Table 6.3 Continued.

	Features	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**	**T**	**U**	**V**	**W**	**X**	**Y**
	Prismatic cryst. chambered up/sq ray cells																									
	Prismatic cryst.non- chamb. ax. parench. cells																									
	Prismatic crystals chamb.ax.par.cells																									
	Prismatic crystals in fibres																									
Silica	Silica bodies in ray cells																									
	Silica bodies in ax. parench. cells																									
	Silica bodies in fibres																									
	Vitreous silica																									

6.2.3. Charring of reference wood samples

Reference samples of different sizes were measured and their weights were taken using a Meter AE 200 balance. Samples were charred, wrapped in tin foil at a temperature between 200 and 300 °C for a period between 30 minutes and two hours 17 minutes, depending on the density of wood, in a Termolyne 1400 muffle furnace. After charring, the samples were re-weighed, they were labelled and stored. These data are recorded in Table 6.4.

Table 6.4 Weights and measurements of wood reference collection samples.

	Length		Width		Thickness		Weight		Temperature °C	Time (hours)
Sample	Uncharred	Charred	Uncharred	Charred	Uncharred	Charred	Uncharred	Charred		
Guatteria cf. ferruginea	2.00	1.90	2.00	1.50	1.50	1.20	1.7796	0.7131	200-300	2.17
Pseudoxandra cf. coriacea	2.00	2.00	1.80	1.30	1.20	0.10	1.7232	0.6830	200-300	0.10
Xylopia sp.	1.90	1.90	2.10	1.30	0.90	0.60	1.3811	0.4828	200-300	1.10
Aspidosperma cf. excelsum	1.30	1.10	3.00	2.00	2.00	1.40	4.4315	1.6289	200-300	1.15
Goupia glabra	2.40	2.30	2.10	1.40	1.40	1.10	2.9018	1.4540	250-300	0.30
Licania apetala	2.00	1.90	2.00	1.40	1.70	1.30	3.7760	1.7938	200-300	1.15
Licania cf. longipedicellata	4.70	3.70	1.80	1.30	1.60	1.20	8.5826	2.9474	200-300	0.45
Licania octandra	1.60	1.60	3.10	2.40	2.60	2.00	7.8653	3.5829	200-300	0.45
Buchenavia aff. parvifolia	3.40	2.10	2.00	1.40	2.00	2.00	6.2854	3.0238	200-300	1.35
Tovomita aff. spruceana	2.40	2.40	2.00	1.30	2.30	1.50	5.0130	1.7959	200-300	0.45
Vismia macrophylla	1.80	1.50	1.30	1.10	1.50	0.80	0.9107	0.2689	200-300	1.10
Licaria sp. 1	2.20	2.20	2.90	2.30	1.70	1.30	7.4607	3.8376	200-300	1.15
Licaria sp. 2	2.50	2.70	2.80	2.50	1.30	0.90	3.8111	1.5833	250-300	0.30
Ocotea aciphylla	1.20	1.20	2.50	2.20	2.00	1.60	1.8501	0.7779	200-300	2.17
Ocotea sp.1	1.30	1.20	2.10	1.50	0.90	0.70	1.2030	0.4629	250-300	1.10
Swartzia racemosa	2.10	2.00	2.00	1.70	1.60	1.30	3.0293	1.8037	200-300	2.17
Bellucia grossularioides	1.60	1.50	1.90	1.30	1.50	1.00	1.2730	0.5093	200-300	2.17
Miconia sp.1	2.20	2.20	2.30	1.70	1.70	1.40	2.3237	0.9271	200-300	0.45
Mouriri cauliflora	2.70	1.80	2.20	1.80	1.40	1.20	3.1260	1.6690	200-300	1.15
Brosimum rubescens	1.30	1.20	5.40	4.60	3.30	2.90	17.6290	8.6609	200-300	0.45
Iryanthera tricornis	1.30	1.20	2.50	1.90	1.50	1.20	1.8524	0.7397	250-300	0.03
Virola calophylla	1.20	1.20	2.10	1.40	1.30	1.00	1.1295	0.1122	250-300	1.10
Minquartia guianensis	4.00	3.00	2.20	3.60	1.30	0.90	4.0471	1.7368	200-300	1.15
Duroia eriophila	2.00	2.00	1.40	1.00	1.20	0.80	1.8863	0.7200	200-300	2.17
Genipa sp.1	2.30	2.10	3.00	2.40	2.30	1.70	6.6877	4.6934	200-300	1.15

6.3. Description and identification of archaeological wood samples

6.3.1. Description of the wood fragments

Wood fragments were fractured to obtain transverse, tangential longitudinal and radial longitudinal surfaces for examination under the microscope. Description of the wood fragments was based on the description of features contained in the reference manual Computer-Aided Wood Identification (Wheeler *et al.* 1986). Although this database was designed for wood description and not for charcoal, it was found useful for the description of several microscopic anatomical features of charcoals.

Descriptions were recorded in a checklist based on the Datasheet published by Wheeler *et al.* 1986, this checklist is shown in Figure 6.3. Presence or absence was recorded for each feature.

An epi-illuminating microscope was used to describe the charred fragments. Magnification ranged between 10 to 400 X depending on the section under view. Features in transverse surfaces were described at lower magnification and features in radial and tangential at higher magnification.

6.3.2. Recording of data

Microscopic anatomical features of the charcoal fragments were described and recorded on the datasheets shown in Figure 6.3. Table 6.5 shows the description of all the archaeological charred wood fragments. Light micro-photographs of archaeological woods were taken with an Olympus camera (OM 2) mounted on an epi-illuminated microscope (Leica DMLM). Scanning electron micro-photographs were taken with an Hitachi (Model S-570) SEM at the Institute of Archaeology, University College London.

Figure 6.3. Wood checklist adapted for charcoal features description. From Wheeler *et al.* (1986: 10-12).

			VESSELS		
	1 - Exclusively Solitary		7 - Multiple Perf. Plates		11 - Pits Opposite or Scalariform
	2 - Radial Groups of 4		8 - Plates with > 20 Bars		14 - Tyloses Abundant
	3 - Radial or Oblique		12 - Pits Vestured		15 - Tyloses Sclerosed
	4 - Tangential Arrangement		13 - Vessels Absent		16 - Deposits or Gum
	5 - Pore Clusters		9 - Spirals in Vessels		
	6 - Perforations Simple		10 - Pits Minute		
			FIBRES/TRACHEIDS		
	23 - Septate Fibres		25 - Pits Distinctly Bordered		27 - Spirals
	24 - Thick Walled Fibres		26 - Tracheids		
			RAYS		
	28 - Commonly > 1mm High		34 - Rays Homocellular		40 - Canals or Latex Tubes
	29 - Exclusively 1-Seriate		35 - Marginal Rows > = 4		41 - Rays Storied
	30 - Commonly 4-10-Seriate		36 - Marginal Rows > = 10		42 - Commonly < 4/mm
	31 - Commonly > 10-Seriate		37 - 2 or 3 Seriate Parts Narrow		43 - Commonly >12/mm
	32 - Aggregate Rays		38 - Tile Cells		44 - Pits to Vessels Large
	33 - Rays 2 Distinct Widths		39 - Sheath Cells		
			PARENCHYMA		
	45 - Predom. Apotracheal		50 - Parench. Absent/Very Rare		55 - Parenchyma Storied
	46 - Diffuse		51 - Banded Parenchyma		56 - Fusiform Cells Common
	47 - Predom. Paratracheal		52 - Bands 1-Seriate		57 - Marginal/Zonate
	48 - Vasicentric		53 - Bands > = 4-Seriate		
	49 - Aliform or Confluent		54 - Bands >= 6/mm		
			OTHER FEATURES		
	58 - Included Phloem		63 - Crystals in Idioblasts		84 - Growth Rings Present
	59 - Vertical Canals		64 - Raphides and Druses		85 - Ring Porous
	60 - Vert. Canals in Tang. Lines		65 - Oil or Mucilage Cells		86 - Semi Ring Porous
	61 - Crystals in Ordinary Cells		66 - Silica		
	62 - Crystals: Chambered Cells		83 - Shurb		

Table 6.5 Description of the anatomical microscopic features of charred wood fragments from archaeological samples. Ceramic levels (manual recovery.) A=Absent. P=Present.

	Vessels														
	Exclusively solitary	Radial groups of 4	Radial or oblique	Tang. arrangement	Pore clusters	Perforations simple	Multiple perf. plates	Plates with > 20 bars	Spirals in vessels	Pits minute	Pits oppos. or scalarif.	Pits vestured	Tyloses abundant	Tyloses sclerosed	Deposits or gum
Sample	1	2	3	4	5	6	7	8	9	10	11	12	14	15	16
5037-	A	A	A	A	A	P		P		A	P				
5074-1	P					P			P	A	A				
5088-1	P										A				
5093-1	P						P				P				
5096-	P						P			A	P			P	
5099-1	P					P				P	A				
5101-1	P														
5506-1	A	A	A	A	A	P					A				
5516-1															
5522-1	A	A	A	A	A	P		P	A	A	P				
5526-1	A	A	A	A	A	P									
5527-1	A	A	A	A	A		P	P		A	P				
5530-	P		P			P				A	A				
5532-1	A	A	A	A	A	P				A	A				
5533-1	A	A	A	A	A		P		P						
5535-1		P				P				A	A				
5537-1	A	A	A	A	A		P			A	A				
5544-1	P					P				A					
5545-1	P						P				P				
5547-1	A	A	A	A	A					A	A				
5551-1	P					P					P				

	Fibres/ Tracheids			Rays													
	Septate fibres	Thick walled fibres	Pits distinctly bordered	Commonly > 1mm high	Exclusively 1-seriate	Commonly 4-10-seriate	Commonly > 10-seriate	Aggregate rays	Rays 2 distinct widths	Rays homocellular	Marginal rows >=4	Marginal rows >=10	2-3 seriate parts narrow	Rays storied	Commonly <4/mm	Commonly >12/mm	Pits vessels large
Sample	23	24	25	28	29	30	31	32	33	34	35	36	37	41	42	43	44
5037-		A		P	A	A	A			A	A	A			P		A
5074-1		A			P					A	P	A					P
5088-1		P		A	A	A	A			A	P	A			A	A	
5093-1		A		A	A	A	A			A					A	A	P
5096-		A		A		P				A	A	A			P		P
5099-1		P		A	A	A	A			P	A	A			A	A	
5101-1		P			A	A	A			A	A	A			A	A	
5506-1		A		P	A	A	A			P			A		A	A	
5516-1																	
5522-1		A	A	P	A	P				A	P	A	A		A	A	P
5526-1		A		P			P			A	A	P			A	A	A
5527-1	A	A	A	P	A	A	A			A	A	A				P	P
5530-		A	P	A	A	A	A			A	P	A	P		A	A	A
5532-1	A	A		A	A	A	A			A	P	A	P		A	A	P
5533-1		A			A	A	A			A	P	A	A				A
5535-1	A	A	A	A	A	A	A			A	P	A	P			P	A
5537-1		A		A						A	P	P	P		A	A	P
5544-1	P	A		A	A	A	A			P					A	A	P
5545-1		P			A	A	A			A	A	A					P
5547-1	A	A	A	A	P					A	A	P			A	A	
5551-1	A	A	A	A	A	A	A			A	P				A	A	P

	Parenchyma												
	Predom. apotracheal	Diffuse	Predom. paratracheal	Vasicentric	Aliform or confluent	Parench. abs./very rare	Banded parenchyma	Bands 1-seriate	Bands >=4-seriate	Bands >=6/mm	Parenchyma storied	Fusiform cells common	Marginal zonate
Sample	45	46	47	48	49	50	51	52	53	54	55	56	57
5037-	P	P											
5074-1	P	P											
5088-1													
5093-1			P	P									
5096-			P		P								
5099-1	P	P											
5101-1		P	P	P									
5506-1			P		P								
5516-1													
5522-1			P	P	P								
5526-1			P	P									
5527-1	P	P											
5530-		P	P										
5532-1	P												P
5533-1	P	P											
5535-1	P	P					P	P		P			
5537-1	P						P			P			
5544-1	P												
5545-1			P		P								
5547-1	P	P											
5551-1	P	P											

Table 6.5 Continued Ceramic levels (manual recovery.) A=Absent. P=Present.

Vessels

Sample	Exclusively solitary	Radial groups of 4	Radial or oblique	Tang. arrangement	Pore clusters	Perforations simple	Multiple perf. plates	Plates with > 20 bars	Spirals in vessels	Pits minute	Pits oppos. or scalarif.	Pits vestured	Tyloses abundant	Tyloses sclerosed	Deposits or gum
5560-1	A	A	A	A	A						A				
5572-1	A	A	A	A	A	A			P	A	A				
5576-1	A	A	A	A	P	P				P	A				
5581-	P					P				A	A	P			
5586-1	A	A	A	A	P					A	A				

Fibres/ Tracheids

Sample	Septate fibres	Thick walled fibres	Pits distinctly bordered
5560-1	A	A	A
5572-1	A	A	A
5576-1		P	
5581-	A	A	A
5586-1	A	A	A

Rays

Sample	Commonly > 1mm high	Exclusively 1-seriate	Commonly 4-10-seriate	Commonly > 10-seriate	Aggregate rays	Rays 2 distinct widths	Rays homocellular	Marginal rows >=4	Marginal rows >=10	2-3 seriate parts narrow	Rays storied	Commonly <4/mm	Commonly >12/mm	Pits vessels large
5560-1		P					P			A				A
5572-1	A	P					A	A	A	A		A	A	A
5576-1	A		P				P					A	A	
5581-	A	A	A	A			A	P				A	A	A
5586-1		A	A	A			A	P				A	A	

Parenchyma

Sample	Predom. apotracheal	Diffuse	Predom. paratracheal	Vasicentric	Aliform or confluent	Parench. abs./very rare	Banded parenchyma	Bands 1-seriate	Bands >=4-seriate	Bands >=6/mm	Parenchyma storied	Fusiform cells common	Marginal zonate
5560-1	P	P											
5572-1			P		P								
5576-1	P	P											
5581-	P						P			P			
5586-1		P	P	P									

Table 6.5 Continued. Ceramic levels (water screening) A=Absent. P=Present.

	Sample	5024-1	5024-2	5040-2	5040-3	5040-4	5040-1	5050-7	5050-3	5050-1	5050-5	5050-6	5050-11	5050-10	5050-8	5050-9	5050-2	5050-4	5072-1	5080-1	5080-2
Parenchyma	Marginal zonate	P																			
	Fusiform cells common																				
	Parenchyma storied																				
	Bands >=6/mm												P	P	P	P		P			
	Bands >=4-seriate												P	P	P	P					
	Bands 1-seriate																	P			
	Banded parenchyma						P						P	P	P	P		P			
	Parench. abs./very rare																				
	Aliform or confluent			P				P	P	P	P								P		
	Vasicentric																P				
	Predom. paratracheal			P	P			P		P	P				P				P		
	Diffuse		P		P	P	P		P			P									P
	Predom. apotracheal	P	P			P						P					P	P			P
Rays	Pits vessels large	P	A	P	P	A		A	P	P		A	A	A	A	A		P	A		
	Commonly >12/mm	A		A	P	P		P		P	A	A	A	A	A	A			P	A	A
	Commonly <4/mm	A		A							A	A	A	A	A	A				A	A
	Rays storied																				
	2-3 seriate parts narrow	A		A		A		A	A	A		A		A		A		A	A		
	Marginal rows >=10	P		A	A	A		A	A	A	A	A	A	A	A	A	A	P			
	Marginal rows >=4	A	P	P	A	A	P	A	P	A	A	P	A	A	P	A	P	A			
	Rays homocellular	A	A	A	P	A	P	A	A	A	P	A	A	A	A	A	A	A	P		P
	Rays 2 distinct widths			A																	
	Aggregate rays			A																	
	Commonly > 10-seriate			A	A	A	A	A	A	A	A		A	A	A	A	A			A	A
	Commonly 4-10-seriate			A	A	A	P	A	A	A	A		A	A	A	A	A			A	A
	Exclusively 1-seriate	P		A	P	P	A	A	P	P	A	P	A	A	A	A	P		P	A	A
	Commonly > 1mm high	A		A	A	A		A		P	A	A		A	A	A			A	P	A
Fibres/ Tracheids	Pits distinctly bordered	A		P	A	A				A	A	A			A				A		
	Thick walled fibres	P	A	P	A	A	A	P	P	P	A		P	P	P	P	P	A	A	A	A
	Septate fibres	A		A	A	A				A	A	A			A				A		
Vessels	Deposits or um																				
	Tyloses sclerosed							P					P	P	P	P					
	Tyloses abundant	P											P	P	P	P					
	Pits vestured																				
	Pits oppos. or scalarif.	P		P	A	A	P	A			A		A	A	A	A			A	P	P
	Pits minute		A	A	A	A		P			A		A	A	A	A			P		
	Spirals in vessels			A								P					P				
	Plates with > 20 bars																				
	Multiple perf. plates	P	A	P				P		P				P	P		P	P		P	
	Perforations simple				P	P	P		P			P	P			P					
	Pore clusters	A			A	A													A	A	
	Tang. arrangement	A			A	A													A	A	
	Radial or oblique	A		P	A	A	P		P								P		A	A	
	Radial groups of 4	A			A	A													A	A	
	Exclusively solitary	A	P	P	A	A	P	P	P	P	P	P	P	P	P	P	P	P	A	A	P

Table 6.5 Continued. Ceramic levels (water screening) A=Absent. P=Present.

	Vessels														
Sample	Exclusively solitary	Radial groups of 4	Radial or oblique	Tang. Arrangement	Pore clusters	Perforations simple	Multiple perf. Plates	Plates with > 20 bars	Spirals in vessels	Pits minute	Pits oppos. Or scalarif.	Pits vestured	Tyloses abundant	Tyloses sclerosed	Deposits or gum
5080-3	A	A	A	A	A		P								
5096-4	P						P			A	P				
5096-2	P					P					A				
5096-1	P				A		P			A	P		P	P	
5096-3	P						P	P		A	A				

	Fibres/ Tracheids		
Sample	Septate fibres	Thick walled fibres	Pits distinctly bordered
5080-3	A		A
5096-4	A	A	A
5096-2		A	
5096-1		A	
5096-3	A	A	A

	Rays													
Sample	Commonly > 1mm high	Exclusively 1-seriate	Commonly 4-10-seriate	Commonly > 10-seriate	Aggregate rays	Rays 2 distinct widths	Rays homocellular	Marginal rows >=4	Marginal rows >=10	2-3 seriate parts narrow	Rays storied	Commonly <4/mm	Commonly >12/mm	Pits vessels large
5080-3	P	A	A	A			P	A	A	A		P		P
5096-4		A	A	A			A	A	A	A		A	A	P
5096-2		A	A	A			P	A	A					
5096-1	P		P	A	A	A	A	A	A	A		A	A	A
5096-3							P	A	A		A	A	A	A

	Parenchyma												
Sample	Predom. Apotracheal	Diffuse	Predom. paratracheal	Vasicentric	Aliform or confluent	Parench. Abs./very rare	Banded parenchyma	Bands 1-seriate	Bands >=4-seriate	Bands >=6/mm	Parenchyma storied	Fusiform cells common	Marginal zonate
5080-3													
5096-4	P	P											
5096-2			P	P	P								
5096-1	A		P		P								
5096-3	P	P											

Table 6.5 Continued. Ceramic levels (Flotation) A=Absent. P=Present.

	Sample	5003-1	5514-1	5516-1	5518-1	5522-1	5529-1	5531-1	5533-1	5534-1	5544-1	5551-	5553-1	5554-1	5556-1	5558-1	5561-1	5563-1	5565-1
Parenchyma	Marginal zonate																		
	Fusiform cells common																		
	Parenchyma storied																		
	Bands >=6/mm														P				
	Bands >=4-seriate																		
	Bands 1-seriate																		
	Banded parenchyma		P		P										P				
	Parench. Abs./very rare																		
	Aliform or confluent	P	P	P			P		P										
	Vasicentric							P	P	P		P				P	P		
	Predom. paratracheal	P	P	P	P		P	P	P	P		P				P	P	P	
	Diffuse				P	P			P				P	P				P	
	Predom. Apotracheal					P							P	P	P				
Rays	Pits vessels large	A		A	P	A	A		P	A			A	A		P	A	P	A
	Commonly >12/mm	A	A			P			A	A		A		P		A			
	Commonly <4/mm	A	A						A	A		A				A			
	Rays storied		P																
	2-3 seriate parts narrow			P		A	P		A			A				P			
	Marginal rows >=10	A	A	A	A	A	P	A	A	A		A	A	A	A	P	P	A	A
	Marginal rows >=4	A		P	A	A	P	P	P	P		P	P	P	A	A	P	P	P
	Rays homocellular	P	P		A	P	A	A	A	A		A		A	A	A	A	A	A
	Rays 2 distinct widths																	A	
	Aggregate rays																	A	
	Commonly > 10-seriate		A	A	A	A		A	A	A		A			A	A	A	A	
	Commonly 4-10-seriate		A	A	A	A		A	A	A		A			A	A	A	A	
	Exclusively 1-seriate	P	A	A	A	P		A	A	A		A		P	A	A	A	A	
	Commonly > 1mm high	A			P	A		A	P	A		A		A		A			
Fibres/ Tracheids	Pits distinctly bordered	A			A	A			A	A			P			A		P	
	Thick walled fibres	P	P	A	A	A		P	A	A		P	A	P		P	A	A	P
	Septate fibres	A				A	P		A	A						A			
Vessels	Deposits or gum																		
	Tyloses sclerosed			P															
	Tyloses abundant															P			
	Pits vestured																		
	Pits oppos. Or scalarif.	A	A	A	P	A			P	A		A	A	A	P	A		P	
	Pits minute	A		A		A			A	A		A	A	A	A	A			
	Spirals in vessels	P								P			P						
	Plates with > 20 bars																		
	Multiple perf. Plates	P	A				A					P		A	P		A	P	
	Perforations simple		P	P	P	P										P			P
	Pore clusters		A		A				A	A						A			
	Tang. Arrangement		A		A				A	A						A			
	Radial or oblique		A		P	P			A	A						A			
	Radial groups of 4		A						A	A						A			
	Exclusively solitary	P	A	P	P	P	P	P	A	A		P	P	P	P	A	P	P	P

Table 6.5 Continued. Ceramic levels (Flotation) A=Absent. P=Present.

	Sample	5566-1	5568-1	5571-1	5573-1	5576-1	5585-1	5587-1
Parenchyma	Marginal zonate							
	Fusiform cells common	A						
	Parenchyma storied							
	Bands >=6/mm		P				A	P
	Bands >=4-seriate							P
	Bands 1-seriate		P				P	
	Banded parenchyma		P				P	P
	Parench. abs./very rare							
	Aliform or confluent	P			P			
	Vasicentric	P			P			
	Predom. paratracheal	P			P			P
	Diffuse			P		P		
	Predom. apotracheal		P	P		P	P	
Rays	Pits vessels large		A	A	P	P	P	A
	Commonly >12/mm			P	A	P	P	A
	Commonly <4/mm				A			A
	Rays storied	A						A
	2-3 seriate parts narrow		A			A	A	A
	Marginal rows >=10	A		A	A	A	A	A
	Marginal rows >=4	P		A	A	A	A	A
	Rays homocellular	A	P	P	P	A	P	P
	Rays 2 distinct widths	A				A		A
	Aggregate rays	A				A		A
	Commonly > 10-seriate	A			A		A	A
	Commonly 4-10-seriate	A	P		A		A	A
	Exclusively 1-seriate	A		P	A	P	P	A
	Commonly > 1mm high	P	P	A	A	A	A	A
Fibres/ Tracheids	Pits distinctly bordered	A				A	A	A
	Thick walled fibres	A	P	A	A	A	A	A
	Septate fibres	A				A	A	A
Vessels	Deposits or gum							
	Tyloses sclerosed							
	Tyloses abundant						P	
	Pits vestured							
	Pits oppos. or scalarif.	P	A	A	P	A	P	A
	Pits minute			A		P	A	P
	Spirals in vessels	A	P				A	A
	Plates with > 20 bars							
	Multiple perf. plates				P	P		
	Perforations simple	P		P			P	P
	Pore clusters	A				A		A
	Tang. arrangement	A				A		A
	Radial or oblique	P				A		A
	Radial groups of 4					A		A
	Exclusively solitary	P	P	P	P	A	P	A

Table 6.5 Continued. Pre-ceramic levels (manual recovery) A=Absent. P=Present.

Group	Sample	5121-1	5125-1	5149-1	5593-1	5594-1	5597-1	5603-	5609-1	5610-1	5616-1	5623-1	5624-	5631-1	5636-1	5636-	5637-1	5646-1	5651-1	5654-
Parenchyma	Marginal zonate																			
	Fusiform cells common																			
	Parenchyma storied																			
	Bands >=6/mm			P						P		P		P		P				P
	Bands >=4-seriate			P				P								P				P
	Bands 1-seriate									P		P				A				
	Banded parenchyma			P				P		P		P		P		P				P
	Parench. abs./very rare																			
	Aliform or confluent		P		P				P		P		P							
	Vasicentric								P						P		P			
	Predom. paratracheal		P	P	P			P	P		P		P	P	P	P	P			P
	Diffuse	P				P	P											P	P	
	Predom. apotracheal	P				P	P			P		P						P	P	
Rays	Pits vessels large	P	P		P	P	P	A			P				P	A	P		A	A
	Commonly >12/mm		A	P	A	A	A	A		A			A	A	A		A	A	A	P
	Commonly <4/mm		A		A	A	A	A		A	P		A	A	A		A	A	A	
	Rays storied																			
	2-3 seriate parts narrow					P					A								A	A
	Marginal rows >=10		A		A	A	A	A		A	A	A	A		A		A		A	A
	Marginal rows >=4	P	P		P	A	A	A		P	P	A	A		A	P			P	P
	Rays homocellular	A	A		A	A	P	P	P	A	A	P	P	P	P	A		P	A	A
	Rays 2 distinct widths																		A	
	Aggregate rays																	P	A	
	Commonly > 10-seriate	A	A		A	A	A	A		A			A	A	A	A	A			A
	Commonly 4-10-seriate	A	A		A	A	A	P		A	P	P	A	A	P	A	A	P	P	A
	Exclusively 1-seriate	A	A	P	A		A	A	P	A			A	A	A	P	A			A
	Commonly > 1mm high		P	A	P			A			P	P	A		A		P	P	A	A
Fibres/ Tracheids	Pits distinctly bordered		A	A	A	A	A	A	A								A		P	
	Thick walled fibres	A	A	P		A		P	A	P	P	P	P	P	A	P	P	A	P	P
	Septate fibres		A	A	A	P	A	A	A			A					A			
Vessels	Deposits or gum																			
	Tyloses sclerosed																			
	Tyloses abundant			P				P	P					P						P
	Pits vestured																			
	Pits oppos. or scalarif.	P	P	A	P	A	P	A	A	P	P	A	P	A	A	A	A	A	A	A
	Pits minute		A	A		A		A	A			P		A	A	A	A	A	P	A
	Spirals in vessels															A	P			
	Plates with > 20 bars																			
	Multiple perf. plates												P					P		P
	Perforations simple			P	P	P	P	P	P	P		P		P	P	P	P		P	
	Pore clusters					A	A			A	A	A	A				A		P	A
	Tang. arrangement					A	A			A	A	A	A				A			A
	Radial or oblique					A	A			A	A	A	A				A			A
	Radial groups of 4					A	A			A	A	A	A				A		P	A
	Exclusively solitary	P	P	P	P	A	A	P	P	A	A	A	A	P	P	P	A	P		A

Table 6.5 Continued. Pre-ceramic levels (manual recovery) A=Absent. P=Present.

Sample	Vessels														
	Exclusively solitary	Radial groups of 4	Radial or oblique	Tang. arrangement	Pore clusters	Perforations simple	Multiple perf. plates	Plates with > 20 bars	Spirals in vessels	Pits minute	Pits oppos. or scalarif.	Pits vestured	Tyloses abundant	Tyloses sclerosed	Deposits or gum
5678-1	A	A	A	A	P	P				P	A				
5693-1															
5695-1	A				A		P			A	A				
5752-1	P					P					A				
5733-I.II	P					P				A	A		P		
5755-1	P					P									

Sample	Fibres/ Tracheids		
	Septate fibres	Thick walled fibres	Pits distinctly bordered
5678-1	A	A	A
5693-1			
5695-1			
5752-1		P	
5733-I.II		P	
5755-1		P	

Sample	Rays													
	Commonly > 1mm high	Exclusively 1-seriate	Commonly 4-10-seriate	Commonly > 10-seriate	Aggregate rays	Rays 2 distinct widths	Rays homocellular	Marginal rows >=4	Marginal rows >=10	2-3 seriate parts narrow	Rays storied	Commonly <4/mm	Commonly >12/mm	Pits vessels large
5678-1	A	A	A	A			A	P	A			A	A	A
5693-1														
5695-1		P					A	P	A			A	A	P
5752-1	A	A	A	A			A	P	A			A	A	A
5733-I.II	A	P					P	A	A	A		A	A	A
5755-1		A	A	A			A	P						

Sample	Parenchyma												
	Predom. apotracheal	Diffuse	Predom. paratracheal	Vasicentric	Aliform or confluent	Parench. abs./very rare	Banded parenchyma	Bands 1-seriate	Bands >=4-seriate	Bands >=6/mm	Parenchyma storied	Fusiform cells common	Marginal zonate
5678-1	P	P											
5693-1													
5695-1	P						P			P			
5752-1	P						P	P		P			
5733-I.II	P						P	A	A	P			
5755-1			P		P								

Table 6.5 Continued. Preceramic levels (water screening). A=Absent. P=Present.

	Sample	5117-1	5126-SW	5126-NW	5134-1	5136-1	5137-1	5142-1	5147-1	5148-1	5151-1	5152-1	5154-1	5155-1	5157-1	5158-1	5159-1	5161-1	5163-1
Parenchyma	Marginal zonate																P		
	Fusiform cells common																		
	Parenchyma storied																		
	Bands >=6/mm	A	P	P					P				P	P		P		P	
	Bands >=4-seriate	A	P	P					P										
	Bands 1-seriate	A											P	P		P		P	
	Banded parenchyma	A	P	P					P				P	P		P		P	
	Parench. abs./very rare																		P
	Aliform or confluent									P		P			P				
	Vasicentric				P	P													
	Predom. paratracheal		P		P	P				P	P	P			P				
	Diffuse	P						P											
	Predom. apotracheal	P						P					P	P		P	P	P	
Rays	Pits vessels large		A	A	A	P		P	A	A	A	P	A	A	P	P	P	P	P
	Commonly >12/mm	P	A	A	A	A	A	P	A	A		A	A	P	A		P	P	A
	Commonly <4/mm		A	A	A	A	A		A	A		A	A		A	P			A
	Rays storied							A											A
	2-3 seriate parts narrow		A	A	A			A	A	A		A	A		A	A			A
	Marginal rows >=10	A	A		A		A	A	A	A			A	A	A	A	A		P
	Marginal rows >=4	A	P		P	P	A	P	A	P	P	P	A	A	P	A	P		A
	Rays homocellular	P			A	A	A	A	P	A	A	A	P	P	A	P	A	P	A
	Rays 2 distinct widths							A											A
	Aggregate rays							A											A
	Commonly > 10-seriate	A	A	A	A	A	A	A	A	A		A	A	A	A		A		A
	Commonly 4-10-seriate	P	A	A	A	A	A	A	A	A		A	P	A	A	P	A		A
	Exclusively 1-seriate	A	A	A	A	A	A	P	A	A		A	A	A	A		A	P	A
	Commonly > 1mm high	P	A	A	A	P	A	A	A	A		A	P	A	A	P	A	P	P
Fibres/ Tracheids	Pits distinctly bordered				P		A	A		A			A	P	A		A		A
	Thick walled fibres		P	P	P	P	A	A	P	P		A	P	P	A		A	P	P
	Septate fibres						A	A		A				A	A		A		
Vessels	Deposits or gum																		
	Tyloses sclerosed																		
	Tyloses abundant	P	P			P						P							
	Pits vestured																		
	Pits oppos. or scalarif.	A	A	A	A	P	A	A	A	A	A	A	A	A	A	A	A	P	A
	Pits minute	P	A	P	A	A	A	A	A	A		A	A		A	P		A	P
	Spirals in vessels			P			A												
	Plates with > 20 bars																		
	Multiple perf. plates							P									P		
	Perforations simple	P	P	P		P	P		P			P	P	P	P	P			P
	Pore clusters			A		A	A	A	A		P	P	A		A	A	A		
	Tang. arrangement			A		A	A	A	A			A	A		A	A	A		
	Radial or oblique			A		A	A	A	A			A	A		A	A	A	P	
	Radial groups of 4			A		A	A	A	A			A	A		A	A	A		P
	Exclusively solitary	P	P	A	P	A	A	A	A	P	P	A	A	P	A	A	A	P	

Table 6.5 Continued. Preceramic levels (water screening). A=Absent. P=Present.

	Sample	5166-	5169-	5174-1a	5174-1b	5177-1	5182-1	5193-1
Parenchyma	Marginal zonate							
	Fusiform cells common							
	Parenchyma storied							
	Bands >=6/mm		P				P	
	Bands >=4-seriate		P				A	
	Bands 1-seriate						A	
	Banded parenchyma		P			P	P	
	Parench. abs./very rare							
	Aliform or confluent	P			P	P		P
	Vasicentric	P		P	P	P		
	Predom. paratracheal	P		P	P	P	P	P
	Diffuse			P				
	Predom. apotracheal							
Rays	Pits vessels large	A	A	P	A	A		A
	Commonly >12/mm	P	A	A	A	A	P	P
	Commonly <4/mm		A	A	A	A		
	Rays storied							A
	2-3 seriate parts narrow	A	A	A	A	A	A	A
	Marginal rows >=10	A				A	A	A
	Marginal rows >=4	A	P	P		A	A	A
	Rays homocellular	P	A		P	A	P	P
	Rays 2 distinct widths							A
	Aggregate rays							A
	Commonly > 10-seriate		A	A	A	A	A	A
	Commonly 4-10-seriate		A	A	A	A	A	A
	Exclusively 1-seriate	P	A	A	A	A	P	P
	Commonly > 1mm high	A	A	P	A	A	A	
Fibres/ Tracheids	Pits distinctly bordered			A	A		A	A
	Thick walled fibres	A	P	A	P	A	A	A
	Septate fibres			A	A	A	A	A
Vessels	Deposits or gum							
	Tyloses sclerosed						P	
	Tyloses abundant						P	
	Pits vestured							
	Pits oppos. or scalarif.	A	A	P	A	A	A	A
	Pits minute	A	P		A	A	A	A
	Spirals in vessels							
	Plates with > 20 bars							
	Multiple perf. plates							
	Perforations simple	P	P		P	P	P	P
	Pore clusters	A	A	A		A	A	
	Tang. arrangement	A	A	A		A	A	
	Radial or oblique	A	A	A		A	A	
	Radial groups of 4	A	A	A		A	A	
	Exclusively solitary	A	A	A	P	A	A	P

Table 6.5 Continued. Pre-ceramic levels (flotation). A=Absent. P=Present.

	Vessels															Fibres/ Tracheids			Rays														Parenchyma												
	Exclusively solitary	Radial groups of 4	Radial or oblique	Tang. arrangement	Pore clusters	Perforations simple	Multiple perf. plates	Plates with > 20 bars	Spirals in vessels	Pits minute	Pits oppos. or scalarif.	Pits vestured	Tyloses abundant	Tyloses sclerosed	Deposits or gum	Septate fibres	Thick walled fibres	Pits distinctly bordered	Commonly > 1mm high	Exclusively 1-seriate	Commonly 4-10-seriate	Commonly > 10-seriate	Aggregate rays	Rays 2 distinct widths	Rays homocellular	Marginal rows >=4	Marginal rows >=10	2-3 seriate parts narrow	Rays storied	Commonly <4/mm	Commonly >12/mm	Pits vessels large	Predom. apotracheal	Diffuse	Predom. paratracheal	Vasicentric	Aliform or confluent	Parench. abs./very rare	Banded parenchyma	Bands 1-seriate	Bands >=4-seriate	Bands >=6/mm	Parenchyma storied	Fusiform cells common	Marginal zonate
5580-	P																P		A	P					P						P		P						P	P		P			
5591-1	P										A						A		P		P				A	P	A			A	A	A	P	P											
5592-1	A	A	A	A	A		P		P	P	A					A	A	A	A	P	A	A			A	A	P	A			P	P	P						P	P					P
5593-1	P						P	P								A		A	P	A	A	A			A	P	A			A	A	P			P		P								
5595-1	P					P			P	A							P		A	A	A	A			A	P	A			A	A				P										
5604-1	P			P						A	A						P			A	A	A			P	P	A					A			P		P								
5616-1	P					P				P	A						P		A	A	A	A			A	A	A	P		A	A	A	P						P			P			
5623-1	P		P			P					A					A			A	A	A	A			P	A	A	A		A	A	A													
5629-1	A	A	A	A	P	P			P	P	A					A	P	A	P	A	P				A	P	P	A				A	P	P											
5637-	P					P			A	A	A					A	P	A	A	P					A	P	A	A			P	A			P		P								
5642-	P					P					P						P		A	A	A	A			A	P	A			A	A	P		P	P										
5647-1	A	A	A	A	A	P				P	A						A	P	A	A	A	A			A	P	A	A			P	P													
5651-1	P								P		A						P		A	A	A	A								A	A				P	P									
5656-1	A	A	A	A	A	P				A	A					A	A	A	P	P	A	A			A	A	A	A			P	P			P		P								
5662-1	p									A	A					A	A	A	A	P	A	A			P	A	A	A	A	A	A	P	P	P											
5671-1	A	A	A	A	P	P				P	A					A	A	A	A	A	A	A			A	P	A	A		A	A	A		P	P	P									
5675-1	P					P				A	P					A	P	A	A	P					A	P	A					P	P						P			P			
5676-1	A	A	A	A	A				P								P		P		P				P	A	A			A	A		P						P	P		P			
5678-1	P						P		P		A						A		A	A	A	A			P					A	A	P		P	P										

Table 6.5 Continued. Pre-ceramic levels (flotation). A=Absent. P=Present.

		5679-1	5681-1	5715-	5749-1	5757-	5773-1
Parenchyma	Marginal zonate	P					
	Fusiform cells common						
	Parenchyma storied						
	Bands >=6/mm					P	P
	Bands >=4-seriate						
	Bands 1-seriate						P
	Banded parenchyma					P	P
	Parench. abs./very rare						
	Aliform or confluent		P	P			
	Vasicentric		P				
	Predom. paratracheal		P	P			
	Diffuse					P	
	Predom. apotracheal	P				P	P
Rays	Pits vessels large	P			A	A	P
	Commonly >12/mm	A	A	A	A	A	P
	Commonly <4/mm	A	A	A	A	A	A
	Rays storied						
	2-3 seriate parts narrow			A	A		A
	Marginal rows >=10	A	A		A	A	A
	Marginal rows >=4	P	A	P	A	A	P
	Rays homocellular	A	P	A	A	P	A
	Rays 2 distinct widths						
	Aggregate rays						
	Commonly > 10-seriate		A	A		A	A
	Commonly 4-10-seriate		A	A		A	A
	Exclusively 1-seriate	P	A	A	P	A	A
	Commonly > 1mm high	A	A	A	A	A	A
Fibres/ Tracheids	Pits distinctly bordered	A	A	A		A	A
	Thick walled fibres	A	P	P		A	A
	Septate fibres	A	A	A		A	
Vessels	Deposits or gum						
	Tyloses sclerosed						
	Tyloses abundant	P					P
	Pits vestured						
	Pits oppos. or scalarif.	A	A	A	A	A	A
	Pits minute	A			A	A	
	Spirals in vessels				P	A	
	Plates with > 20 bars						
	Multiple perf. plates	P					
	Perforations simple		P	P	P	P	P
	Pore clusters	A	A			A	A
	Tang. arrangement	A	A			A	A
	Radial or oblique	A	A			A	A
	Radial groups of 4	A	A			A	A
	Exclusively solitary	A	A	P	P	A	A

Table 6.5 Continued. Pit 5. A=Absent. P=Present.

	Sample	705-1	705-2	706-1	706-2	707-1	707-2	708-1	708-2	709-1	709-2	710-1	710-2	711-1	711-2	712-1	712-2	713-1	713-2	714-1
Parenchyma	Marginal zonate														P					
	Fusiform cells common																			
	Parenchyma storied																			
	Bands >=6/mm	P	P		P				P			P	P			P	P	P		
	Bands >=4-seriate																			
	Bands 1-seriate	P	P		P							P	P							
	Banded parenchyma	P	P		P				P			P	P			P	P	P		
	Parench. abs./very rare																			
	Aliform or confluent			P													A		A	
	Vasicentric						P							P			A		A	
	Predom. paratracheal			P			P			P				P			A		A	P
	Diffuse					P								P					P	
	Predom. apotracheal	P	P		P	P			P			P	P		P	P	P	P	P	
Rays	Pits vessels large	A		P	A	A	P		P	A	P	A	A		P	A	P	A	A	A
	Commonly >12/mm	A	A	A	A		A		P	A		P	A	A	P	P	P	P	P	A
	Commonly <4/mm	A	A	A	A		A	P		A			A	A						A
	Rays storied																			
	2-3 seriate parts narrow	A				A	A				A	A			A	A	A		A	A
	Marginal rows >=10	P	A	A	A	A	A	A	A	A	A				A	A	A	A	A	A
	Marginal rows >=4	P	A	A	P	A	A	A	A	A	A	P	P	P	P	A	A	A	P	A
	Rays homocellular	A	A	P	A	A	P	A	P	P	A	A	A	A	A	P	P	P	A	P
	Rays 2 distinct widths																		A	
	Aggregate rays																		A	
	Commonly > 10-seriate		A	A	A	A	A				A	A	A	A		A			A	A
	Commonly 4-10-seriate		A	A	A	A	A				A	A	A	A		A			A	A
	Exclusively 1-seriate	P	A	A	A	A	A		P	P	A	A	A	A	P	A	P	P	P	P
	Commonly > 1mm high	A	A	A	A	A	A	P	A	A	A	A	A	A	P	A	A	A		A
Fibres/ Tracheids	Pits distinctly bordered		A	A		A		A		A	A			A	A		P	A		
	Thick walled fibres	P		P	P		A	A	P		A	A	A	P	A	A	P	P	A	
	Septate fibres			A		A		A	A		A			A	A	A	A	A	A	
Vessels	Deposits or gum																			
	Tyloses sclerosed			P																P
	Tyloses abundant																			
	Pits vestured																			
	Pits oppos. or scalarif.		A			A	A	P	A	A	A	A	P	A	A	A	A	A	A	A
	Pits minute		A			A	A	A	A	A	A	P			P	P	P	A	A	P
	Spirals in vessels									P						A		A	P	
	Plates with > 20 bars																			
	Multiple perf. plates														P					
	Perforations simple		P	P	P	P			P			P			P	P	P	P	P	P
	Pore clusters		A				A				A	A			A	A				A
	Tang. arrangement		A				A				A	A			A	A				A
	Radial or oblique		A				A				A	A			A	A			P	A
	Radial groups of 4		A				A				A	A	P		A	A				A
	Exclusively solitary	P	A	P	P	P	A	P	P	P	A	A		P	A	A	P	P	P	A

Table 6.5 Continued. Pit 5. A=Absent. P=Present.

Group	Feature	714-2	715-1	715-2	716-1	716-2	717-1	717-2	718-2	719-1	719-2	720-1	720-2	721-1	721-2	722-1	722-2	723-1	723-1	724-1
Parenchyma	Marginal zonate																			
	Fusiform cells common																			
	Parenchyma storied												P							
	Bands >=6/mm			P	P				P	P		P						P		P
	Bands >=4-seriate			P								A								
	Bands 1-seriate											P								
	Banded parenchyma			P	P				P	P		P	P	P				P	P	P
	Parench. abs./very rare																			
	Aliform or confluent	P	P	P		P		P			P	A				P				
	Vasicentric		P								P	A								
	Predom. paratracheal	P	P	P		P		P			P	A				P				
	Diffuse	P			P		P								P				P	
	Predom. apotracheal				P		P		P	P		P	P	P	P			P	P	P
Rays	Pits vessels large	P	A	A	P	A	A		A		P	A	A	P	P	A	A	A	P	P
	Commonly >12/mm	P	A	P	A		P	A	P	P			P	P	P	A	A	A	P	P
	Commonly <4/mm		A		A	P		A									A	A		
	Rays storied								P		A									
	2-3 seriate parts narrow			A	A	A	A		A			A		A	A	A			A	A
	Marginal rows >=10	A		A	A	A	A		A	A	A	A		A	A	A	A	A	A	A
	Marginal rows >=4	P		A	A	A	A		A	A	A	A	P	A	A	A	A	P	A	A
	Rays homocellular	A	P	P	A	P	P	P	P	P	A	P		A	P	A	P	A	P	P
	Rays 2 distinct widths										A	A							A	
	Aggregate rays										A	A							A	
	Commonly > 10-seriate	A	A	A	A	A		A	A		A	A		A	A	A	A	A		
	Commonly 4-10-seriate	A	A	A	A	A		A	A		P	A		A	A	A	A	A		
	Exclusively 1-seriate	P	A	A	A	A	P	A	A		A	P	P	A	P	A	A	A	P	P
	Commonly > 1mm high	A	A	A	A	A	A		A	P	A		A	A	A	P	A	A		A
Fibres/ Tracheids	Pits distinctly bordered					A			A		A		A		A	A	A	A	A	A
	Thick walled fibres	A	P	P	A	A	A	P	A		A	A	A	A	A	P	P	A	A	P
	Septate fibres		A			A			A		A	A	A		A		A	A	A	A
Vessels	Deposits or gum																			
	Tyloses sclerosed																			
	Tyloses abundant																			
	Pits vestured																			
	Pits oppos. or scalarif.	A		A	A	A	A	A	A		P	A	A	A	A	A	A	A	A	
	Pits minute	A		A	A	A	P		P		A	A	P	P	A	P	P	A	A	
	Spirals in vessels																			
	Plates with > 20 bars																			
	Multiple perf. plates																			
	Perforations simple		P	P	P	P	P	P	P	P		P	P		P	P	P	P	P	P
	Pore clusters	A		A	A	A	A	A						A	A			A	A	
	Tang. arrangement	A		A	A	A	A	A						A	A			A	A	
	Radial or oblique	A		A	A	A	A	A			P			A	A			A	A	
	Radial groups of 4	A		A	A	A	A	A						A	A			A	A	
	Exclusively solitary	A	P	A	A	A	A	A	P	P	P	P	P	A	A	P	P	A	A	P

Table 6.5 Continued. Pit 5. A=Absent. P=Present.

	Sample	724-2	725-1	725-2	726-1	726-2	727-1	728-1	728-2	729-1	729-2	
Parenchyma	Marginal zonate											
	Fusiform cells common											
	Parenchyma storied											
	Bands >=6/mm	P		P	P				P			
	Bands >=4-seriate				A							
	Bands 1-seriate	P		P	A							
	Banded parenchyma	P	P	P	A				P			
	Parench. abs./very rare											
	Aliform or confluent											
	Vasicentric					P						
	Predom. paratracheal					P						
	Diffuse		P		A					P	P	
	Predom. apotracheal	P	P	P	P		P		P	P	P	
Rays	Pits vessels large	A	P	P	P	P	P		A	A	A	
	Commonly >12/mm	P	P	P		A	A		A		A	
	Commonly <4/mm					A	A		A	P	A	
	Rays storied											
	2-3 seriate parts narrow		P	A	P	A	A			A	A	
	Marginal rows >=10	A	A	A	A		A		P	P	A	
	Marginal rows >=4	A	A	A	A	P	A	P	A	P	P	
	Rays homocellular	P	A	P	P	A	A	A	A	A	A	
	Rays 2 distinct widths				A							
	Aggregate rays				A							
	Commonly > 10-seriate		A		A	A			A	A	A	
	Commonly 4-10-seriate		A		A	A			A	A	A	
	Exclusively 1-seriate	P	A	P	P	A	P		A	A	A	
	Commonly > 1mm high	A	A	A	A	P	A		A	A	A	
Fibres/ Tracheids	Pits distinctly bordered	A	A						A	P	A	
	Thick walled fibres	A	A	A	P	P	A	A	P	A	A	
	Septate fibres	A	A						A	A	A	
Vessels	Deposits or gum											
	Tyloses sclerosed											
	Tyloses abundant											
	Pits vestured											
	Pits oppos. or scalarif.	A		A	P	P	A		A	A	A	
	Pits minute	A		A	A		A		A	A	A	
	Spirals in vessels									A	P	
	Plates with > 20 bars					P						
	Multiple perf. plates					P						
	Perforations simple	P	P	P	P		P			P	P	
	Pore clusters		A	A			A		A			
	Tang. arrangement		A	A			A		A			
	Radial or oblique		A	A			A		A			
	Radial groups of 4		A	A			A		A			
	Exclusively solitary	P	A	A	P	P	A	P	A	P	P	

6.3.3. Levels of identification

The level of identification of any archaeological plant remains depends on the research questions. In the case of this thesis it was considered that the family level was a reasonable one, taking into account both the huge diversity of woody taxa present in the studied area and the high variability present within families and genera. On the other hand, the huge amount of woody taxa used by present day indigenous people from the Colombian Amazon (more than 275 different species and 35 families. See Chapter seven), shows the wide spectrum from which people could choose woody taxa. Palaeoenvironmental reconstruction, using data derived from archaeological charcoal assemblages is not an aim of the present study. Instead, one of the aims of this thesis is to assess the applicability of current archaeological charcoal analysis to the particular case of the Colombian Amazon with regard to investigating charcoal assemblage formation in archaeological sites from the region.

There are several problems related to the identification of ancient woods from archaeological sites. The first aspect to bear in mind is the fact that wood remains found at archaeological sites are often fragmented. Although these fragments present the same diagnostic set of features that allow assignation to a particular taxon it is not possible to determine whether two or more fragments of the same species were necessarily derived from the same plant. Furthermore, we must always bear in mind the possibility that assignation of a modern taxon name to a fragment of a plant from the past does not necessarily reflect phylogenetic relationships (Hather 1994: 3).

Charcoal identification specificity is greatly affected by the diversity of woody taxa in the area. Unfortunately, as the numbers of species per genus and of genera per family increase, it becomes much more difficult to identify charcoal to the species and even the genus level (Smart and Hoffman 1988: 179). In this case, where tree species are studied, the nature and number of diagnostic characters have been affected by both the preservation condition (charring) of samples and by the high variability existing within and between different woody taxa from the Colombian Amazon region.

Usually keys or atlases and reference specimens are used to identify unknown woods by comparison with identified specimens. These keys, atlases and reference specimens are mostly applicable to fresh woods and therefore the identification of charred wood may be more difficult. Although most of the anatomical traits are preserved after charring of woods, some of the diagnostic traits used to identify modern woods are affected by charring processes. Charring of wood can modify some anatomical features such as pore size and shape, presence of deposits and gums, and may produce holes that could be confused with vessels. Post-depositional processes such as root penetration of modern trees can cause holes in charcoal fragments that could be mistaken for vessels or resin ducts (Minnis 1897: 122). The availability of wood reference manuals and extensive comparative collection for the region also affect the level of specificity of charcoal identifications (Smart and Hoffman 1988: 179).

The variation of wood anatomy is another problem that has to be considered when identification of wood is intended. Variation is high and can be affected by the geographical area the charred wood comes from. The number of tree species in the temperate zones is significantly less than in the tropical areas. Some woods, particularly from tropical areas, have never been described or incorporated into keys. There may be variation of anatomical wood traits according to the position in the tree of the fragment under examination and also according to the age of the tree. Wood from trunks, roots and branches can vary in both quantitative and qualitative features. Also cell diameters and lengths, vessel and parenchyma arrangements and their abundance can vary according to position in the tree and age (Jane 1970, Panshin and de Zeeuw 1980 quoted by Wheeler and Baas 1998: 251, 259). Some families and genera have relatively homogeneous anatomical features while others are highly heterogeneous. It is difficult to build a list of universal diagnostic features for the same level (Minnis 1987: 122).

What is needed for identification of woods is a diagnostic combination of features. Many descriptions of woods have been made by using only a few specimens and therefore the variability between genera and species is not fully known. This diagnostic list of features cannot usually be obtained from all the charred wood fragments under analysis because cell sizes can be affected by charring processes and therefore quantitative measures have to be used with caution. The size of fragments can also affect identification if relatively few features can be observed (Wheeler and Baas 1998: 242-243). Smaller fragments are more difficult to break for examination, especially for the radial and tangential sections. Also, small pieces permit fewer exposures of each section making it difficult to check features that are absent or unclear in the first break (Smart and Hoffman 1988: 178-179).

Anatomical structural features used to identify a charcoal fragment are distorted or even destroyed by burning or after deposition. For example, rays may shrink less than other structures but tend to split during charring (Slocum *et al.* 1978: 45, Rossen and Olson 1985: 452 quoted by Smart and Hoffman 1988: 178) and spiral thickening can be destroyed at high temperatures (Knudson and Williamson 1971: 183 quoted by Smart and Hoffman 1988: 178).

6.3.4. Computer aided data base

The OPCN database was used as a tool for wood identification (Wheeler *et al.* 1986). The database is accompanied by the Guess program which allows mismatches, and therefore a 1:1 correspondence between anatomical characteristics of the unknown specimens and the entries in the database is not required. This characteristic makes this database useful for the present study because of the preservational condition of the charcoal fragments studied. It was not possible to describe all the anatomical features of a particular specimen.

After description of the anatomical features observed in the charred fragments the program was used to generate lists of woods with determined sets of characteristics. These lists provided families and genera suggestions to which the archaeological specimens could belong. An example of a list produced for three fragments with similar features is shown below. Anatomical features for each fragment can be seen in Table 6.5.

- Unknown # 3 - 711-2

number of missmatches allowed = 4

search of HARDWOOD -NCSU/OXFORD/PRL/CTFT =**-> 6 possible IDs found. Definition of this unknown: 1(a) 2(a) 3(a) 4(a) 5(p) 6(p) 7(p) 10(p) 11(a) 23(a) 24(a) 25(a) 28(p) 29(p) 34(a) 35(p) 36(a) 37(a) 43(p) 44(p) 57(p)

Possible IDs follow:

Leguminosae *Heterostemon Mimosoides*-DJ

Features not matching = 5 7 28 44

6 10 (V) 12 18 21 29 35 (V) 43 47 48 57 61 (R) 63 (R)

Euphorbiaceae *Conceveibastrum Martianum*-DJ

Features not matching = 5 10 28 57

6 7 (V) 14 17 18 22 (V) 29 35 40 43 44 45 46 (A) 51 61 (R) 62 (R)

Euphorbiaceae *Dodecastigma* sp

Features not matching = 5 7 10 57

6 14 17 28 29 35 43 44 45 46 51 52 61 62

Guttiferae *Thornea* spp-AG

Features not matching = 5 23 29 57

3 (V) 6 7 (V) 10 19 20 (V) 21 23 28 (V) 35 43 44 (V) 50

Myristicaceae *Myristica Surinamensis*

Features not matching = 5 10 29 43

6 7 18 28 35 44 47 48 57 (V) 81 84

Ochnaceae *Tyleria Floribunda*+JD

Features not matching = 7 24 29 44

5 6 10 20 21 24 28 30 33 35 39 43 47 48 57 (?) 61 62

- unknown # 4 - 5695-1

number of misses allowed = 2

search of HARDWOOD -NCSU/OXFORD/PRL/CTFT =**-> 6 possible IDs found. definition of this unknown:1(a) 5(a) 7(r) 10(a) 11(a) 29(p) 34(a) 35(p) 36(a) 42(a) 43(a) 44(r) 45(p) 51(p) 54(p)

possible IDs follow:

Euphorbiaceae *Conceveibastrum Martianum*-DJ

Features not matching = 43 54

6 7 (V) 14 17 18 22 (V) 29 35 40 43 44 45 46 (A) 51 61 (R) 62 (R) Euphorbiaceae *Maprounea Guianensis*-DJ

Features not matching = 35 43

6 7 (V) 14 (V) 18 24 29 43 44 (V) 45 51 54

Icacinaceae *Discophora Guianensis*-DJ

Features not matching = 29 54

7 11 (?) 18 (V) 20 (?) 21 24 25 28 30 33 35 39 (V) 44 45 46 (A) 51

Lecythidaceae *Grias Neuberthii*-DJ

Features not matching = 29 42

6 7 18 24 28 30 31 (V) 35 (?) 42 44 45 46 (A) 51 54 61 (R) 62 (A)

Myristicaceae *Iryanthera Sagotiana*-DJ

Features not matching = 51 54

7 14 16 18 29 (V) 35 (?) 37 40 (T) 44 45 57

Myristicaceae *Iryanthera Tessmannii*-DJ

Features not matching = 51 54

7 18 21 29 35 (?) 37 40 (T) 44 45 57 61 (R)

• unknown # 5 - 5024-1

number of misses allowed = 4

search of HARDWOOD -NCSU/OXFORD/PRL/CTFT =**-> 3 possible IDs found. Definition of this unknown:1(a) 2(a) 3(a) 4(a) 5(a) 7(r) 8(a) 11(p) 14(p) 23(a) 24(p) 25(a) 29(p) 34(a) 35(a) 36(p) 37(a) 43(a) 44(p) 45(p) 57(p)

Possible IDs follow:

Bnt *Neotalea neblinae*-TBK

Features not matching = 11 36 45 57

1 (V) 6 7 14 19 21 24 29 44 46 47 50 56 (V)

Euphorbiaceae *Maprounea Guianensis*-DJ

Features not matching = 11 36 43 57

6 7 (V) 14 (V) 18 24 29 43 44 (V) 45 51 54 (?)

Myristicaceae *Iryanthera Sagotiana*-DJ

Features not matching = 11 24 36 37

7 14 16 18 29 (V) 35 (?) 37 40 (T) 44 45 57

6.3.5. Comparison with reliably identified woods

Comparison of each charred wood fragment was carried out with descriptions and illustrations found in the atlas and with reliably identified thin sections of woods contained in the Reference Collection of wood thin sections from the Jodrell Laboratory, at Royal Botanical Gardens at Kew, and the Herbarium from the University of Utrecht, as well as with the thin sections from the reference collection made during the course of this investigation. The publication "*Atlas d'Identification des Bois de l'Amazonie et des Régions Voisines*" (Détienne and Jacquet 1983), was found very useful because it contains descriptions and illustrations of woods from the Amazonian region. In addition, the "Commented catalogue on the middle Caquetá flora" (Sánchez Sáenz 1997), was consulted to be sure that the taxon suggested for each fragment is present in the Middle Caquetá river region.

7. RESULTS

7.1. Identified taxa

The identifications were made according to the reference material consulted. This means that the possible woody taxa to which the archaeological specimens could belong is restricted to taxa available in the published atlases and in the reference collections available. In some cases there are other families that also present the characteristics described for some of the specimens. In those cases identification of the taxa was made taking into account the presence of the family in the area as well as the present uses that indigenous people from the region give to these taxa.

There are certain microscopic anatomical features which are diagnostic for families (see Metcalfe and Chalk 1983) and genera that are very difficult to distinguish or not preserved when woods are charred. For example, vestured pits are very common in woods from the Combretaceae, Euphorbiaceae, Apocynaceae, Melastomataceae, Moraceae, Myrtaceae and Leguminoseae families (for a complete list of families with vestured pits see Jansen *et al.* 1998), but these could not be observed in any of the examined specimens. Other traits such as silica bodies and crystals and tyloses were not often observed, in the archaeological specimens. Tanniniferous tubes, oil cells, gums and other deposits were not observed. Fungal activity and other pre-depositional or post-depositional processes can affect the anatomy of archaeological woods in several ways. Experimental work is needed to assess the preservation of diagnostic anatomical features in charred woods from the Amazon tropical rain forest.

A total of 84 charred wood fragments were identified. From these, 16 different families were recognised and four possible genera. The total number of taxa are 23. From the identified taxa 81 fragments correspond to hardwoods and three to palms. The 116 non-identified fragments are hardwoods. Table 7.1 contains a list of the identified taxa; Table 7.2 summarises the information in terms of amount and types of wood identified. Tables 7.3 and 7.4 include information on the number of specimens identified for each family and allow for comparison of the data. In this chapter identified families will be evaluated in terms of their wood anatomy, ecology and ethnobotany. In Chapter eight these results will be analysed in more detail.

7.1.1. General wood anatomy and ecological aspects of the identified families

Botanical information was obtained from several published sources; in particular, Sánchez Sáenz's catalogue (1997) on the middle Caquetá river flora was very useful. This includes information on botanical collections gathered up to 1992 from approximately 35 ha distributed in all the physiographic units of the middle Caquetá region. The catalogue reports 178 families, 777 genera and 2419 species. Leguminosae, Rubiaceae, Melastomataceae, Annonaceae, Euphorbiaceae, Arecaceae, Clusiaceae and Araceae are the most numerous in the region. Within the most common genera *Inga* (Leguminosae), *Psychotria* (Rubiaceae), *Miconia* (Melastomataceae), *Protium* (Burseraceae), *Pouteria* (Sapotaceae), *Piper* (Piperaceae), *Licania* (Chrysobalanaceae), *Clusia* (Clusiaceae) and *Swartzia* (Leguminosae) can be mentioned (Sánchez 1997: 24).

Particular studies of some families from the middle Caquetá river were consulted and the ecology of those families is summarised.

Table 7.1 Identified taxa.

	Taxon	Family	Possible Genus	Sub-sample	Specimens
	1	Annonaceae		1	5568-1
				2	5623-1, 5676-1,5154-1, 5158-1
	2	Apocynaceae	Aspidosperma	2	5662-1
	3	Apocynaceae		1	5099-1, 5522-1, 5530
				2	5597-1
	4	Arecaceae		1	5544-1
				3	727-2, 718-1
	5	Burseraceae		2	5594
	6	Chrysobalanaceae		1	5585-1
	7	Clusiaceae	Calophyllum	3	724-1, 712-2
	8	Clusiaceae	Tovomita	1	5037
	9	Euphorbiaceae		1	5560-1, 5547-1, 5072-1, 5040-3
				3	717-1
	10	Flacourtiaceae		2	5163-1
	11	Lauraceae		2	5651-1
	12	Lecythidaceae	Eschweilera	3	720-1, 719-1
	13	Lecythidaceae		2	5733-I-II5737, 5155-1, 5623-1
				3	724-2, 712-1, 725-2, 708-2, 726-1
	14	Leguminosae		1	5050-11, 5050-10, 5050-8, 5050-9, 5587-1, 5551k6, 5514-1,
				2	5126SWH7, 5147-1, 5174-1b, 5166H7, 5636-L5, 5609-1, 5755-1, 5177-1, 5637k8, 5681-1, 5631k6, 5603-L6, 5169-G6,
				3	722-1, 715-1, 716-2, 715-2, 718,2
	15	Melastomataceae		2	5193-1
	16	Moraceae		2	5637-1
				3	719-2
	17	Moraceae		1	5516-1
	18	Myristicaceae	Iryanthera	1	5532-1, 5024-1
				2	5159-1,5142-1, 5695-1
				3	711-2
	19	Myristicaceae		2	5679-1
	20	Myrtaceae		1	5581k8
				2	5752-1, 5182-1, 5616-1
				3	706-2
	21	Sapotaceae		3	723-1, 725-1
				1	5535-1
				2	5610-1
				3	710-2, 716-1, 710-1, 705-2
Totals	21	16	5		

Table 7.2 Identified taxa including amount and type of wood.

Sub-sample	No. of fragments chosen	Total fragments	Identified hardwoods	Non identified palms	Non identified others	Taxa	families	Possible genera
1.Ceramic occupation	75	292	23	1	51	11	11	4
2. Pre-ceramic occupation	75	369	35		40	15	14	4
3. Pit 5	50	1401	26	2	22	11	8	2
Total	200	2062	84	3	113			

Table 7.3 Identified families for each archaeological sub-sample.

	families															
Sub - sample	Annonaceae	Apocynaceae	Arecaceae	Burseraceae	Chrysobalanaceae	Clusiaceae	Euphorbiaceae	Flacourtiaceae	Lauraceae	Lecythidaceae	Leguminosae	Melastomataceae	Moraceae	Myristicaceae	Myrtaceae	Sapotaceae
1.Ceramic occup.	X	X	X		X	X	X				X		X	X	X	X
2.Pre-ceramic - occup.	X	X		X				X	X	X	X	X	X	X	X	X
3.Pit 5			X			X	X			X	X		X	X	X	X

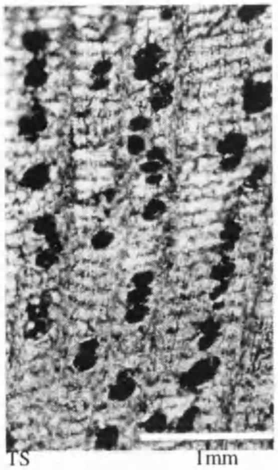
Table 7.4 Identified families for each sub-sample and possible genera.

Sub-sample	Families		Possible genera		Taxa
1	Annonaceae				
	Apocynaceae				
	Arecaceae				
	Chrysobalanaceae				
	Clusiaceae		Tovomita		
	Euphorbiaceae				
	Leguminosae				
	Moraceae				
	Myristicaceae		Iryanthera		
	Myrtacaceae				
	Sapotaceae				
	Total families	11	**Total genera**	2	11
2	Annonaceae				
	Apocynaceae		Aspidosperma		
	Apocynaceae				
	Burseraceae				
	Flaucourtiaceae				
	Lauraceae				
	Lecythidaceae				
	Leguminosae				
	Melastomataceae				
	Moraceae				
	Myristicaceae		Iryanthera		
	Myrtacaceae				
	Sapotaceae				
	Total families	12	**Total genera**	2	13
3	Arecaceae				
	Clusiaceae		Calophyllum		
	Euphorbiaceae				
	Lecythidaceae		Eschweilera		
	Leguminosae				
	Moraceae				
	Myristicaceae		Iryanthera		
	Myrtacaceae				
	Sapotaceae				
	Total families	9	**Total genera**	3	9

7.1.1.1. Annonaceae family

A very few species within this family are lianas rather than trees (Gentry 1993: 225-226). There are more than 20 *Annona* genera in tropical America. In South America these are distributed especially in the Amazonian region (Record and Hess 1943: 54). In the middle Caquetá river 16 genera and 81 species from the Annonaceae family have been reported by Sánchez Sáenz (1997: 25).

Trees from the Annonaceae family are very big. Their woods are characterised by scalariform or reticulate parenchyma (see IAWA Committee 1964 for definitions and IAWA Committee 1989 for pictures). This characteristic is also typical of the families Ebenaceae and Lecythidaceae (Détienne and Jacquet 1983: 25), which are both present in the middle Caquetá region. The archaeological specimens from this group show wide rays in the tangential longitudinal section, 4 to 10 cells wide. Wide rays are also present in *Grias neuberthii* from the Lecythidaceae family. However this genus is not reported in the middle Caquetá river by Sánchez Sáenz (1997). Specimens from the Ebenaceae family shown by Détienne and Jacquet (1983) present uni-seriate rays. Here it is suggested that the fragments could belong to the Annonaceae family. Figure 7.1 shows an example of them and the anatomical features from the specimens labelled as Annonaceae family are shown in Table 7.5.



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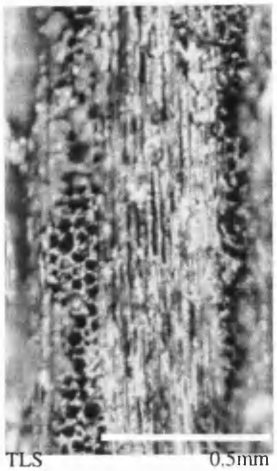

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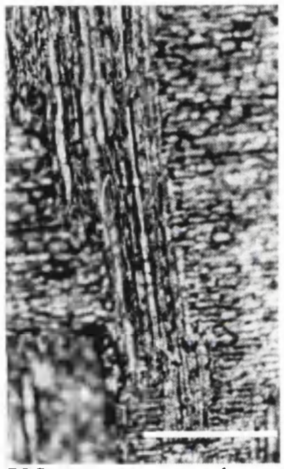
5623 s-s 2

RLS 1 mm
5623 s-s 2

TS 1mm
5158 s-s 2

TLS 1mm
5158 s-s 2



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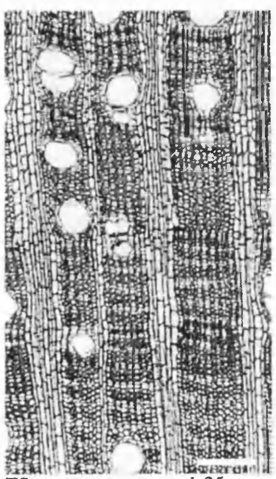
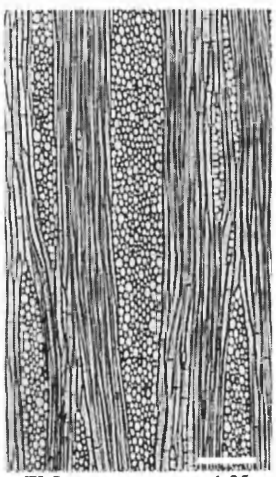
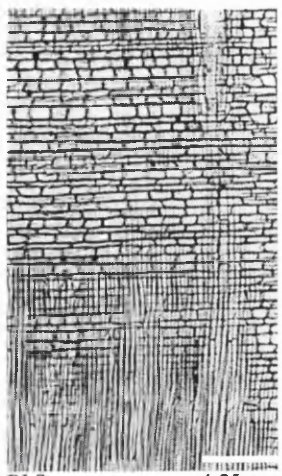
5158 s-s 2



TS 1.25mm
Guatteria clusenii U-13675



TLS 1.25mm
Guatteria clusenii U-13675



RLS 1.25mm
Guatteria clusenii U- 13675

Fig. 7.1 Micro-photographs of Annonaceae woods.

KG: Kew Gardens collection; U: Utrecht Univ. collection; s-s sub-sample.

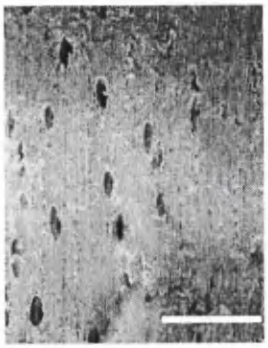
Table 7.5 Microscopic anatomical features of the specimens identified as Annonaceae

	Vessels														Fibres/ Tracheids			Rays														Parenchyma									
Sample	Exclusively solitary	Radial groups of 4	Radial or Oblique	Tang. arrangement	Pore clusters	Perforations simple	Plates with > 20 bars	Spirals in vessels	Pits minute	Pits oppos. or scalarif.	Pits vestured	Tyloses abundant	Tyloses sclerosed	Deposits or Gum	Septate fibres	Thick walled fibres	Pits distinctly bordered	Commonly > 1mm high	Exclusively 1-seriate	Commonly 4-10-seriate	Commonly > 10-seriate	Aggregate rays	Rays 2 distinct widths	Rays Homocellular	Marginal rows >=4	Marginal rows >=10	2-3 seriate parts narrow	Rays storied	Commonly <4/mm	Commonly >12/mm	Pits vessels large	Predom. apotracheal	Diffuse	Predom. Paratracheal	Vasicentric	Aliform or confluent	Parench. abs./very rare	Banded parenchyma	Bands 1-seriate	Bands >=4-seriate	Bands >=6/mm
	1	2	3	4	5	6	8	9	10	11	12	14	15	16	23	24	25	28	29	30	31	32	33	34	35	36	37	41	42	43	44	45	46	47	48	49	50	51	52	53	54
5623-1	A	A	A	A	A	P			P	A					A	P		P		P				P	A	A						P						P	P		P
5676-1	A	A	A	A	A			P								P		P		P				P	A	A			A	A		P						P	P		P
5568-1	P							P		A						P		P		P				P			A				A	P						P	P		P
5154-1	A	A	A	A	A	P			A	A						P	A	P	A	P	A			P	A	A	A		A	A	A	P						P	P		P
5158-1	A	A	A	A	A	P			P	A								P		P				P	A	A	A		P		P	P						P	P		P

7.1.1.2. Apocynaceae family

Most of the plants of the Apocynaceae family are trees and lianas and they usually produce latex (Gentry 1993: 238). In the Araracuara region this family is represented by 17 genera and 42 species (Sánchez Sáenz 1997: 25). The most diverse genera are *Lacmellea, Aspidosperma, Odontadenia* and *Parahancornia* (Cárdenas López and Giraldo-Cañas 1995).

This family is important because of the high number of genera and species which it contains. Apocynaceae woods can be divided into three groups. Woods from the first group exhibit predominately isolated vessels e.g. *Aspidosperma*, *Geissipermum* and *Microplumeria*. Woods from the second group e.g. *Anartia* and *Peschiera* have vessels in groups and septate fibres with simple pits. Parenchyma is absent. Woods from the third group have vessels in groups, parenchyma and non-septate fibre with pits distinctly bordered, e.g. *Couma-Parahancornia* and *Ambelania-Lacmellia.* Distinction between genera of the third group is very difficult (Détienne and Jacquet 1983: 33). The archaeological specimens identified as Apocynaceae included a probable fragment from *Aspidosperma.* Figure 7.2 shows fresh and archaeological specimens of Apocynaceae. Anatomical features of the archaeological specimens classified as Apocynaceae are shown in Table 7.6.



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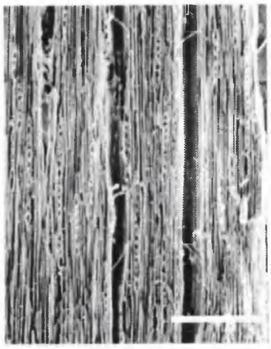
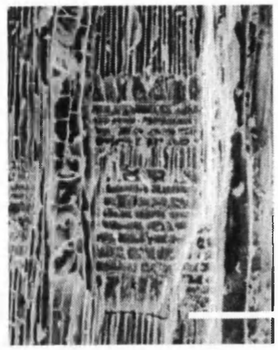
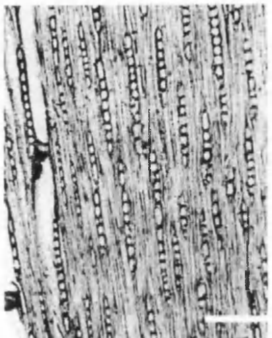


TLS 231um
5522 s-s 1

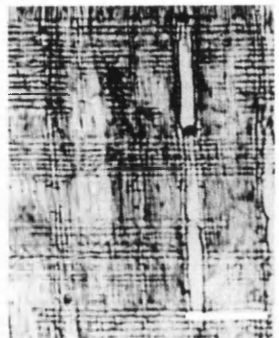


RLS 150um
5522 s-s 1

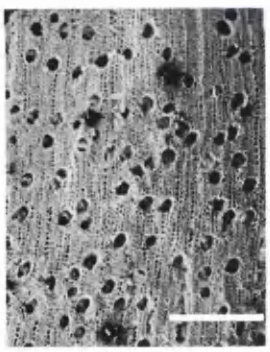
TS 1.25mm
Apocynum



TLS 0.5mm
Apocynum

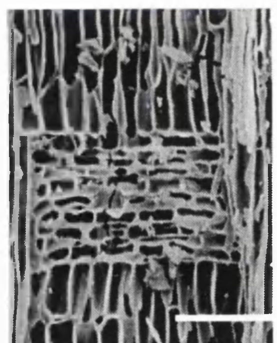


RLS 1.25mm
Apocynum

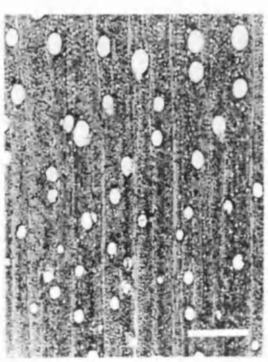


TS 0.43mm
5530 s-s1

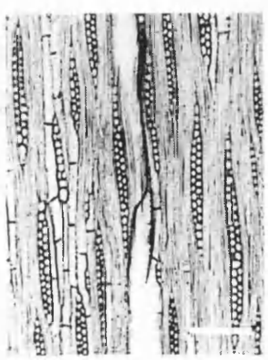
TLS 250um
5530 s-s1



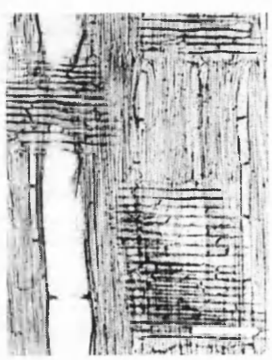
RLS 100um
5530 s-s 1



TS 1.25mm
Aspidossperma megalocarpon



TLS 0.5mm
Aspidossperma megalocarpon



RLS 0.5mm
Aspidossperma megalocarpon

Figure 7.2 Micro-photographs of Apocynaceae woods.
KG: Kew Gardens collection; U: Utrecht Univ. collection; s-s sub-sample.

Table 7.6 Microscopic anatomical features of charred fragments identified as Apocynaceae.

	Vessels								Fibres/Tracheids			Rays												Parenchyma		
	Exclusively solitary	Radial groups of 4	Radial or oblique	Tang. arrangement	Pore clusters	Perforations simple	Pits minute	Pits oppos. or scalarif.	Septate fibres	Thick walled fibres	Pits distinctly bordered	Commonly > 1mm high	Exclusively 1-seriate	Commonly 4-10-seriate	Commonly > 10-seriate	Rays homocellular	Marginal rows >=4	Marginal rows >=10	2-3 seriate parts narrow	Rays storied	Commonly <4/mm	Commonly >12/mm	Pits vessels large	Predom. apotracheal	Diffuse	Predom. paratracheal
	1	2	3	4	5	6	10	11	23	24	25	28	29	30	31	34	35	36	37	41	42	43	44	45	46	47
5099-1	P					P	P	A		P		A	A	A	A	P	A	A			A	A		P	P	
5522-1	P		P			P	A	A	A	A	A	A	P	A	A	P	A	A	A			P	A	P	P	
5662-1	P					P	A	A	A	A	A	A	P	A	A	P	A	A	A	A	A	A	P	P	P	
5530-	P		P			P	A	A		A	P	A	A	A	A	A	P	A	P		A	A	A		P	P
5597-1	A	A	A	A	A	P		P	A		A		A	A	A	P	A	A			A	A	P	P	P	

7.1.1.3. Arecaceae family

The distribution of palms from the middle Caquetá river is related to the different physiographic units where these are found. There are also different ecological patterns in the distribution of palms which are influenced by the soil conditions, humidity and availability of sunlight. For example, the *Mauritia flexuosa* palm is dominant in swamp areas and it is usually found together with *Mauritiella aculeata*, *precatoria* and occasionally with *Oenocarpus bataua* and *Manicaria saccifera* (Galeano 1991: 10).

Palms are characteristic of the Amazonian landscape; these plants are very important from both ecological and economic points of view. Palms can be found in all types of forests within the Amazonian region and are vital for humans, who exploit them in several ways and consider palms as important elements of their mythology. Sixty four palm species belonging to 26 genera were reported for the middle Caquetá region (Galeano 1991: 14).

In the studied region, the highest diversity of palms, i.e.: the highest number of species, is found in well drained areas, such as the high terraces of the Caquetá river (between 25 and 60 metres above the middle level of the river waters) and on the tertiary sedimentary plain. In those physiographic units, 43 species of palms were found, all of medium to small size, which are characteristic of the undergrowth. In other physiographic units such as the swamp areas or the hard rock areas the diversity of palms is lower. The species in the latter areas are very big and gregarious. The species *Astrocaryum javari* and *Bactris ripari* are gregarious and their distribution is riparian (Galeano 1991: 22).

Figure 7.3 shows three archaeological specimens of charred woody palms and charred specimens from the reference collection. Identification of these fragments at the genus level is not possible at present.

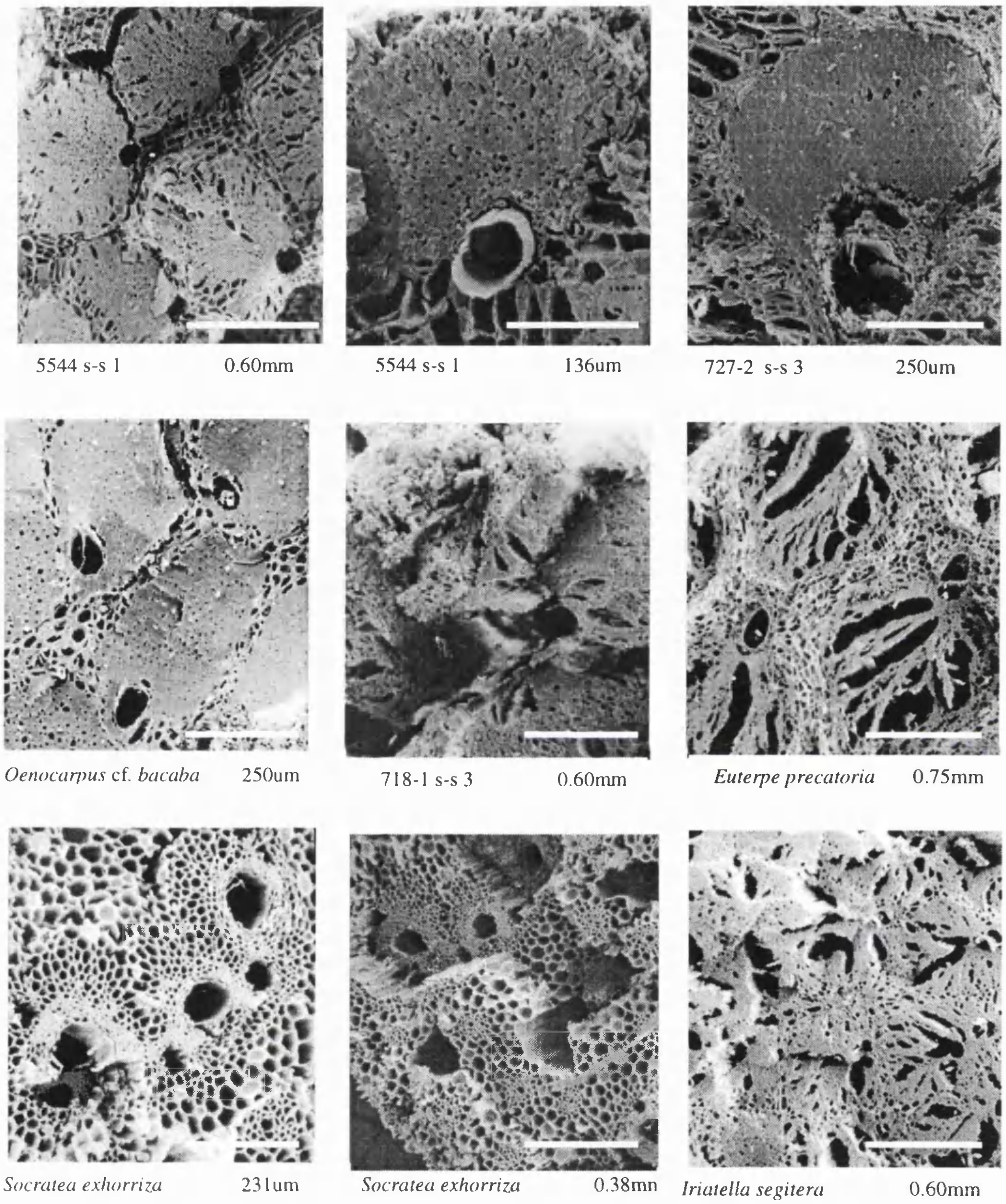
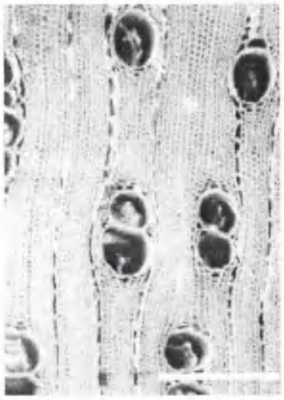


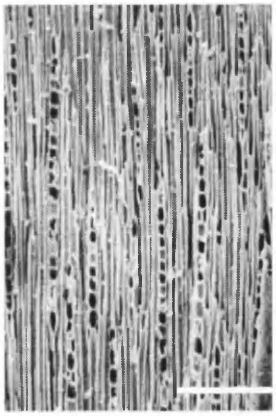
Figure 7.3 Micro-photographs of Arecaceae woods.
KG: Kew Gardens collection; U: Utrecht Univ. Collection; s-s sub-sample

7.1.1.4. Burseraceae family

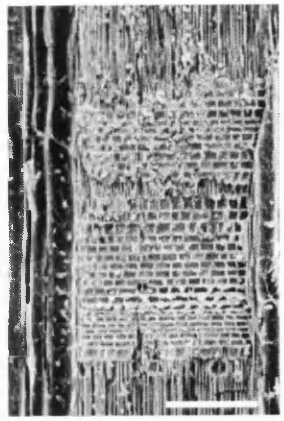
The majority of species in this family are trees, but it also includes some shrubs. Such trees almost always have resinous white latex either in the twigs or in the bark (Gentry 1993: 301). Sánchez Sáenz (1997: 25) reports five genera and 47 species of Burseraceae in the middle Caquetá region. Woods from the Burseraceae family are difficult to distinguish from their wood anatomy. They are characterised by rare parenchyma, septate fibres, homocellular or heterocellular rays and secretory canals in *Bursera*, *Protium* and *Tetragastris* genera. The cell content could help to characterise genera: the number of silica bodies in ray cells for *Dacryodes* and *Trattinickia*; crystals in rays of *Bursera*, *Hemicrepidospermum*, *Protium* and *Tetragastris*; and numerous silica bodies in fibres of some *Protium* and *Hemicrepidospermum* (Détienne and Jacquet 1983: 70). Unfortunately none of the above anatomical features were observed in the examined charcoals, and therefore at present it is not possible to suggest to which genus the specimen could belong. Figure 7.4 shows photographs of Burseraceae fresh wood and of the archaeological specimen. The anatomical features of the specimen classified as from the Burseraceae family are shown in Table 7.7.



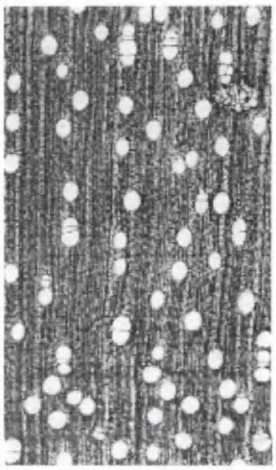
TS 0.30mm
5594 s-s 2



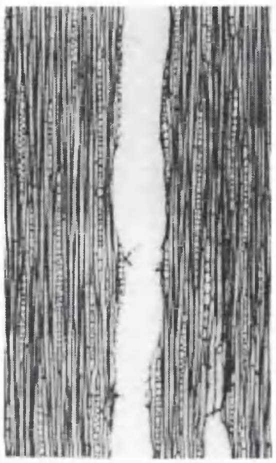
TLS 250um
5594 s-s 2



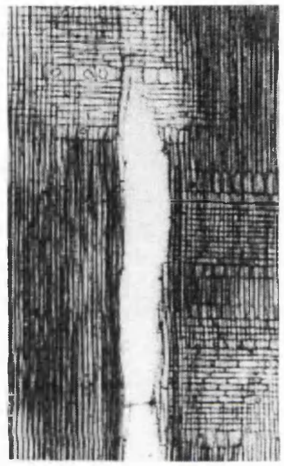
RLS 0.43 mm
5594 s-s 2



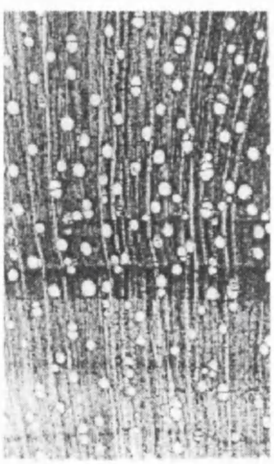
TS *Protium nodulodsum*
(After Détienne & Jacquet 1983: 71)



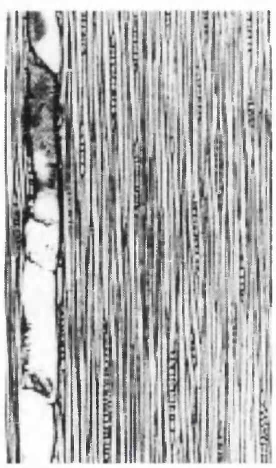
TLS *Protium nodulodsum*
(After Détienne & Jacquet 1983: 71)



RLS *Protium nodulodsum*
(After Détienne & Jacquet 1983: 71)



TS *Protium aracouchini*
(After Détienne & Jacquet 1983: 71)



TLS *Protium aracouchini*
(After Détienne & Jacquet 1983: 71)

RLS *Protium aracouchini*
(After Détienne & Jacquet 1983: 71)

Figure 7.4 Micro- photographs of Burseraceae woods.
KG: Kew Gardens collection; U: Utrecht Univ. Collection; s-s sub-sample
Scales in Détienne and Jacquet are not published. Page numbers refer to descriptions of each genus.

Table 7.7 Microscopic anatomical features of the specimens identified as Burseraceae.

	Vessels								Fibres/Tracheids			Rays										Parenchyma	
	Exclusively solitary	Radial groups of 4	Radial or oblique	Tang. arrangement	Pore clusters	Perforations simple	Pits minute	Pits oppos. or scalarif.	Septate fibres	Thick walled fibres	Pits distinctly bordered	Commonly 4-10-seriate	Commonly > 10-seriate	Rays homocellular	Marginal rows >=4	Marginal rows >=10	2-3 seriate parts narrow	Commonly <4/mm	Commonly >12/mm	Pits vessels large	Predom. apotracheal	Diffuse
	1	2	3	4	5	6	10	11	23	24	25	30	31	34	35	36	37	42	43	44	45	46
5594-1	A	A	A	A	A	P	A	A	P	A	A	A	A	A	A	A	P	A	A	P	P	P

7.1.1.5. Chrysobalanaceae family

In the middle Caquetá region there are four genera and 39 species which belong to the Chrysobalanaceae family (Sánchez Sáenz 1997: 25). The Chrysobalanaceae wood anatomy is very similar, so distinction between genera is very difficult based on wood anatomy. The main anatomical features of the family include: big vessels which are predominantly isolated, most rays are uniseriate, large ray vertical vessel pits and abundant silica bodies in ray cells (Détienne and Jacquet 1983: 80). Figure 7.5 illustrates the archaeological specimen which could belong to this family and Table 7.8 shows its anatomical features.

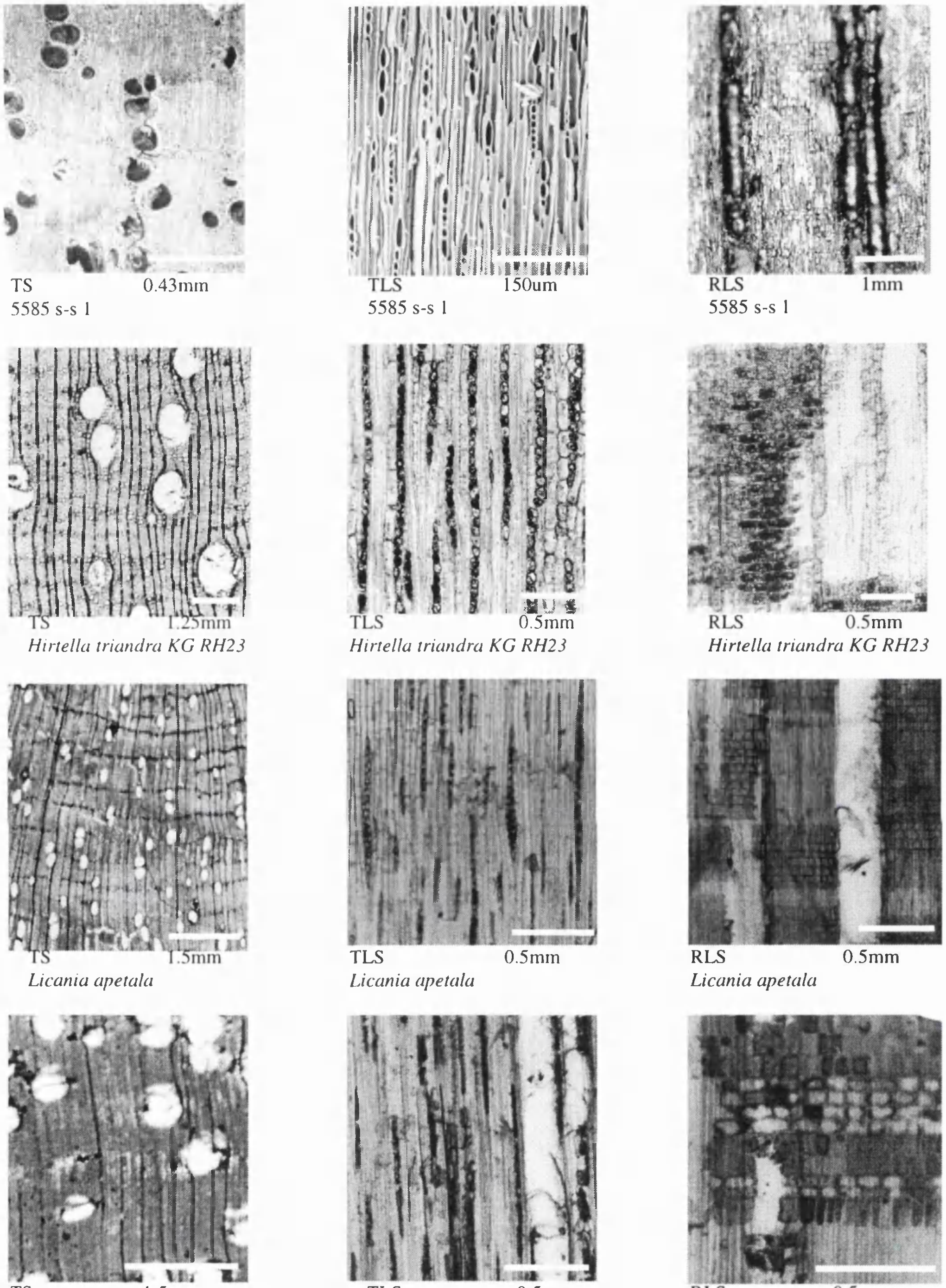


Figure 7.5 Micro-photographs of Chrysobalanaceae woods
KG: Kew Gardens collection; U: Utrecht Univ. collection; s-s sub-sample.

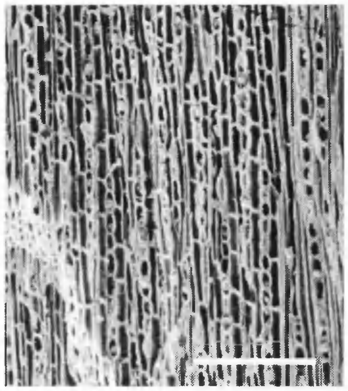
Table 7.8 Microscopic anatomical features of the specimen identified as Chrysobalanaceae.

	Vessels						Fibres/Tracheids			Rays											Parenchyma			
	Exclusively solitary	Perforations simple	Spirals in vessels	Pits minute	Pits oppos. or scalarif.	Tyloses abundant	Septate fibres	Thick walled fibres	Pits distinctly bordered	Commonly > 1mm high	Exclusively 1-seriate	Commonly 4-10-seriate	Commonly > 10-seriate	Rays homocellular	Marginal rows >=4	Marginal rows >=10	2-3 seriate parts narrow	Commonly >12/mm	Pits vessels large	Predom. apotracheal	Banded parenchyma	Bands 1-seriate	Bands >=6/mm
	1	6	9	10	11	14	23	24	25	28	29	30	31	34	35	36	37	43	44	45	51	52	54
5585-1	P	P	A	A	P	P	A	A	A	A	P	A	A	P	A	A	A	P	P	P	P	P	A

7.1.1.6. Clusiaceae family

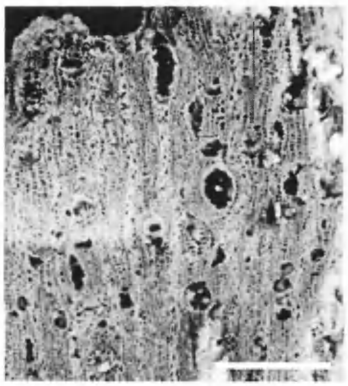
Most of the species from this family are woody and some are important timber trees. *Clusia* is the most characteristic genus of Clusiaceae family, which includes 300 species (Gentry 1993: 448). In the studied region the Clusiaceae family is represented by 14 genera and 61 species (Sánchez Sáenz 1997: 25). Woods from the Clusiaceae family have few anatomical features in common. However some genera and species showed similar features within sub–families (Détienne and Jacquet 1983: 85). According to Détienne and Jacquet, woods belonging to the Clusioideae sub-family have scalariform pitting. Woods from the Calophylloideae sub-family have isolated vessels, some in diagonal lines. It is suggested that the specimen 5037-1 could belong to the *Tovomita* genus, taking into account its scalariform inter-vessel pitting as well as other anatomical features (see Table 7.9). The other two specimens (712-2 and 724-1) could belong to the *Calophyllum* genus taking into account their isolated vessels in diagonal arrangement as well as other features such as their long and vertical vessel-ray pits (see Figure 7.6).

TS 0.27mm
724-1 s-s 3



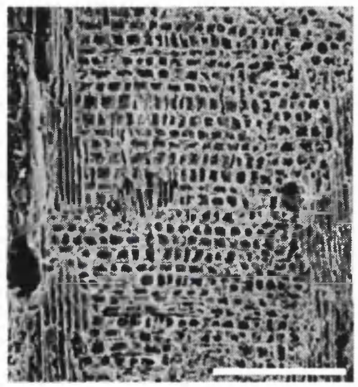
TLS 150um
724-1 s-s 3

RSL 136um
724-1 s-s 3

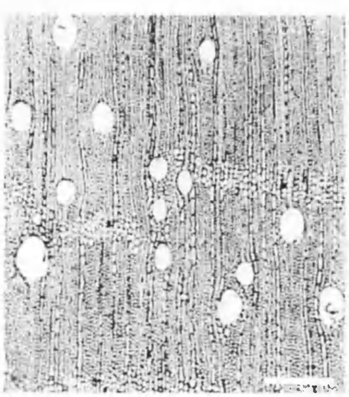


TS 0.5mm
5037 s-s 1

RLS 176 um
5037 s-s 1

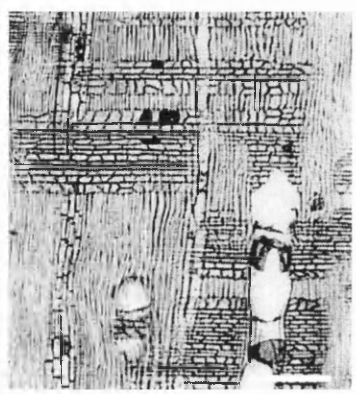


RSL 0.27mm
5037 s-s 1



TS 1.25mm
Callophyllum calaba KG

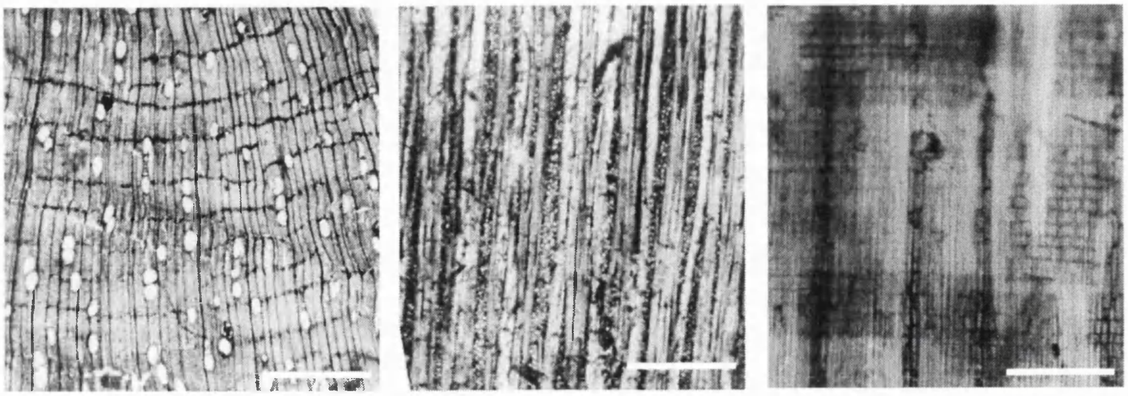
TLS 1..25mm
Callophyllum calaba KG



RSL 1.25mm
Callophyllum calaba KG

Figure 7.6 Micro-photographs of Clusiaceae woods

KG: Kew Gardens collection; U: Utrecht Univ. collection; s-s sub-sample.



TS 1.5mm *Tomovita sprunceana*

TLS 1.5mm *Tomovita sprunceana*

RLS 0.5mm *Tomovita sprunceana*

Figure 7.6 Micro-photographs of Clusiaceae woods (Continued)

KG: Kew Gardens collection; U: Utrecht Univ. collection; s-s sub-sample.

Table 7.9 Microscopic anatomical features of the specimens identified as Clusiaceae.

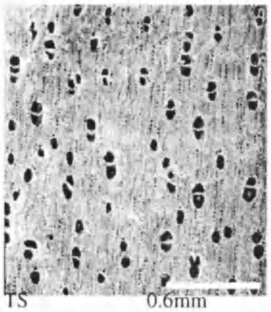
	Vessels								Fibres/Tracheids			Rays												Parenchyma						
	Exclusively solitary	Radial groups of 4	Radial or oblique	Tang. arrangement	Pore clusters	Perforations simple	Pits minute	Pits oppos. or scalarif.	Septate fibres	Thick walled fibres	Pits distinctly bordered	Commonly > 1mm high	Exclusively 1-seriate	Commonly 4-10-seriate	Commonly > 10-seriate	Rays homocellular	Marginal rows >=4	Marginal rows >=10	2-3 seriate parts narrow	Commonly <4/mm	Commonly >12/mm	Pits vessels large	Predom. apotracheal	Diffuse	Predom. paratracheal	Vasicentric	Aliform or confluent	Banded parenchyma	Bands >=6/mm
	1	2	3	4	5	6	10	11	23	24	25	28	29	30	31	34	35	36	37	42	43	44	45	46	47	48	49	51	54
712-2	P					P	P	A	A	P	P	A	P			P	A	A	A		P	P	P		A	A	A	P	P
724-1	P					P			A	P	A	A	P			P	A	A	A		P	P	P					P	P
5037-	A	A	A	A	A	P	A	P		A		P	A	A	A	A	A	A		P		A	P	P					

7.1.1.7. Euphorbiaceae family

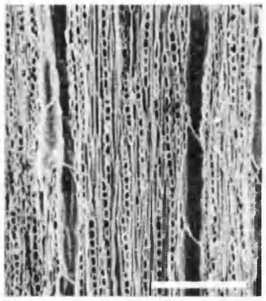
Woods from the Euphorbiaceae family have isolated vessels or vessel groups in radial lines of 2 to 4 vessels; generally the number of vessels is low, i.e. less than 10 per mm. The perforation plates are simple but reticulate perforation plates can be found in some genera. In general, parenchyma is diffuse-in-aggregates but it can also be banded. Generally rays are uniseriate and heterocellular. Pits in fibres can be bordered (Détienne and Jacquet 1983: 107). Figure 7.7 shows examples of archaeological specimens. Table 7.10 shows the microscopic anatomical features described for the specimens considered as Euphorbiaceae.

A study of this family, carried out in the middle Caquetá region, identified the presence of 64 species and 36 genera. Euphorbs can be found in many growth forms and all types of environment. Most of the species in the Araracuara region are neotropical in distribution, but ten of them are found only in the Amazonian region. According to the number of species, the most important genera in the Araracuara region are *Mabea* with five species, *Alchornea, Croton, Hevea, Micrandra, Phyllanthus* each with four species and *Pausandra* with three species (Murillo Aldana and Franco Rosselli 1995: 14).

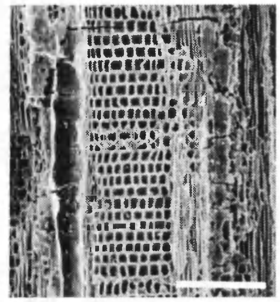
Euphorbs are found in different transitional stages between the Caquetá river and its terraces. Some species grow along rivers of white waters and others along rivers of black waters. The *Micrandra spruceana*, *Vaupesia cataractarum* and *Hevea* spp. are common in Amazon canopy whilst *Mabea* spp. are common in the understorey. *Pausandra* spp. grows only on the sandstone plateau. Most of the Euphorbs from the Araracuara region are trees, generally having milky or coloured exudates and stipules (81%) (Murillo Aldana and Franco Rosselli 1995: 14).



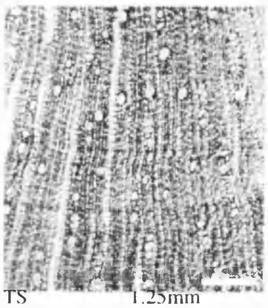
TS 0.6mm
5547 s-s 1



TLS 0. 27mm
5547 s-s 1

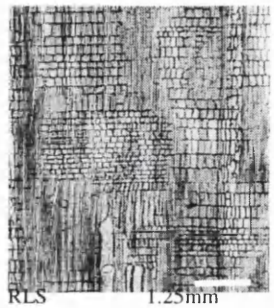


RLS 231um
5547 s-s 1

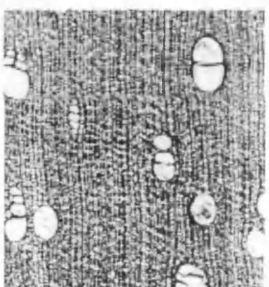


TS 1.25mm
Alchornea ilicifolia U-3102

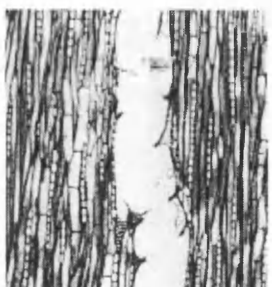
TLS 1.25mm
Alchornea ilicifolia U-3102



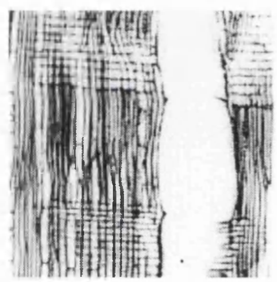
RLS 1.25mm
Alchornea ilicifolia U-3102



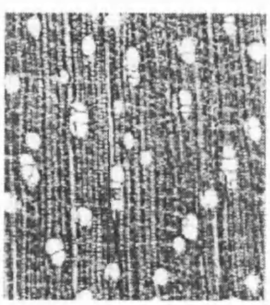
TS *Hura crepitans*
(After Détienne & Jacquet 1983: 113)



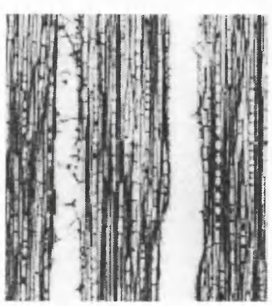
TLS *Hura crepitans*
(After Détienne & Jacquet 1983: 113)



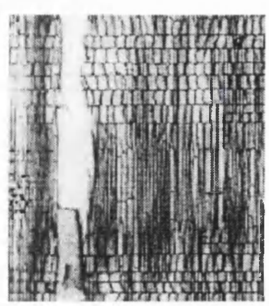
RLS *Hura crepitans*
(After Détienne & Jacquet 1983: 113)



TS *Mabea argutissima*
(after Détienne & Jacquet 1983: 114)



TLS *Mabea argutissima*
(after Détienne & Jacquet 1983: 114)



RLS *Mabea argutissima*
(after Détienne & Jacquet 1983: 114)

Figure 7.7 Micro-photographs of Euphorbiaceae woods.

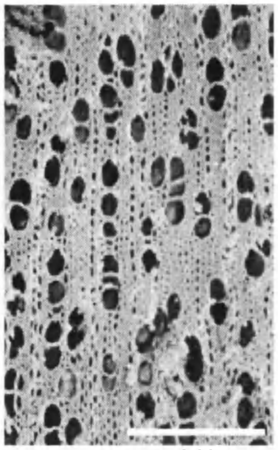
KG: Kew Gardens collection; U: Utrecht Univ. collection; s-s sub-sample.
Scales in Detienne and Jacquet are not published. Page numbers refer to descriptions of each genus.

Table 7.10 Microscopic anatomical features of the specimens identified as Euphorbiaceae.

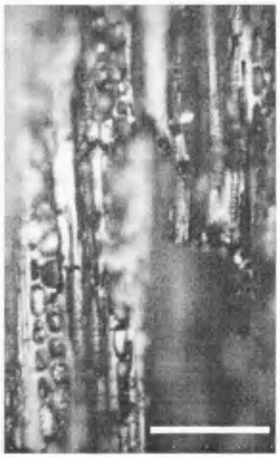
	Vessels								Fibres/Tracheids			Rays											Parenchyma			
	Exclusively solitary	Radial groups of 4	Radial or oblique	Tang. arrangement	Pore clusters	Perforations simple	Pits minute	Pits oppos. or scalarif.	Septate fibres	Thick walled fibres	Pits distinctly bordered	Commonly > 1mm high	Exclusively 1-seriate	Commonly 4-10-seriate	Commonly > 10-seriate	Rays homocellular	Marginal rows >=4	Marginal rows >=10	2-3 seriate parts narrow	Commonly <4/mm	Commonly >12/mm	Pits vessels large	Predom. apotracheal	Diffuse	Predom. paratracheal	Aliform or confluent
	1	2	3	4	5	6	10	11	23	24	25	28	29	30	31	34	35	36	37	42	43	44	45	46	47	49
5547-1	A	A	A	A	A		A	A	A	A	A	A	P			A	A	P		A	A		P	P		
5560-1	A	A	A	A	A			A	A	A	A		P			P			A			A	P	P		
5040-3	A	A	A	A	A	P	A	A	A	A	A	A	P	A	A	P	A	A			P	P		P	P	
5072-1	A	A	A	A	A		P	A	A	A	A	A	P			P			A		P	A			P	P
717-1	A	A	A	A	A	P	P	A		A		A	P			P	A	A	A		P	A	P	P		

7.1.1.8. Flacourtiaceae family

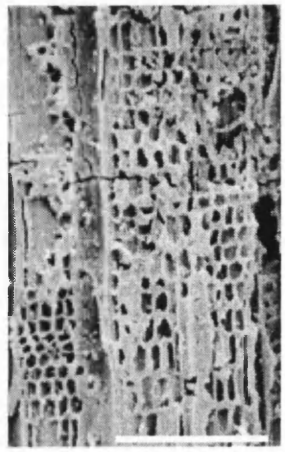
The Flacourtiaceae is one of the most heterogeneous families from the neotropics (Gentry 1993: 426). In the middle Caquetá region nine genera and 20 species from this family have been reported by Sánchez Sáenz (1997: 25). Figure 7.8 shows photographs of the archaeological and fresh specimens and Table 7.11 shows the microscopic anatomical features described for the archaeological charred wood fragment identified as Flacourtiaceae.



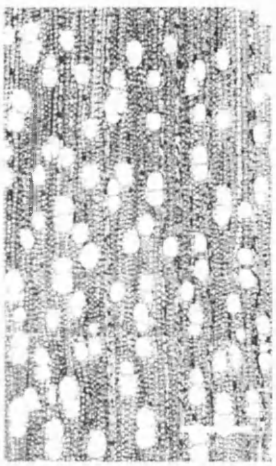
TS 0.30mm
5163 s-s 2



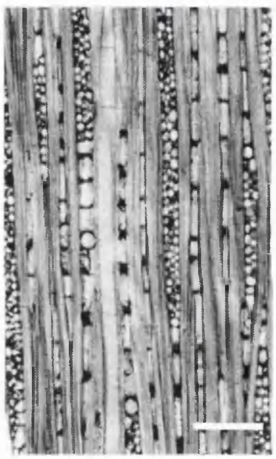
TLS 0.25mm
5163 s-s 2



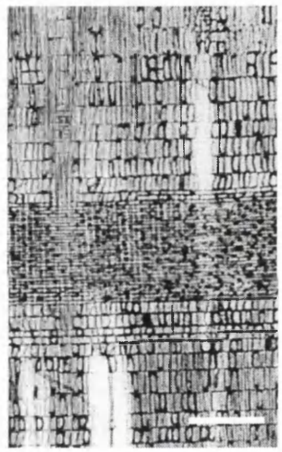
RLS 200um
5163 s-s 2



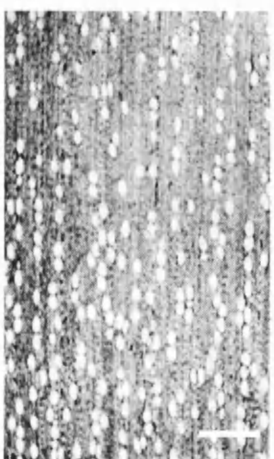
TS 1.25mm
Casearia arborea U-1426



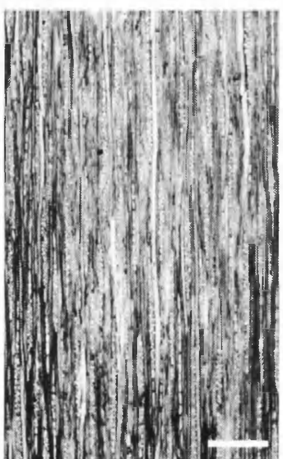
TLS 1.25mm
Casearia arborea U-1426



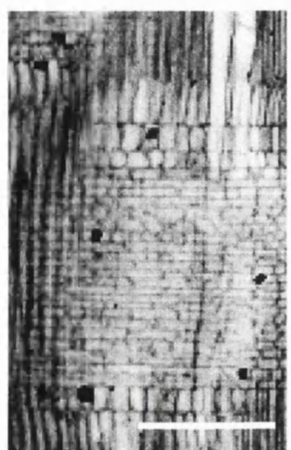
RLS 1.25mm
Casearia arborea U-1426



TS 1.25mm
Casearia praeco KG



TLS 1.25mm
Casearia praeco KG



RLS 1.25mm
Casearia praeco KG

Figure 7.8 Micro-photographs of Flacourtiaceae woods.

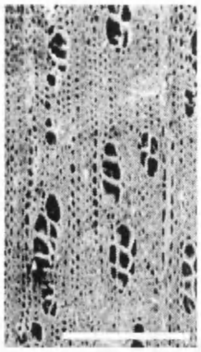
KG: Kew Gardens collection; U: Utrecht Univ. collection; s-s sub-sample.

Table 7.11 Microscopic anatomical features of the specimens identified as Flacourtiaceae.

							Rays														
	Radial groups of 4	Perforations simple	Pits minute	Pits oppos. or scalarif.	Thick walled fibres	Pits distinctly bordered	Commonly > 1mm high	Exclusively 1-seriate	Commonly 4-10-seriate	Commonly > 10-seriate	Aggregate rays	Rays 2 distinct widths	Rays homocellular	Marginal rows >=4	Marginal rows >=10	2-3 seriate parts narrow	Rays storied	Commonly <4/mm	Commonly >12/mm	Pits vessels large	Parench. abs./very rare
	2	6	10	11	24	25	28	29	30	31	32	33	34	35	36	37	41	42	43	44	50
5163-1	P	P	P	A	P	A	P	A	A	A	A	A	A	A	P	A	A	A	A	P	P

7.1.1.9. Lauraceae family

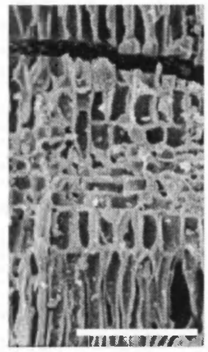
Plants from this family are easy to recognise but not to genus level. Seventeen genera occur in Northwest South America (Gentry 1993: 485). Fifty-six species belonging to 10 genera of the Lauraceae family were reported to the middle Caquetá region (Sánchez Sáenz 1997: 25). The wood anatomy of the Lauraceae family is very similar among its species. The presence of oil cells in rays and in the parenchyma is one of the main characteristics of these woods. Vessel pits are large, between 9 and 15 μm and vessel ray pits are larger than inter-vessel pits (Détienne and Jacquet 1983: 138). Figure 7.9 includes photographs of the archaeological and fresh specimens and Table 7.12 shows the anatomical description of the archaeological specimens from this family.



TS 0.27mm
5651 s-s 2

TLS 0.30mm
5651 s-s 2

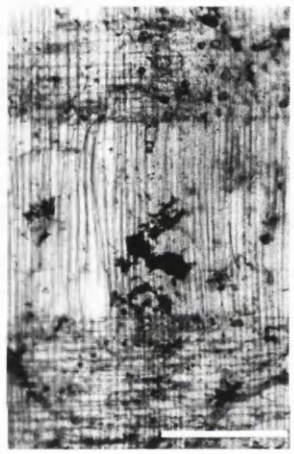
RLS 38um
5651 s-s 2



RLS 120um
5651 s-s 2

TS 1.5mm
Ocotoea sp.

TLS 0.5mm
Ocotoea sp.



RLS 0.5mm
Ocotoea sp.

Figure 7.9 Micro-photographs of Lauraceae woods.

KG: Kew Gardens collection; U: Utrecht Univ. collection; s-s sub-sample.

Table 7.12 Microscopic anatomical features of the specimen identified as Lauraceae.

								Rays											Parenchyma	
	Radial groups of 4	Pore clusters	Perforations simple	Pits minute	Pits oppos. or scalarif.	Thick walled fibres	Pits distinctly bordered	Commonly > 1mm high	Commonly 4-10-seriate	Aggregate rays	Rays 2 distinct widths	Rays homocellular	Marginal rows >=4	Marginal rows >=10	2-3 seriate parts narrow	Commonly <4/mm	Commonly >12/mm	Pits vessels large	Predom. apotracheal	Diffuse
	2	5	6	10	11	24	25	28	30	32	33	34	35	36	37	42	43	44	45	46
5651-1	P	P	P	P	A	P	P	A	P	A	A	A	P	A	A	A	A	A	P	P

7.1.1.10. Lecythidaceae family

There are 11 genera from the Lecythidaceae family in northwest South America. Trees from this family are recognised by their strong barks (Gentry 1983: 497). Sánchez Sáenz (1997: 25) reports five genera and 27 species from this family in the middle Caquetá region.

Genera from this family are similar. Vessels can occur isolated and in groups, some have tyloses. Parenchyma is banded except in *Couroupita*, *Grias* and *Gustavia* where parenchyma is diffuse-in-aggregates. Rays are homocellular generally but can contain square cells and silica bodies (Détienne and Jacquet 1983: 144). It is suggested that two specimens could belong to *Eschweileira* (719-1 and 720-1). Figure 7.10 shows photographs of these fragments. Table 7.13 shows the anatomical description of the archaeological specimens in this category.

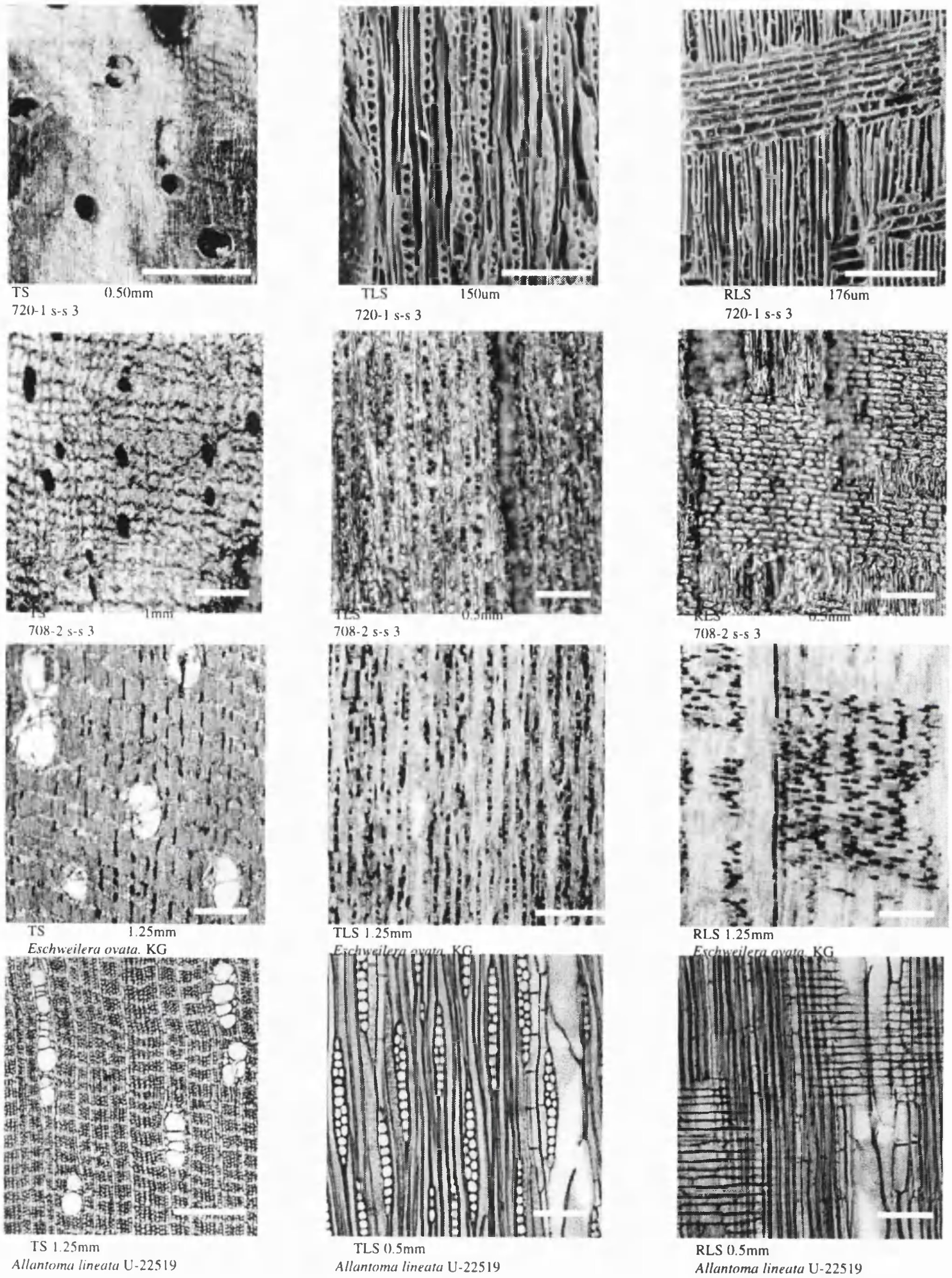


Figure 7.10 Micro-photographs of Lecythidaceae woods.

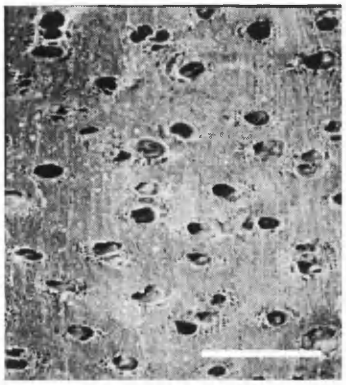
KG: Kew Garden collection; U: Utrecht Univ. collection; s-s sub-sample.

Table 7.13 Microscopic anatomical features of the specimens identified as Lecythidaceae.

	Vessels										Fibres/Tracheids			Rays													Parenchyma								
	Exclusively solitary	Radial groups of 4	Radial or oblique	Tang. arrangement	Pore clusters	Perforations simple	Spirals in vessels	Pits minute	Pits oppos. or scalarif.	Tyloses abundant	Septate fibres	Thick walled fibres	Pits distinctly bordered	Commonly > 1mm high	Exclusively 1-seriate	Commonly 4-10-seriate	Commonly > 10-seriate	Aggregate rays	Rays 2 distinct widths	Rays homocellular	Marginal rows >=4	Marginal rows >=10	2-3 seriate parts narrow	Commonly <4/mm	Commonly >12/mm	Pits vessels large	Predom. apotracheal	Diffuse	Predom. paratracheal	Vasicentric	Aliform or confluent	Banded parenchyma	Bands 1-seriate	Bands >=4-seriate	Bands >=6/mm
	1	2	3	4	5	6	9	10	11	14	23	24	25	28	29	30	31	32	33	34	35	36	37	42	43	44	45	46	47	48	49	51	52	53	54
5733-I,II	P					P		A	A	P		P		A	P					P	A	A	A	A	A	A	P					P	A	A	P
5155-1	P					P			A		A	P	P	A	A	A	A			P	A	A			P	A	P					P	P		P
5623-1	P		P			P			A		A			A	A	A	A			P	A	A	A	A	A	A									
724-2	P					P		A	A		A	A	A	A	P					P	A	A			P	A	P					P	P		P
712-1	A	A	A	A	A	P	A	P	A		A	A		A	A	A	A			P	A	A	A		P	A	P					P			P
725-2	A	A	A	A	A	P		A	A			A		A	P					P	A	A	A		P	P	P					P	P		P
708-2	P					P		A	A		A	P		A	P					P	A	A			P	P	P					P			P
726-1	P					P		A	P			P		A	P	A	A	A	A	P	A	A	P			P	P	A				A	A	A	P
719-1	P					P								P						P	A	A			P		P					P			P
720-1	P					P		A	A		A	A			P	A	A	A	A	P	A	A	A			A	P		A	A	A	P	P	A	P

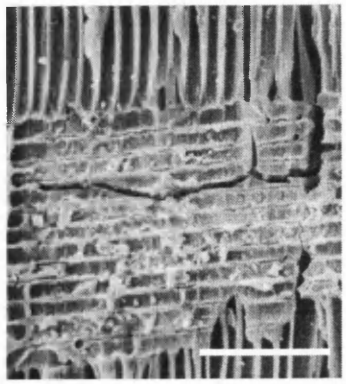
7.1.1.11. Leguminosae family

The Leguminosae (now known as Fabaceae) is the most important neotropical tree family (Gentry 1993: 503). The Leguminosae family is represented by 58 genera and 204 species in the middle Caquetá river (Sánchez Sáenz 1997: 25). Woods from this enormous family are relatively easily recognised as a family by their anatomical structure. Vessels are isolated or grouped in radial lines, perforation plates are simple and inter-vessel pitting is alternate. The parenchyma is generally associated with vessels and can range from scanty paratracheal to very abundant, banded, aliform and confluent. Rays are homocellular and vessel ray pits are similar in size to intervascular pits. Storied elements are frequent. Three genera present axial canals: *Copaifera*, *Eperua* and *Prioria* (Détienne and Jacquet 1983: 152). Figure 7.11 includes photographs of archaeological and fresh Leguminosae specimens and Table 7.14 shows the anatomical description of the specimens classified as Leguminosae.

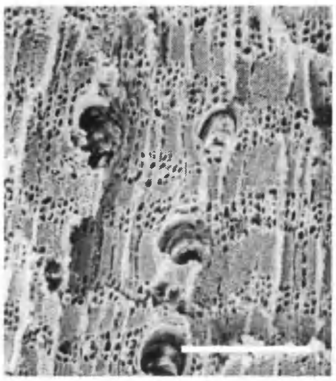


TS 0.43mm
5166 s-s 2

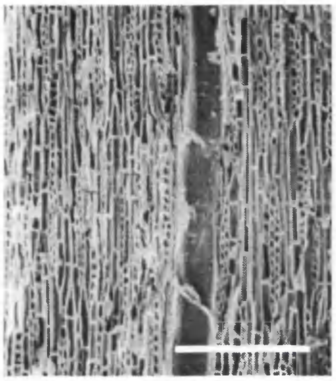
TLS 136um
5166 s-s 2



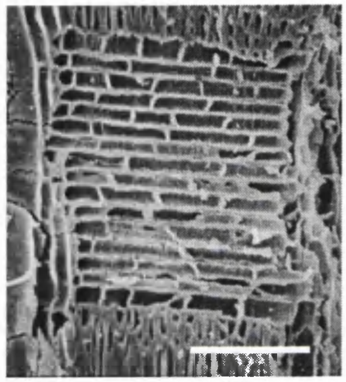
RLS 75um
5166 s-s 2



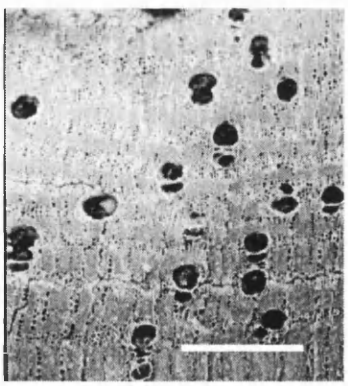
TS 136um
715-2 s-s 3



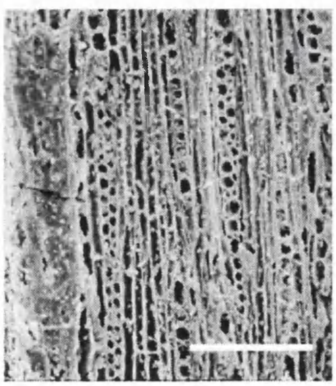
TLS 176um
715-2 s-s 3



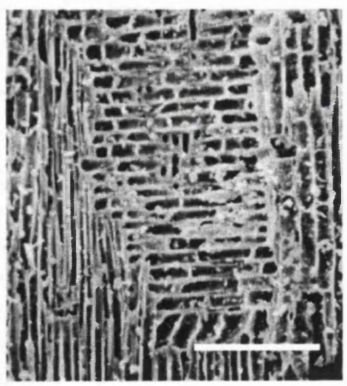
RLS 100um
715-2 s-s 3



TS 0.43mm
5587 s-s 1



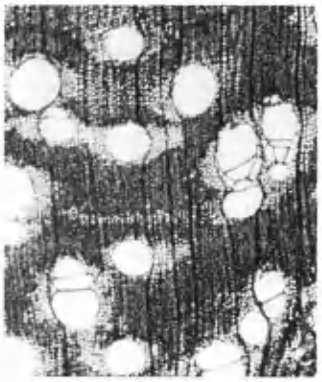
TLS 136um
5587 s-s 1



RLS 120um
5587 s-s 1

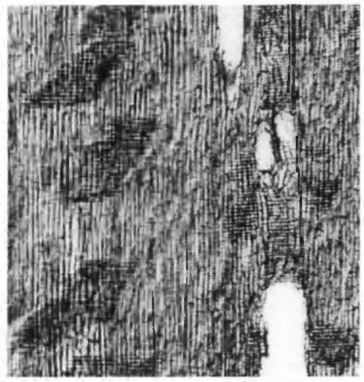
Figure 7.11 Micro-photograohs Leguminosae woods

KG: Kew Garden collection; U: Utrecht Univ. collection; s-s sub-sample

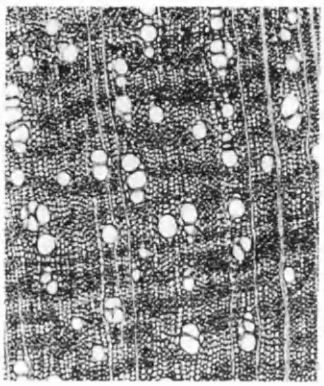


TS 1.25mm
Inga macrophylla KG

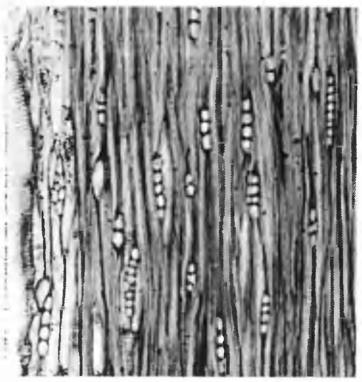
TLS 1.25mm
Inga macrophylla KG



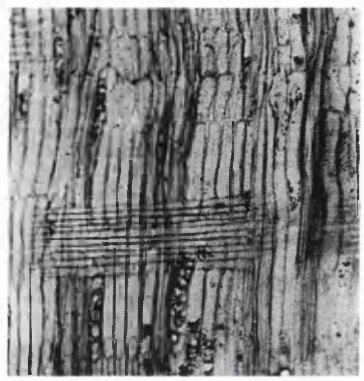
RLS 1.25mm
Inga macrophylla KG



TS 1.25mm
Calliandra tweediei KG



TLS 0.5mm
Calliandra tweediei KG



RLS 0.5mm
Calliandra tweediei KG

Figure 7.11 Micro-photograohs Leguminosae woods (Continued).

KG: Kew Garden collection; U: Utrecht Univ. collection; s-s sub-sample.

Table 7.14 Microscopic anatomical features of the specimens identified as Leguminosae.

	Vessels												Fibres/Tracheids			Rays														Parenchyma							
	Exclusively solitary	Radial groups of 4	Radial or oblique	Tang. arrangement	Pore clusters	Perforations simple	Multiple perf. plates	Spirals in vessels	Pits minute	Pits oppos. or scalarif.	Tyloses abundant	Tyloses sclerosed	Septate fibres	Thick walled fibres	Pits distinctly bordered	Commonly > 1mm high	Exclusively 1-seriate	Commonly 4-10-seriate	Commonly > 10-seriate	Aggregate rays	Rays 2 distinct widths	Rays homocellular	Marginal rows >=4	Marginal rows >=10	2-3 seriate parts narrow	Rays storied	Commonly <4/mm	Commonly >12/mm	Pits vessels large	Predom. apotracheal	Predom. paratracheal	Vasicentric	Aliform or confluent	Banded parenchyma	Bands 1-seriate	Bands >=4-seriate	Bands >=6/mm
	1	2	3	4	5	6	7	9	10	11	14	15	23	24	25	28	29	30	31	32	33	34	35	36	37	41	42	43	44	45	47	48	49	51	52	53	54
5050-11	P					P			A	A	P	P		P			A	A	A			A	A	A			A	A	A					P		P	P
5050-10	P						P		A	A	P	P		P		A	A	A	A			A	A	A	A		A	A	A					P		P	P
5050-8	P						P		A	A	P	P	A	P		A	A	A	A			A	P	A			A	A	A		P			P		P	P
5050-9	P					P			A	A	P	P		P		A	A	A	A			A	A	A	A		A	A	A					P		P	P
5514-1	A	A	A	A	A	P	A			A				P			A	A	A			P		A		P	A	A			P		P	P			
5551-	P						P		A	A				P		A	A	A	A			A	P	A	A		A	A			P	P					
5587-1	A	A	A	A	A	P		A	P	A			A	A		A	A	A	A	A	A	P	A	A	A	A	A	A	A		P			P		P	P
5603-	P					P			A	A	P		A	P		A	A	P	A			P	A	A			A	A	A		P			P		P	
5609-1	P					P			A	A	P		A	A			P					P									P	P	P				
5631-1	P					P			A	A	P			P			A	A	A			P					A	A			P			P			P
5636-	P					P		A	A	A				P			P	A	A			A	P						A		P			P	A	P	P
5755-1	P					P								P			A	A	A			A	P								P		P				
5126-SW	P					P			A	A	P			P		A	A	A	A				P	A	A		A	A	A		P			P		P	P
5147-1	A	A	A	A	A	P			A	A				P		A	A	A	A			P	A	A	A		A	A	A					P		P	P

Table 7.14 Microscopic anatomical features of the specimens identified as Leguminosae (Continued).

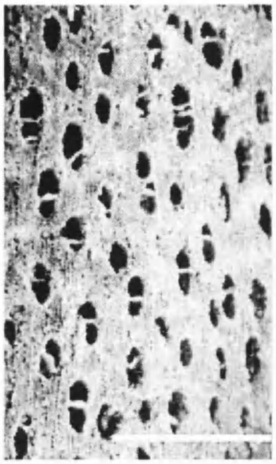
	Vessels												Fibres/Tracheids			Rays														Parenchyma							
	Exclusively solitary	Radial groups of 4	Radial or oblique	Tang. arrangement	Pore clusters	Perforations simple	Multiple perf. plates	Spirals in vessels	Pits minute	Pits oppos. or scalarif.	Tyloses abundant	Tyloses sclerosed	Septate fibres	Thick walled fibres	Pits distinctly bordered	Commonly > 1mm high	Exclusively 1-seriate	Commonly 4-10-seriate	Commonly > 10-seriate	Aggregate rays	Rays 2 distinct widths	Rays homocellular	Marginal rows >=4	Marginal rows >=10	2-3 seriate parts narrow	Rays storied	Commonly <4/mm	Commonly >12/mm	Pits vessels large	Predom. apotracheal	Predom. paratracheal	Vasicentric	Aliform or confluent	Banded parenchyma	Bands 1-seriate	Bands >=4-seriate	Bands >=6/mm
	1	2	3	4	5	6	7	9	10	11	14	15	23	24	25	28	29	30	31	32	33	34	35	36	37	41	42	43	44	45	47	48	49	51	52	53	54
5166-	A	A	A	A	A	P			A	A				A		A	P					P	A	A	A			P	A		P	P	P				
5169-	A	A	A	A	A	P			P	A				P		A	A	A	A			A	P		A		A	A	A					P		P	P
5174-1b	P					P			A	A			A	P	A	A	A	A	A			P			A		A	A	A		P	P	P				
5177-1	A	A	A	A	A	P			A	A			A	A		A	A	A	A			A	A	A	A		A	A	A		P	P	P	P			
5637-	P					P		A	A	A			A	P	A	A	P					A	P	A	A			P	A		P		P				
5681-1	A	A	A	A	A	P				A			A	P	A	A	A	A	A			P	A	A			A	A			P	P	P				
715-1	P					P							A	P		A	A	A	A			P					A	A	A		P	P	P				
715-2	A	A	A	A	A	P			A	A				P		A	A	A	A			P	A	A	A			P	A		P		P	P		P	P
716-2	A	A	A	A	A	P			A	A			A	A	A	A	A	A	A			P	A	A	A		P		A		P		P				
718-2	P					P			P	A			A	A	A	A	A	A	A			P	A	A	A	P		P	A	P				P			P
722-1	P					P			P	A				P	A	P	A	A	A			A	A	A	A			A	A		P		P				

7.1.1.12. Melastomataceae family

The Melastomataceae is a large family which does include large trees, but consists mostly of shrubs (Gentry 1993: 595). In the middle Caquetá region this family is represented by 23 genera and 103 species (Sánchez Sáenz 1997: 26). Many genera of Melastomataceae present septate fibres in the transverse section that may be interpreted as parenchyma cells when the wood is macroscopically examined. Woods from the genus *Mouriri* present included phloem (Détienne and Jacquet 1983: 221). Photographs of the Melastomataceae woods can be seen in Figure 7.12. Table 7.15 show the anatomical features described for the specimen classified as Melastomataceae.

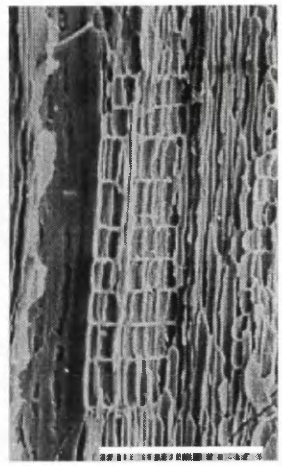
Table 7.15 Microscopic anatomical features of the specimens identified as Melastomataceae.

	Vessels				Fibres/Tracheids																
	Exclusively solitary	Perforations simple	Pits minute	Pits oppos. or scalarif.	Septate fibres	Thick walled fibres	Pits distinctly bordered	Exclusively 1-seriate	Commonly 4-10-seriate	Commonly > 10-seriate	Aggregate rays	Rays 2 distinct widths	Rays Homocellular	Marginal rows >=4	Marginal rows >=10	2-3 seriate parts narrow	Rays storied	Commonly >12/mm	Pits vessels large	Predom. Paratracheal	Aliform or confluent
	1	6	10	11	23	24	25	29	30	31	32	33	34	35	36	37	41	43	44	47	49
5193-1	P	P	A	A	A	A	A	P	A	A	A	A	P	A	A	A	A	P	A	P	P

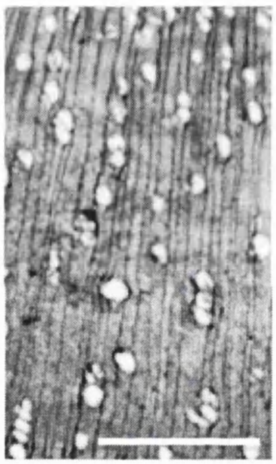


TS 0.50mm
5193 s-s 2

TLS 136um
5193 s-s 2

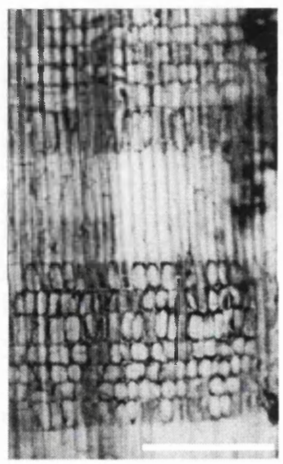


RLS 150um
5193 s-s 2



TS 1.5mm
Bellucia grossularioidies

TLS 0.5mm
Bellucia grossularioidies



RLS 0.5mm
Bellucia grossularioidies

Figure 7.12 Micro-photographs of Melastomataceae woods

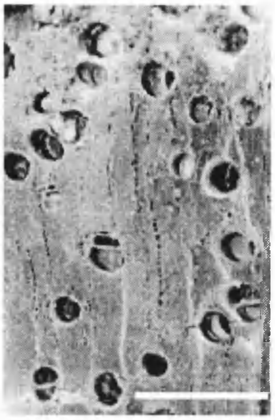
KG: Kew Garden collection; U: Utrecht Univ. collection; s-s sub-sample.

7.1.1.13. Moraceae family

The Moraceae is one of the most important neotropical tree families. The majority of Moraceae consists of trees with latex (Gentry 1993: 626). The Moraceae from the middle Caquetá river include 12 genera and 56 species (Sánchez Sáenz1997: 26). It is difficult to distinguish between some genera of this family from their wood anatomical features. Distinctive features of some genera from this family include latex tubes. Vessel pits are large and vessel-ray pits are generally round and similar in size to vessel pits (Détienne and Jacquet 1983: 234). Figure 7.13 presents examples of Moraceae specimens and Table 7.16 shows the anatomical features for the archaeological fragments belonging to this family.

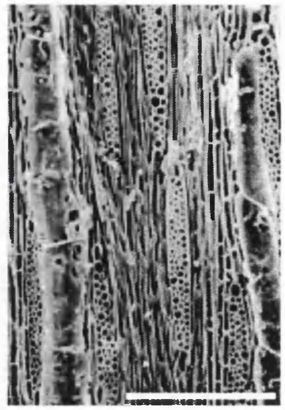
Table 7.16 Microscopic anatomical features of the specimens identified as Moraceae

	Vessels										Fibres/Tracheids			Rays																
	Exclusively solitary	Radial groups of 4	Radial or oblique	Tang. arrangement	Pore clusters	Perforations simple	Spirals in vessels	Pits minute	Pits oppos. or scalarif.	Tyloses sclerosed	Septate fibres	Thick walled fibres	Pits distinctly bordered	Commonly > 1mm high	Exclusively 1-seriate	Commonly 4-10-seriate	Commonly > 10-seriate	Aggregate rays	Rays 2 distinct widths	Rays homocellular	Marginal rows >=4	Marginal rows >=10	2-3 seriate parts narrow	Rays storied	Commonly <4/mm	Commonly >12/mm	Pits vessels large	Predom. paratracheal	Vasicentric	Aliform or confluent
	1	2	3	4	5	6	9	10	11	15	23	24	25	28	29	30	31	32	33	34	35	36	37	41	42	43	44	47	48	49
5516-1	P					P		A	A	P		A			A	A	A				P	A	P				A	P		P
5637-1	A	A	A	A	A	P	P	A	A		A	P	A	P	A	A	A					A			A	A	P	P	P	
719-2	P		P					A	P		A	A	A	A	A	P	A	A	A	A	A	A		A			P	P	P	P



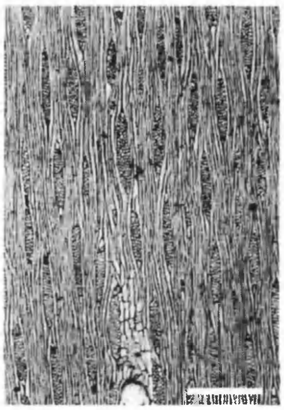
TS 0.60mm
719-2 s-s 3

TLS 176 um
719-2 s-s 3

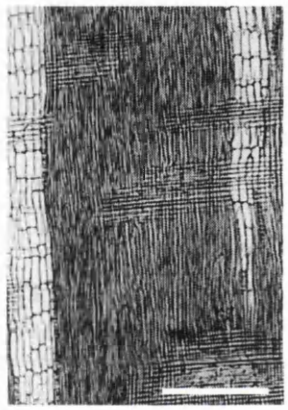


RSL 231um
719-2 s-s 3

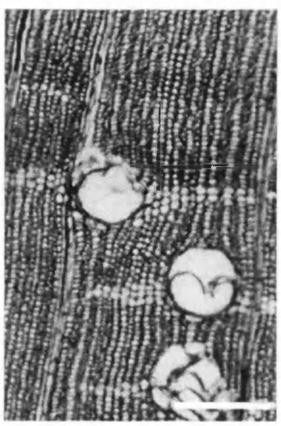
TS 1.25mm
Chlorophora excelsa KG



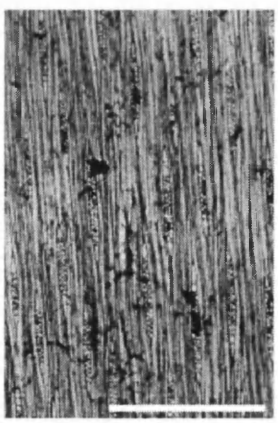
TLS 1.25mm
Chlorophora excelsa KG



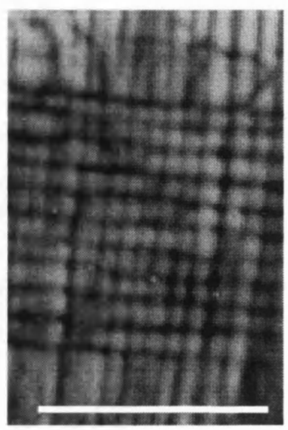
RLS 1.25mm
Chlorophora excelsa KG



TS 0.5mm
Brosimum rubescens



TLS 1.5mm
Brosimum rubescens



RLS 0.5mm
Brosimum rubescens

Figure 7.13 Micro-photographs of Moraceae woods.
KG: Kew Garden collection; U: Utrecht Univ. collection; s-s sub-sample.

7.1.1.14. Myristicaceae family

Most Myristicaceae are medium to large trees. *Virola* is the main Myristicaceae genus; it includes 40 species. The second most important genus, especially in the Amazonian region, is *Iryanthera* (Gentry 1993: 638-639). According to Sánchez Sáenz (1997: 26), in the middle Caquetá region there are four genera and 20 species which belong to the Myristicaceae family. Woods from the Myristicaceae family are characterised by the presence of scalariform perforation plates and reticulate perforation plates with a variable number of plates within genera. Tanniniferous tubes are commonly found in rays (Détienne and Jacquet 1983: 249). Archaeological specimens classified as *Iryanthera* show reticulate perforation plates. Figure 7.14 shows sections of archaeological and reference specimens from this genus. Wood from *Didymopanax* and *Dendropanax* belonging to the Araliaceae family also show reticulate scalariform perforation plates (IAWA Committee 1989: 249), but these do not have marginal parenchyma or uniseriate rays. *Virola* and *Osteophloem*, both from the Myristicaceae family, also have scalariform perforation plates. *Virola* woods generally have biseriate rays and the archaeological specimens have uniseriate rays. Table 7.17 includes an anatomical description of the charred wood fragments identified as Myristicaceae. Tanniniferous tubes were not observed in any archaeological specimen even though some of these specimens are well preserved.

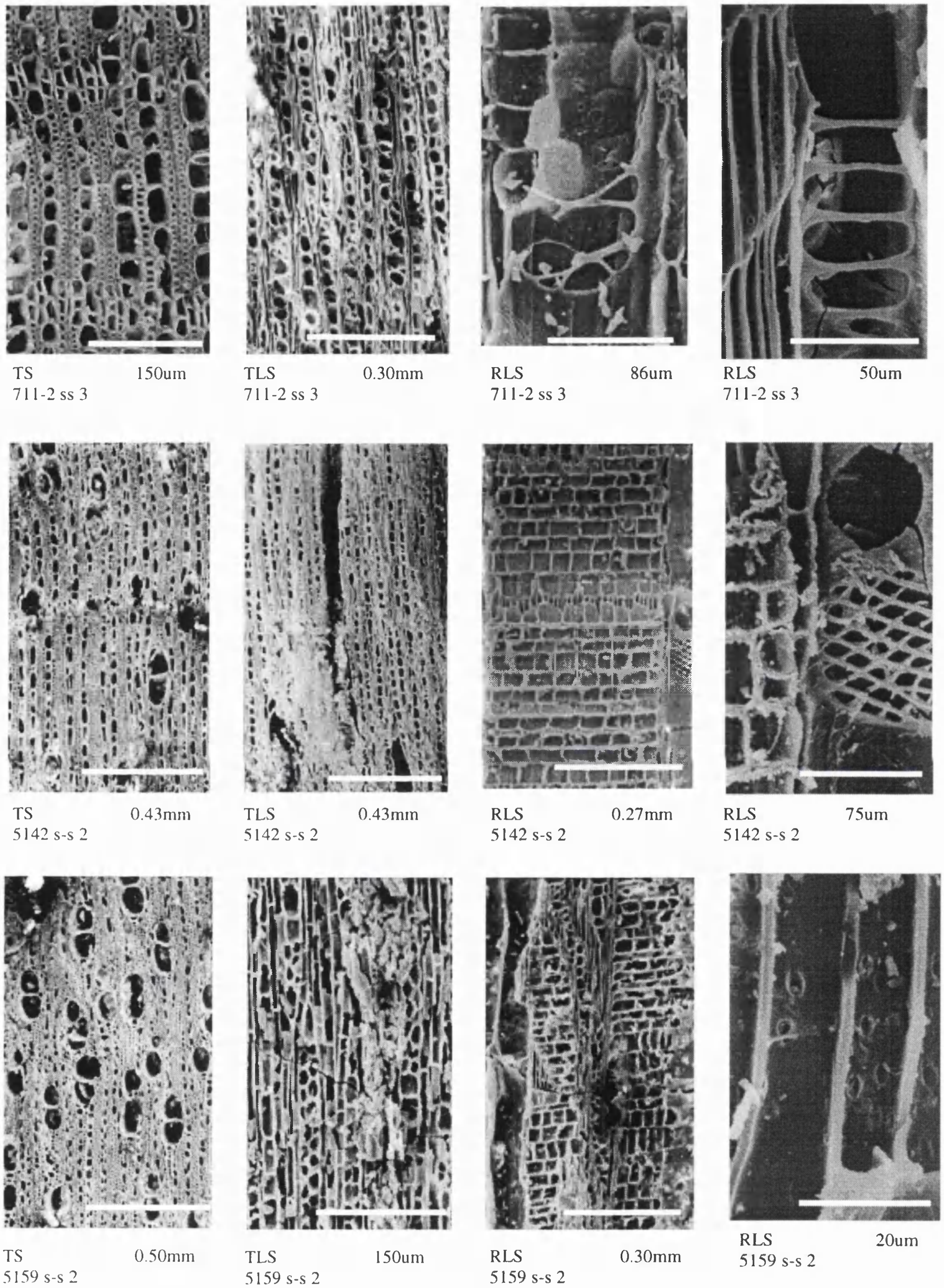
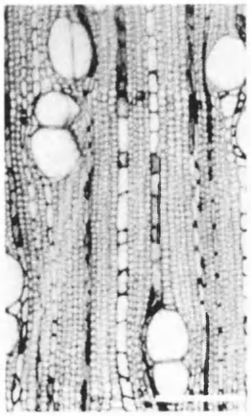
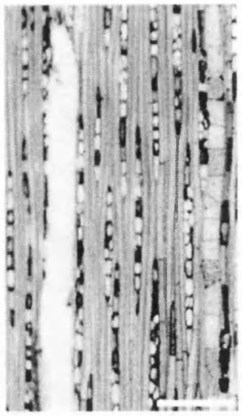


Figure 7.14 Micro-photographs of Myristicaceae woods

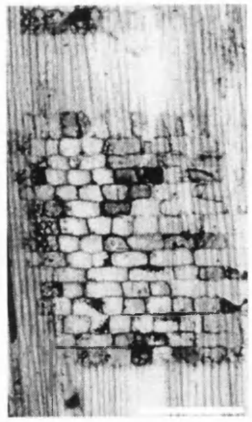
KG: Kew Garden collection; U: Utrecht Univ. collection; s-s sub-sample.



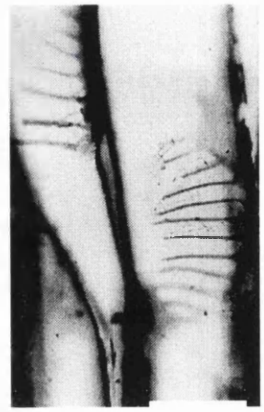
TS 1.25mm
Irianthera macrophyla



TLS 1.25mm
Irianthera macrophyla



RLS 1.25mm
Irianthera macrophyla



RLS 0.5mm
Irianthera macrophyla

Figure 7.14 Micro-photographs of Myristicaceae woods (Continued).

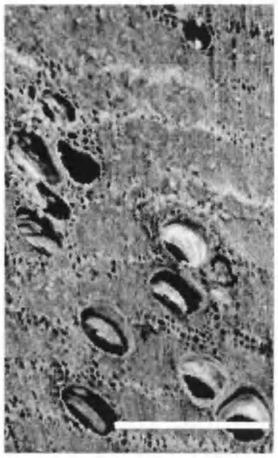
KG: Kew Garden collection; U: Utrecht Univ. collection; s-s sub-sample.

Table 7.17 Microscopic anatomical features of the specimens identified as Myristicaceae.

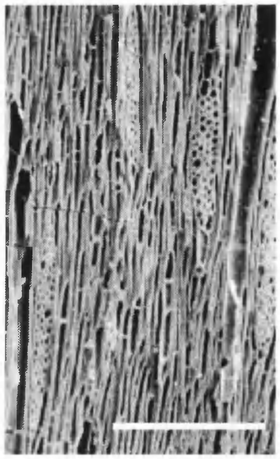
	Vessels										Fibres/ Tracheids			Rays														Parenchyma				
	Exclusively solitary	Radial groups of 4	Radial or oblique	Tang. arrangement	Pore clusters	Perforations simple	Multiple perf. plates	Pits minute	Pits oppos. or scalarif.	Tyloses abundant	Septate fibres	Thick walled fibres	Pits distinctly bordered	Commonly > 1mm high	Exclusively 1-seriate	Commonly 4-10-seriate	Commonly > 10-seriate	Aggregate rays	Rays 2 distinct widths	Rays homocellular	Marginal rows >=4	Marginal rows >=10	2-3 seriate parts narrow	Rays storied	Commonly <4/mm	Commonly >12/mm	Pits vessels large	Predom. apotracheal	Diffuse	Banded parenchyma	Bands >=6/mm	Marginal zonate
	1	2	3	4	5	6	7	10	11	14	23	24	25	28	29	30	31	32	33	34	35	36	37	41	42	43	44	45	46	51	54	57
5532-1	A	A	A	A	A	P		A	A		A	A		A	A	A	A			A	P	A	P		A	A	P	P				P
5024-1	A	A	A	A	A		P		P	P	A	P	A	A	P					A	A	P	A		A	A	P	P				P
5695-1	A				A		P	A	A						P					A	P	A			A	A	P	P		P	P	
5142-1	A	A	A	A	A		P	A	A		A	A	A	A	P	A	A	A	A	A	P	A	A	A		P	P	P	P			
5159-1	A	A	A	A	A		P		A		A	A	A	A	A	A	A			A	P	A				P	P	P				P
5679-1	A	A	A	A	A		P	A	A	P	A	A	A	A	P					A	P	A			A	A	P	P				P
711-2	A	A	A	A	A	P	P	P	A		A	A	A	P	P					A	P	A	A			P	P	P				P

7.1.1.15. Myrtaceae family

Plants from this group are easy to recognise to the family level but not to genus (Gentry 1993: 646). Genera are difficult to distinguish both because of their relatively similarity and their heterogeneous wood anatomy (Détienne and Jacquet 1983: 254). In the middle Caquetá river Myrtaceae family includes eight genera and 46 species (Sánchez Sáenz 1997: 26). Figure 7.15 shows photographs of Myrtaceae woods and Table 7.18 includes anatomical descriptions of the archaeological specimens.

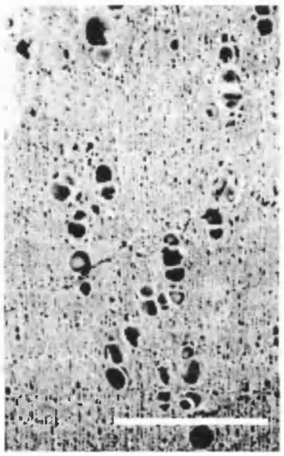


TS 0.27mm
5616 s-s 2

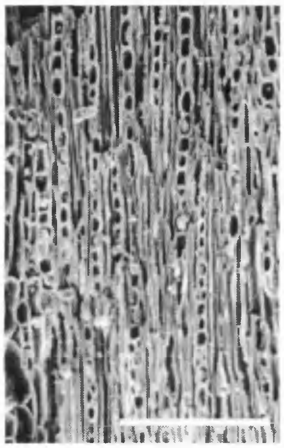


TLS 231um
5616 s-s 2

RLS 150um
5616 s-s 2

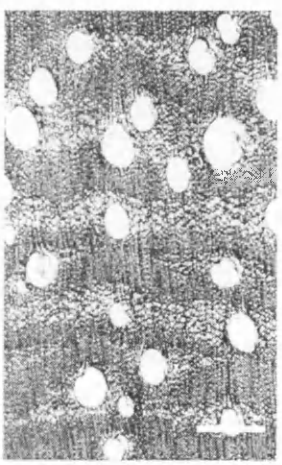


TS 0.50mm
5182 s-s 2

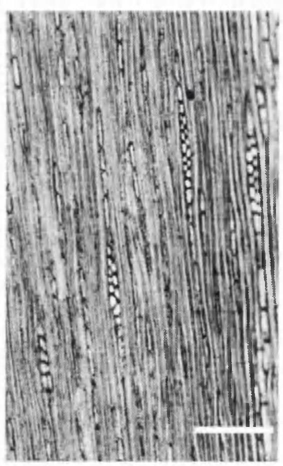


TLS 176um
5182 s-s 2

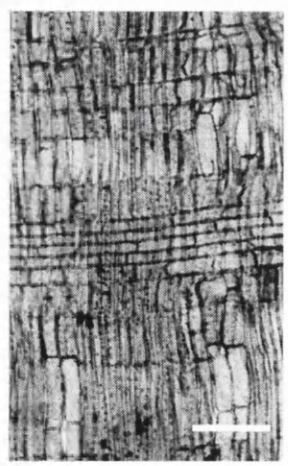
RLS 220um
5182 s-s 2



TS 1.25mm
Marliera sylvatica U-12536



TLS 0.5mm
Marliera sylvatica U-12536



RLS 0.5mm
Marliera sylvatica U-12536

Figure 7.15 Micro-photographs of Myrtaceae woods.

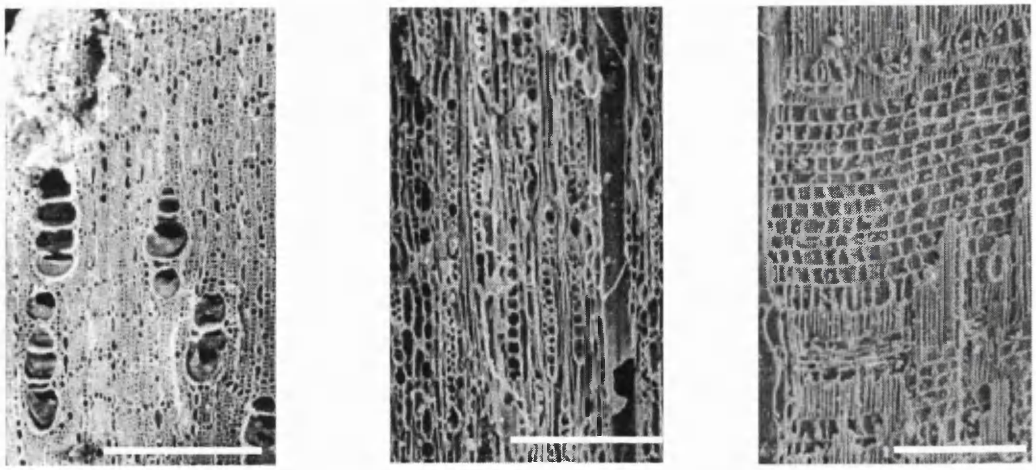
KG: Kew Garden collection; U: Utrecht Univ. collection; s-s sub-sample.

Table 7.18 Microscopic anatomical features of the specimens identified as Myrtaceae.

	Vessels											Fibres/Tracheids			Rays											Parenchyma					
	Exclusively solitary	Radial groups of 4	Radial or oblique	Tang. arrangement	Pore clusters	Perforations simple	Pits minute	Pits oppos. or scalarif.	Pits vestured	Tyloses abundant	Tyloses sclerosed	Septate fibres	Thick walled fibres	Pits distinctly bordered	Commonly > 1mm high	Exclusively 1-seriate	Commonly 4-10-seriate	Commonly > 10-seriate	Rays homocellular	Marginal rows >=4	Marginal rows >=10	2-3 seriate parts narrow	Commonly <4/mm	Commonly >12/mm	Pits vessels large	Predom. apotracheal	Predom. paratracheal	Banded parenchyma	Bands 1-seriate	Bands >=4-seriate	Bands >=6/mm
	1	2	3	4	5	6	10	11	12	14	15	23	24	25	28	29	30	31	34	35	36	37	42	43	44	45	47	51	52	53	54
5581-	P					P	A	A	P			A	A	A	A	A	A	A	A	P			A	A	A	P		P			P
5752-1	P					P		A					P		A	A	A	A	A	P	A		A	A	A	P		P	P		P
5182-1	A	A	A	A	A	P	A	A		P	P	A	A	A	A	P	A	A	P	A	A	A		P			P	P	A	A	P
5616-1	P					P	P	A					P		A	A	A	A	A	A	A	P	A	A	A	P		P			P
706-2	P					P							P		A	A	A	A	A	P	A		A	A	A	P		P	P		P

7.1.1.16. Sapotaceae family

Sapotaceae is a diverse and ecologically important family, whose trees often produce latex (Gentry 1993: 771). Sapotaceae from the middle Caquetá river include eight genera and 57 species (Sánchez Sáenz 1997: 26). The Sapotaceae is a large family and genera are difficult to distinguish based on wood anatomy. The main characteristics of the wood from this family include: vessels in radial groups, parenchyma in tangential bands but also diffuse-in-aggregates, numerous rays (10 to 20 per mm), vessel-ray pits large and silica bodies in ray cells (Détienne and Jacquet 1983: 309). Figure 7.16 includes photographs of Sapotaceae woods and Table 7.19 gives the anatomical description of the archaeological specimens.



TS 0.38mm
5535 s-s 1

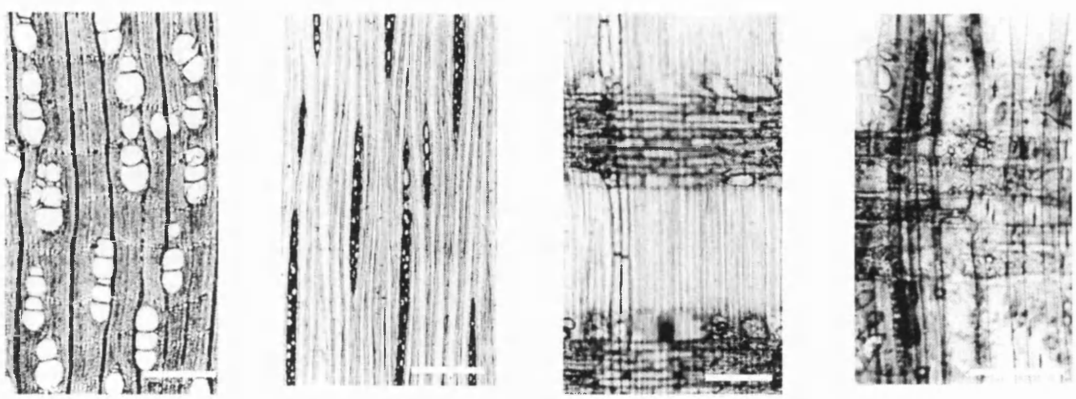
TLS 0.27mm
5535 s-s 1

RLS 0.31mm
5535 s-s 1

TS 0.60mm
5610 s-s 2

TLS 176um
5610 s-s 2

RLS 0.27mm
5610 s-s 2



TS 1.25 mm
Micropholis guianensis KG

TLS 0.5mm
Micropholis guianensis KG

RLS 0.5mm
Micropholis guianensis KG

RLS 0.2mm
Micropholis guianensis KG

Figure 7.16 Micro-photographs of Sapotaceae woods

KG: Kew Garden collection; U: Utrecht Univ. collection; s-s sub-sample.

Table 7.19 Microscopic anatomical features of the specimens identified as Sapotaceae

	Vessels									Fibres/Tracheids			Rays													Parenchyma				
	Exclusively solitary	Radial groups of 4	Radial or oblique	Tang. arrangement	Pore clusters	Perforations simple	Pits minute	Pits oppos. or scalarif.	Pits vestured	Tyloses abundant	Tyloses sclerosed	Septate fibres / Thick walled fibres	Pits distinctly bordered	Commonly > 1mm high	Exclusively 1-seriate	Commonly 4-10-seriate	Commonly > 10-seriate	Rays homocellular	Marginal rows >=4	Marginal rows >=10	2-3 seriate parts narrow	Commonly <4/mm	Commonly >12/mm	Pits vessels large	Predom. apotracheal	Predom. paratracheal	Banded parenchyma	Bands 1-seriate	Bands >=4-seriate	Bands >=6/mm
	1	2	3	4	5	6	9	10	11	23	24	25	28	29	30	31	32	33	34	35	36	37	42	43	44	45	46	51	52	54
5535-1		P				P		A	A	A	A	A	A	A	A	A			A	P	A	P		P	A	P	P	P	P	P
5610-1	A	A	A	A	A	P			P		P			A	A	A			A	P	A		A	A		P		P	P	P
705-2	A	A	A	A	A	P		A	A			A	A	A	A	A			A	A	A		A	A		P		P	P	P
710-1	A	A	A	A	A	P		P	A		A		A	A	A	A			A	P		A		P	A	P		P	P	P
710-2		P							P		A		A	A	A	A			A	P			A	A	A	P		P	P	P
716-1	A	A	A	A	A	P		A	A		A		A	A	A	A			A	A	A	A	A	A	P	P	P	P		P
723-1	A	A	A	A	A	P		A	A	A	A	A		P			A	A	P	A	A	A		P	P	P	P	P		
725-1	A	A	A	A	A	P				A	A	A	A	A	A	A			A	A	A	P		P	P	P	P	P		

7.1.2. Ethnobotanical data

Ethnobotanical sources from the Colombian Amazon were consulted in order to construct a complete picture of the range of uses of wood by the present day indigenous people of the region. In particular, information from the middle Caquetá region was taken into account. Possible uses are:

1. Firewood: direct use of wood for combustion. Sometimes the information specifies if the wood is used for cooking.
2. Firewood for smoking meat and/or fish.
3. Wood to provide light ("popai").
4. Timber for house construction. Species from which leaves are used for roofing were not included. Woods used as beams and to make planks for house construction as well as palm trunks used to build house floors and walls were included.
5. Domestic artefacts: including fibres used for manufacturing baskets and hammocks, wood used for making shelves and furniture, containers for food and other items, fish traps, tools used for collecting and processing food such as bitter manioc, sieves and graters, mortars and hand mills. Woods used for making axe handles were included in this category. Plants from which bark is taken as raw material for domestic artefacts or from which resins and dyes are extracted are excluded.
6. Manufacture of hunting and fishing equipment such as knives, arrows, blowpipes, fishing darts and fishing rods.
7. Musical instruments.
8. Manufacture of pottery. There are several woody taxa from which bark and/or latex are used as temper in pottery. Some specific woods are also used in firing pottery.
9. Material for canoe manufacture. This category includes paddles and in one case a small raft. There are several woods from which latex is extracted and processed to make resinous products to repair or waterproof canoes. When this is the only use

for a particular species, it has not been included here because latex can be extracted without felling trees.

10. Ornaments/Ritual. Included in this category were trees from which bark or wood is used to manufacture cloths, ornaments and other different objects associated with rituals and ceremonies. Plants from which salt is extracted by charring, boiling and filtering the bark or pieces of wood were included in this category (this salt is added to tobacco paste). Woods from which sap is used to prepare hallucinogenic brews were also included.
11. Food. This category includes all those trees from which fruits and other parts are used as food or to prepare drinks and oils.
12. Rearing of larvae. Insect larvae of the genus *Rhynchophorus* are found in fallen palm trunks. Sometimes palms are deliberately felled to encourage the insects which are later collected and eaten.
13. Medicinal. It includes trees from which one or more parts can be used for different medicinal purposes.
14. Fishing and hunting baits. It includes trees from which the fruits are used as fish bait or from which fruits are eaten by animals that are hunted.
15. Fishing and hunting poisons. It includes trees from which bark is used to prepare hunting poisons ("curares") to be used in darts or for fishing.

The ethnobotanical information has been recorded from several indigenous groups which inhabit the region at present. These groups are: Huitoto, Muinane, Andoque, Muinane, Miraña and Yucuna–Matapí (Acero Duarte 1979, 1982, Schultes 1979, 1988, Glenboski 1983, La Rotta 1983, La Rotta *et al.* 1989, Schultes and Raffauf 1990, Galeano 1991, Sánchez Sáenz *et al.* 1991, Garzón *et al.* 1992, Cabrera *et al.*1994, Politis and Rodríguez 1994, Cárdenas López and Giraldo Cañas 1995, Murillo Aldana 1995, Herrera and Urrego 1996, Morcote *et al.* 1996, 1998, Politis 1996b, 1998, Sánchez Sáenz 1997). Woody taxa and palms recorded in Tables (7.20 to 7.35) are those from which wood is used for more than one purpose. All uses of each part of the plant are recorded. In Chapter eight specific uses for each family identified in the archaeological sample will be analysed in detail.

When the reported use of a plant indicates that bark, leaves, fruits and/or other parts of the plants other than wood were utilised, the plants were not included in the Tables because there is no available information on whether trees were felled in order to obtain the required products and whether their wood was used or not. Data contained in these sources and collected during the field trip are shown in Table 7.20. Woods of 275 species from 35 families have been reported as being used by people today. Table 7.21 to 7.35 show the species employed for each of the defined uses. These Tables include the landscape units where each species has been reported in the middle Caquetá region. Tables 7.36 to 7.51 contain information on the different uses of the species from the families identified in the archaeological samples from Peña Roja site.

Table 7.20 Differemt uses given to woody taxa by indigenous people living at present in the studied region.

Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A)Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
1	Anacardiaceae	Tapirira guianensis				X		X								X			X		X	X		X		X	X	X
2	Annonaceae	Bocageopsis canescens				X		X								X					X			X	X			
3	Annonaceae	Bocageopsis multiflora				X	X														X			X			X	X
4	Annonaceae	Duguetia odorata	X			X							X						X	X	X						X	
5	Annonaceae	Duguetia quitarensis						X													X	X						
6	Annonaceae	Duguetia stenantha						X					X								X					X		
7	Annonaceae	Ephedranthus amazonicus						X													X	X					X	X
8	Annonaceae	Fusaea longifolia				X							X								X			X				
9	Annonaceae	Guatteria decurrens				X						X			X					X	X			X				X
10	Annonaceae	Guatteria ferruginea	X				X								X												X	X
11	Annonaceae	Guatteria kuhlmannii				X		X								X			X	X	X			X				
12	Annonaceae	Guatteria megalophylla				X											X		X	X	X	X		X		X	X	X
13	Annonaceae	Guatteria puncticulata	X			X															X	X					X	
14	Annonaceae	Guatteria recurvisepala				X															X							
15	Annonaceae	Guatteria schomburgkiana				X	X														X							X
16	Annonaceae	Guatteriella tomentosa				X						X								X							X	

Table 7.20 Different uses given to woody taxa by indigenous people living at present in the studied region (Continued)

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
17	Annonaceae	Malmea dielsiana				X													X		X	X						
18	Annonaceae	Oxandra euneura					X	X				X								X	X						X	
19	Annonaceae	Oxandra leucodermis				X		X								X								X				
20	Annonaceae	Oxandra mediocris				X													X	X								
21	Annonaceae	Oxandra polyantha				X		X								X			X	X	X			X				
22	Annonaceae	Pseudoxandra cf. coriacea				X						X									X							
23	Annonaceae	Pseudoxandra leiophylla				X																X						
24	Annonaceae	Pseudoxandra pacifica				X		X								X			X	X				X				
25	Annonaceae	Unonopsis guatterioides				X		X								X			X	X	X			X				
26	Annonaceae	Unonopsis spectabilis				X							X							X	X	X						
27	Annonaceae	Unonopsis stipitata					X	X													X	X				X	X	X
28	Annonaceae	Unonopsis venificiorum				X									X		X											
29	Annonaceae	Xylopia sp.	X			X																						
30	Annonaceae	Xylopia amazonica	X			X									X												X	
31	Annonaceae	Xylopia benthamii				X									X												X	
32	Annonaceae	Xylopia cuspidata						X													X						X	
33	Annonaceae	Xylopia emarginata				X	X																		X			
34	Annonaceae	Xylopia macrantha						X													X							
35	Annonaceae	Xylopia micans	X			X	X														X	X		X			X	
36	Annonaceae	Xylopia spruceana				X		X													X			X			X	X
37	Apocynaceae	Aspidosperma sp.				X	X				X		X		X													
38	Apocynaceae	Aspidosperma cf. excelsum	X	X	X																							
39	Apocynaceae	Couma macrocarpa					X			X	X	X	X		X		X			X	X			X			X	
40	Araceae	Heteropsis flexuosa				X						X							X	X	X			X			X	X
41	Araceae	Heteropsis jenmani				X	X														X							
42	Araceae	Heteropsis oblongifolia				X															X			X				
43	Araceae	Heteropsis spruceana				X	X														X	X		X			X	
44	Arecaceae	Astrocaryum aculeatum	X			X	X	X	X				X							X	X			X				

Table 7.20 Different uses given to woody taxa by indigenous people living at present in the studied region (Continued)

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
45	Arecaceae	Astrocaryum gynacanthum	X									X	X														X	
46	Arecaceae	Attalea maripa	X			X	X	X	X			X	X								X							X
47	Arecaceae	Bactris gasipaes	X				X	X				X	X	X														
48	Arecaceae	Catoblastus drudei				X		X												X								
49	Arecaceae	Dictocaryum ptarianum				X																					X	X
50	Arecaceae	Dictocaryum ptariense				X																						X
51	Arecaceae	Euterpe catinga				X							X													X		X
52	Arecaceae	Euterpe precatoria				X							X							X				X	X			X
53	Arecaceae	Geonoma deversa				X						X			X						X						X	
54	Arecaceae	Geonoma stricta var. piscicauda					X												X		X	X					X	X
55	Arecaceae	Iriartea deltoidea				X							X							X	X	X					X	
56	Arecaceae	Iriartella setigera				X		X					X		X						X	X				X	X	X
57	Arecaceae	Manicaria saccifera				X							X											X				
58	Arecaceae	Mauritia flexuosa	X			X	X	X				X	X	X					X		X			X				
59	Arecaceae	Mauritiella aculeata				X							X			X				X	X	X					X	X
60	Arecaceae	Maximiliana maripa					X	X					X									X					X	
61	Arecaceae	Oenocarpus bacaba	X				X						X									X		X		X	X	X
62	Arecaceae	Oenocarpus bataua	X			X	X	X				X	X	X							X	X				X	X	X
63	Arecaceae	Oenocarpus mapora	X				X						X						X	X	Z						X	
64	Arecaceae	Pholydostachys synanthea				X						X								X							X	
65	Arecaceae	Phytelephas microcarpa				X													X	X	X	X		X			X	X
66	Arecaceae	Socratea exorrhiza				X	X								X				X	X	X	X		X			X	X
67	Arecaceae	Wettinia augusta	X			X		X							X												X	
68	Arecaceae	Wettinia drudei						X															X					
69	Bignoniaceae	Jacaranda macrocarpa				X															X	X				X	X	X
70	Bombacaceae	Catostemma commune				X															X							
71	Bombacaceae	Matisia achrocalyx				X						X							X		X	X		X			X	
72	Bombacaceae	Ochroma pyramidale					X				X								X		X							

Table 7.20 Different uses given to woody taxa by indigenous people living at present in the studied region (Continued)

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
73	Bombacaceae	Scleronema micranthum				X							X							X	X	X		X		X	X	X
74	Bombacaceae	Scleronema praecox				X									X						X					X	X	X
75	Burseraceae	Crepidospermum prancei				X														X	X						X	
76	Burseraceae	Crepidospermum rhoifolium	X																			X					X	X
77	Burseraceae	Dacryodes peruviana				X							X						X		X	X		X		X		
78	Burseraceae	Protium aracouchini	X								X										X	X					X	
79	Burseraceae	Protium decandrum				X																						
80	Burseraceae	Protium divaricatum				X									X						X						X	
81	Burseraceae	Protium krukoffii	X																X					X				
82	Burseraceae	Protium nodulosum				X							X		X				X	X	X			X				
83	Burseraceae	Protium subserratum	X												X						X	X					X	X
84	Burseraceae	Protium urophyllidium	X												X												X	
85	Burseraceae	Tetragastris panamensis				X									X					X	X							
86	Burseraceae	Trattinnickia glaziovii				X									X						X			X			X	X
87	Cecropiaceae	Cecropia sp.	X															X										
88	Cecropiaceae	Cecropia discolor							X			X																
89	Cecropiaceae	Cecropia ficifolia	X							X		X							X	X	X							X
90	Cecropiaceae	Pourouma ferruginea				X							X								X	X						
91	Cecropiaceae	Pourouma mollis	X																		X	X						
92	Cecropiaceae	Pourouma ovata				X							X								X							X
93	Cecropiaceae	Pourouma tomentosa				X		X					X			X						X				X	X	X
94	Celastraceae	Goupia glabra	X									X			X	X					X	X				X	X	X
95	Chrysobalanaceae	Hirtella macrophylla								X																		
96	Chrysobalanaceae	Licania apetala	X							X										X	X	X			X		X	X
97	Chrysobalanaceae	Licania arachnoidea			X	X							X						X	X	X	X					X	X
98	Chrysobalanaceae	Licania cf. longipedicellata	X																		X							
99	Chrysobalanaceae	Licania harlingii			X	X													X			X						X
100	Chrysobalanaceae	Licania heteromorpha				X									X				X	X	X	X					X	X

Table 7.20 Different uses given to woody taxa by indigenous people living at present in the studied region (Continued)

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
101	Chrysobalanaceae	Licania micrantha			X	X														X	X	X		X			X	
102	Chrysobalanaceae	Licania octandra	X							X											X					X		
103	Chrysobalanaceae	Licania parvifolia			X										X									X				
104	Chrysobalanaceae	Licania urceolaris	X			X													X								X	
105	Chrysobalanaceae	Parinari parilis			X								X						X	X								
106	Clusiaceae	Calophyllum longifolium									X								X	X	X			X				X
107	Clusiaceae	Tovomita schomburgkii	X																X	X		X		X			X	
108	Clusiaceae	Tovomita aff. spruceana	X	X						X											X						X	X
109	Clusiaceae	Vismia macrophylla	X				X					X			X				X	X	X			X				
110	Clusiaceae	Vismia sandwithii	X			X													X	X	X							
111	Combretaceae	Buchenavia amazonica				X													X	X	X						X	
112	Combretaceae	Buchenavia parvifolia				X															X	X					X	
113	Ebenaceae	Diospyros glomerata						X									X				X						X	
114	Ebenaceae	Diospyros pseudoxylopia	X			X	X	X											X		X							
115	Ebenaceae	Diospyros tetranda						X																			X	
116	Elaeocarpaceae	Sloanea macroana				X													X		X						X	
117	Euphorbiaceae	Alchornea schomburgkii				X													X									
118	Euphorbiaceae	Asparisthmium cordatum				X												X									X	X
119	Euphorbiaceae	Gavarretia terminalis				X															X						X	X
120	Euphorbiaceae	Hyeronima oblonga	X			X													X		X						X	
121	Euphorbiaceae	Mabea nitida					X								X	X			X	X	X			X	X			
122	Euphorbiaceae	Micrandra lopezii									X	X															X	
123	Euphorbiaceae	Micrandra spruceana	X			X					X	X	X			X					X	X					X	X
124	Euphorbiaceae	Micradropsis scleroxylon				X																					X	
125	Euphorbiaceae	Nealchornea yapurensis	X																	X	X	X					X	
126	Euphorbiaceae	Sandwithia heterocalyx	X									X									X	X		X			X	X
127	Euphorbiaceae	Senefeldera inclinata	X					X							X	X					X	X					X	
128	Euphorbiaceae	Senefeldera karsteniana	X				X																				X	

Table 7.20 Different uses given to woody taxa by indigenous people living at present in the studied region (Continued)

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
129	Euphorbiaceae	Vaupesia cataractarum	X			X							X								X	X					X	
130	Flacourtiaceae	Lindackeria maynensis				X									X													
131	Flacourtiaceae	Lindackeria paludosa	X			X													X		X					X		
132	Flacourtiaceae	Mayna grandiflora													X				X		X					X		
133	Humiriaceae	Humiriastrum piraparanense				X									X													X
134	Humiriaceae	Vantanea peruviana	X																								X	
135	Lauraceae	Endlicheria formosa				X													X	X	X							
136	Lauraceae	Endlicheria multiflora				X														X					X			
137	Lauraceae	Licaria sp.(1)	X			X												X										
138	Lauraceae	Licaria sp.(2)	X			X												X										
139	Lauraceae	Licaria aurea				X																					X	
140	Lauraceae	Licaria cannella				X																					X	X
141	Lauraceae	Licaria macrophylla				X															X					X		X
142	Lauraceae	Mezilaurus itauba				X					X															X	X	X
143	Lauraceae	Nectandra cuspidata				X					X		X								X							
144	Lauraceae	Ocotea sp.				X					X	X								X	X	X				X	X	X
145	Lauraceae	Ocotea aciphylla				X												X										
146	Lauraceae	Ocotea argyrophylla				X					X																X	X
147	Lauraceae	Ocotea cymbarum				X																					X	
148	Lauraceae	Ocotea javitensis				X					X								X		X	X		X			X	X
149	Lauraceae	Ocotea rubrinervis										X									X						X	
150	Lecythidaceae	Cariniana multiflora				X															X						X	
151	Lecythidaceae	Eschweilera alata				X	X								X						X	X					X	
152	Lecythidaceae	Eschweilera albiflora			X														X	X	X			X				
153	Lecythidaceae	Eschweilera andina			X		X												X	X		X		X				
154	Lecythidaceae	Eschweilera bracteosa				X															X	X					X	
155	Lecythidaceae	Eschweilera chartaceifolia				X							X								X	X					X	
156	Lecythidaceae	Eschweilera coriacea			X	X	X												X	X	X	X		X			X	X

Table 7.20 Different uses given to woody taxa by indigenous people living at present in the studied region (Continued)

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
157	Lecythidaceae	Eschweilera gigantea			X																	X						
158	Lecythidaceae	Eschweilera itayensis			X		X					X			X					X	X			X				
159	Lecythidaceae	Eschweilera laevicarpa				X	X														X						X	
160	Lecythidaceae	Eschweilera parvifolia			X	X	X												X	X		X			X		X	X
161	Lecythidaceae	Eschweilera punctata			X	X	X								X						X	X					X	X
162	Lecythidaceae	Eschweilera revoluta			X																	X						
163	Lecythidaceae	Eschweilera rufifolia			X	X	X					X			X					X	X					X	X	X
164	Lecythidaceae	Eschweilera tessmannii			X	X	X								X						X	X				X	X	X
165	Lecythidaceae	Eschweilera turbinata				X																						
166	Lecythidaceae	Lecythis chartacea				X														X							X	
167	Leguminosae	Clathrotropis macrocarpa	X									X			X		X				X	X					X	X
168	Leguminosae	Clathrotropis nitida	X			X														X	X			X			X	X
169	Leguminosae	Diplotropis duckei				X															X	X				X		X
170	Leguminosae	Dipteryx micrantha				X	X																					
171	Leguminosae	Heterostemon conjugatus	X																X			X					X	X
172	Leguminosae	Hydrochorea gonggrijpii				X															X			X			X	
173	Leguminosae	Hymenolobium pulcherrimum				X					X													X			X	
174	Leguminosae	Inga ciliata				X							X								X							
175	Leguminosae	Inga pruriens				X							X						X		X	X					X	
176	Leguminosae	Inga tessmanni				X							X								X							
177	Leguminosae	Monopteryx uaucu	X		X						X		X		X						X	X				X	X	X
178	Leguminosae	Poecilanthe amazonica	X					X									X											X
179	Leguminosae	Swartzia cardiosperma				X													X	X	X	X		X			X	X
180	Leguminosae	Swartzia racemosa	X	X		X							X		X					X	X			X			X	
181	Leguminosae	Swartzia schomburgkii	X			X					X				X						X	X		X		X	X	X
182	Leguminosae	Vatairea guianensis									X								X	X	X			X	X			
183	Leguminosae	Zygia latifolia	X																X	X	X			X				
184	Melastomataceae	Adelobotrys macrophylla								X																		

Table 7.20 Different uses given to woody taxa by indigenous people living at present in the studied region (Continued)

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
185	Melastomataceae	Bellucia grossularioides	X																	X	X							X
186	Melastomataceae	Miconia dispar	X																X	X	X							
187	Melastomataceae	Miconia phaeophylla	X																		X						X	
188	Melastomataceae	Miconia prasina	X																		X							
189	Melastomataceae	Miconia pubipetala	X																								X	
190	Melastomataceae	Miconia sp.		X								X															X	
191	Melastomataceae	Mouriri cauliflora	X										X								X	X					X	
192	Melastomataceae	Mouriri myrtifolia				X							X						X	X				X				X
193	Meliaceae	Carapa guianensis				X									X													
194	Meliaceae	Cedrela fissilis				X	X		X		X	X																
195	Meliaceae	Guarea grandifolia				X													X	X	X	X						
196	Meliaceae	Guarea macrophylla				X									X				X	X	X			X				
197	Meliaceae	Guarea purusana				X													X	X	X	X					X	
198	Meliaceae	Guarea trunciflora				X						X									X	X					X	
199	Meliaceae	Trichilia micrantha				X		X							X	X					X	X					X	X
200	Meliaceae	Trichilia septentrionalis	X									X								X						X	X	
201	Moraceae	Brosimum rubescens				X	X					X									X	X				X	X	X
202	Moraceae	Clarisia racemosa									X		X								X	X					X	
203	Moraceae	Naucleopsis imitans	X																X		X	X				X		X
204	Moraceae	Naucleopsis ulei				X	X				X									X	X						X	
205	Moraceae	Perebea mollis				X							X							X								
206	Moraceae	Perebea xanthochyma				X													X	X	X							
207	Moraceae	Pseudolmedia laevigata					X					X	X						X		X	X					X	X
208	Moraceae	Sorocea hirtella subsp. oligotricha				X							X						X	X	X			X				
209	Myristicaceae	Iryanthera crassifolia	X				X					X								X	X	X						
210	Myristicaceae	Iryanthera juruensis				X	X						X		X					X	X	X					X	X
211	Myristicaceae	Iryanthera laeviss				X						X	X								X	X				X		

Table 7.20 Different uses given to woody taxa by indigenous people living at present in the studied region (Continued)

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
212	Myristicaceae	Iryanthera lancifolia				X	X					X	X							X	X	X				X	X	
213	Myristicaceae	Iryanthera macrophylla				X						X									X							
214	Myristicaceae	Iryanthera obovata				X																						X
215	Myristicaceae	Iryanthera polyneura	X										X						X	X	X	X					X	
216	Myristicaceae	Iryanthera tricornis	X			X	X	X					X								X	X					X	X
217	Myristicaceae	Iryanthera ulei	X			X	X			X		X	X		X	X			X	X	X	X		X			X	X
218	Myristicaceae	Virola calophylla	X			X						X			X				X	X	X	X		X		X	X	
219	Myristicaceae	Virola divergens				X						X			X						X							
220	Myristicaceae	Virola elongata	X			X		X				X			X	X			X	X	X	X		X	X		X	X
221	Myristicaceae	Virola loretensis				X						X							X	X	X			X				
222	Myristicaceae	Virola multinervia	X																			X					X	
223	Myristicaceae	Virola pavonis	X			X		X				X				X			X	X	X	X		X		X		X
224	Myristicaceae	Virola surinamensis	X					X							X	X			X	X	X			X				
225	Myrtaceae	Calyptranthes pulchella				X	X																	X				X
226	Myrtaceae	Marlierea spruceana				X													X	X	X			X			X	
227	Myrtaceae	Myrcia revolutifolia						X																				X
228	Myrtaceae	Plinia rivularis				X															X							
229	Nyctaginaceae	Neea obovata	X																									X
230	Olacaceae	Histeria barbata				X														X								
231	Olacaceae	Miniquartia guianensis	X			X	X										X		X	X	X	X		X		X		
232	Rubiaceae	Alibertia edulis	X									X												X			X	
233	Rubiaceae	Botryarrhena pendula				X															X						X	X
234	Rubiaceae	Duroia eriophila	X									X	X								X							
235	Rubiaceae	Genipa sp.	X															X										
236	Rubiaceae	Genipa americana	X				X				X	X							X		X			X				
237	Rubiaceae	Pagamea guianensis				X															X	X		X				
238	Rubiaceae	Stachyococcus adinanthus	X																	X	X							
239	Rubiaceae	Warszewiczia coccinea									X				X				X	X	X			X				X

Table 7.20 Different uses given to woody taxa by indigenous people living at present in the studied region (Continued)

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
240	Sabiaceae	Meliosma herbertii				X					X										X						X	X
241	Sapiandaceae	Matayba purgans				X	X														X						X	X
242	Sapiandaceae	Talisia grandifolia				X															X						X	X
243	Sapotaceae	Chrysophyllum prieurii				X							X								X	X					X	
244	Sapotaceae	Chrysophyllum sanguinolentum				X									X					X	X	X					X	X
245	Sapotaceae	Ecclinusa guianensis	X																			X					X	
246	Sapotaceae	Ecclinusa lanceolata				X							X						X	X	X			X				
247	Sapotaceae	Manilkara inundata				X																		X				
248	Sapotaceae	Micropholis guyanensis	X			X							X						X	X	X	X					X	X
249	Sapotaceae	Micropholis obscura	X																		X							X
250	Sapotaceae	Pouteria arcuata				X															X							X
251	Sapotaceae	Pouteria caimito				X							X		X						X							X
252	Sapotaceae	Pouteria cladantha				X														X		X						
253	Sapotaceae	Pouteria cuspidata			X	X							X						X	X	X			X			X	
254	Sapotaceae	Pouteria glauca				X														X								
255	Sapotaceae	Pouteria glomerata				X		X					X														X	
256	Sapotaceae	Pouteria hispida				X							X								X	X		X				X
257	Sapotaceae	Pouteria maguirei				X																					X	X
258	Sapotaceae	Pouteria retinervis	X										X								X	X					X	
259	Simaroubaceae	Picramnia sellowii subsp.spruceana				X						X							X								X	
260	Simaroubaceae	Simarouba amara				X	X												X	X	X						X	X
261	Violaceae	Leonia cymosa				X						X			X						X	X					X	
262	Violaceae	Leonia glycycarpa				X													X	X	X	X		X			X	
263	Violaceae	Rinorea racemosa	X			X															X	X				X	X	X
264	Vochysiaceae	Erisma bicolor	X			X															X					X	X	X
265	Vochysiaceae	Erisma calcaratum				X															X						X	
266	Vochysiaceae	Qualea acuminata				X							X		X				X		X	X		X	X			

Table 7.20 Different uses given to woody taxa by indigenous people living at present in the studied region (Continued)

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
267	Vochysiaceae	Qualea ingens	X			X													X	X	X							X
268	Vochysiaceae	Qualea paraensis				X															X					X	X	
269	Vochysiaceae	Ruizterania cassiquiarensis				X															X							
270	Vochysiaceae	Vochysia diversa				X																						X
271	Vochysiaceae	Vochysia lomatophylla	X										X		X				X	X	X							
272	Vochysiaceae	Vochysis punctata				X																						X
273	Vochysiaceae	Vochysia venulosa				X																X					X	
274	Vochysiaceae	Vochysia vismiifolia				X															X							X
275	Vochysiaceae	Vochysia vochysiaceae				X																						
		Total	85	4	18	187	50	38	4	8	22	47	61	3	51	18	7											

Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A)Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.

Table 7.21 Woods used as firewood.

Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A)Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
1	Annonaceae	Duguetia odorata	X			X							X						X	X	X						X	
2	Annonaceae	Guatteria ferruginea	X				X								X												X	X
3	Annonaceae	Guatteria puncticulata	X			X															X	X					X	
4	Annonaceae	Xylopia sp.	X			X																						
5	Annonaceae	Xylopia amazonica	X			X									X												X	
6	Annonaceae	Xylopia micans	X			X	X														X	X		X			X	
7	Apocynaceae	Aspidosperma cf. excelsum	X	X	X																							
8	Arecaceae	Astrocaryum aculeatum	X			X	X	X	X				X							X	X			X				
9	Arecaceae	Astrocaryum gynacanthum	X									X	X														X	
10	Arecaceae	Attalea maripa	X			X	X	X	X			X	X								X							X
11	Arecaceae	Bactris gasipaes	X				X	X				X	X	X														
12	Arecaceae	Mauritia flexuosa	X			X	X	X				X	X	X					X		X			X				
13	Arecaceae	Oenocarpus bacaba	X				X						X									X		X		X	X	X
14	Arecaceae	Oenocarpus bataua	X			X	X	X				X	X	X							X	X				X	X	X
15	Arecaceae	Oenocarpus mapora	X				X						X						X	X	Z						X	
16	Arecaceae	Wettinia augusta	X			X		X							X												X	
17	Burseraceae	Crepidospermum rhoifolium	X																			X					X	X
18	Burseraceae	Protium aracouchini	X								X										X	X					X	

Table 7.21 Woods used as firewood (Continued)

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
19	Burseraceae	Protium krukoffii	X																X					X				
20	Burseraceae	Protium subserratum	X												X						X	X					X	X
21	Burseraceae	Protium urophyllidium	X												X												X	
22	Cecropiaceae	Cecropia sp.	X															X										
23	Cecropiaceae	Cecropia ficifolia	X							X		X							X	X	X							X
24	Cecropiaceae	Pourouma mollis	X																		X	X						
25	Celastraceae	Goupia glabra	X									X			X	X					X	X				X	X	X
26	Chrysobalanaceae	Licania apetala	X							X										X	X	X			X		X	X
27	Chrysobalanaceae	Licania cf. longipedicellata	X																		X							
28	Chrysobalanaceae	Licania octandra	X							X											X					X		
29	Chrysobalanaceae	Licania urceolaris	X			X													X								X	
30	Clusiaceae	Tovomita schomburgkii	X																X	X		X		X			X	
31	Clusiaceae	Tovomita aff. spruceana	X	X						X											X						X	X
32	Clusiaceae	Vismia macrophylla	X				X					X			X				X	X	X			X				
33	Clusiaceae	Vismia sandwithii	X			X													X	X	X							
34	Ebenaceae	Diospyros pseudoxylopia	X			X	X	X											X		X							
35	Euphorbiaceae	Hyeronima oblonga	X			X													X		X						X	
36	Euphorbiaceae	Micrandra spruceana	X			X					X	X	X			X					X	X					X	X
37	Euphorbiaceae	Nealchornea yapurensis	X																	X	X	X					X	
38	Euphorbiaceae	Sandwithia heterocalyx	X									X									X	X		X			X	X
39	Euphorbiaceae	Senefeldera inclinata	X					X							X	X					X	X					X	
40	Euphorbiaceae	Senefeldera karsteniana	X				X																				X	
41	Euphorbiaceae	Vaupesia cataractarum	X			X							X								X	X					X	
42	Flacourtiaceae	Lindackeria paludosa	X			X													X		X					X		
43	Humiriaceae	Vantanea peruviana	X																								X	
44	Lauraceae	Licaria sp.(1)	X			X												X										
45	Lauraceae	Licaria sp.(2)	X			X												X										
46	Leguminosae	Clathrotropis macrocarpa	X									X			X		X				X	X					X	X
47	Leguminosae	Clathrotropis nitida	X			X														X	X			X			X	X

Table 7.21 Woods used as firewood (Continued)

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
48	Leguminosae	Heterostemon conjugatus	X																X			X					X	X
49	Leguminosae	Monopteryx uaucu	X		X						X		X		X						X	X				X	X	X
50	Leguminosae	Poecilanthe amazonica	X					X									X											X
51	Leguminosae	Swartzia racemosa	X	X		X							X		X					X	X			X			X	
52	Leguminosae	Swartzia schomburgkii	X			X					X				X						X	X		X		X	X	X
53	Leguminosae	Zygia latifolia	X																X	X	X			X				
54	Melastomataceae	Bellucia grossularioides	X																	X	X							X
55	Melastomataceae	Miconia dispar	X																X	X	X							
56	Melastomataceae	Miconia phaeophylla	X																		X						X	
57	Melastomataceae	Miconia prasina	X																		X							
58	Melastomataceae	Miconia pubipetala	X																								X	
59	Melastomataceae	Mouriri cauliflora	X										X								X	X					X	
60	Meliaceae	Trichilia septentrionalis	X									X								X						X	X	
61	Moraceae	Naucleopsis imitans	X																X		X	X				X		X
62	Myristicaceae	Iryanthera crassifolia	X				X					X								X	X	X						
63	Myristicaceae	Iryanthera polyneura	X										X						X	X	X	X					X	
64	Myristicaceae	Iryanthera tricornis	X			X	X	X					X								X	X					X	X
65	Myristicaceae	Iryanthera ulei	X			X	X			X		X	X		X	X			X	X	X	X		X			X	X
66	Myristicaceae	Virola calophylla	X			X						X			X				X	X	X	X		X		X	X	
67	Myristicaceae	Virola elongata	X			X		X				X			X	X			X	X	X	X		X	X		X	X
68	Myristicaceae	Virola multinervia	X																			X					X	
69	Myristicaceae	Virola pavonis	X			X		X				X				X			X	X	X	X		X		X		X
70	Myristicaceae	Virola surinamensis	X					X							X	X			X	X	X			X				
71	Nyctaginaceae	Neea obovata	X																									X
72	Olacaceae	Miniquartia guianensis	X			X	X										X		X	X	X	X		X		X		
73	Rubiaceae	Alibertia edulis	X									X												X			X	
74	Rubiaceae	Duroia eriophila	X									X	X								X							
75	Rubiaceae	Genipa sp.	X															X										
76	Rubiaceae	Genipa americana	X				X				X	X							X		X			X				

Table 7.21 Woods used as firewood (Continued)

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
77	Rubiaceae	Stachyococcus adinanthus	X																	X	X							
78	Sapotaceae	Ecclinusa guianensis	X																			X					X	
79	Sapotaceae	Micropholis guyanensis	X			X							X						X	X	X	X					X	X
80	Sapotaceae	Micropholis obscura	X																		X							X
81	Sapotaceae	Pouteria retinervis	X										X								X	X					X	
82	Violaceae	Rinorea racemosa	X			X															X	X				X	X	X
83	Vochysiaceae	Erisma bicolor	X			X															X					X	X	X
84	Vochysiaceae	Qualea ingens	X			X													X	X	X							X
85	Vochysiaceae	Vochysia lomatophylla	X										X		X				X	X	X							

Table 7.22.Woods used for smoking fish/meat.

Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A)Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
1	Apocynaceae	Aspidosperma cf. excelsum	X	X	X																							
2	Clusiaceae	Tovomita aff. spruceana	X	X						X											X						X	X
3	Leguminosae	Swartzia racemosa	X	X		X							X		X					X	X			X			X	
4	Melastomataceae	Miconia sp.		X								X															X	

Table 7.23.Woods used as to provide light.

Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A)Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
1	Apocynaceae	Aspidosperma cf. excelsum	X	X	X																							
2	Chrysobalanaceae	Licania arachnoidea			X	X							X						X	X	X	X					X	X
3	Chrysobalanaceae	Licania harlingii			X	X													X			X						X
4	Chrysobalanaceae	Licania micrantha			X	X														X	X	X		X			X	
5	Chrysobalanaceae	Licania parvifolia			X										X									X				
6	Chrysobalanaceae	Parinari parilis			X								X						X	X								
7	Lecythidaceae	Eschweilera albiflora			X														X	X	X			X				
8	Lecythidaceae	Eschweilera andina			X		X												X	X		X		X				
9	Lecythidaceae	Eschweilera coriacea			X	X	X												X	X	X	X		X			X	X
10	Lecythidaceae	Eschweilera gigantea			X																	X						
11	Lecythidaceae	Eschweilera itayensis			X		X					X			X					X	X			X				
12	Lecythidaceae	Eschweilera parvifolia			X	X	X												X	X		X			X		X	X
13	Lecythidaceae	Eschweilera punctata			X	X	X								X						X	X					X	X
14	Lecythidaceae	Eschweilera revoluta			X																	X						
15	Lecythidaceae	Eschweilera rufifolia			X	X	X					X			X					X	X					X	X	X
16	Lecythidaceae	Eschweilera tessmannii			X	X	X								X						X	X				X	X	X
17	Leguminosae	Monopteryx uaucu	X		X						X		X		X						X	X				X	X	X
18	Sapotaceae	Pouteria cuspidata			X	X							X						X	X	X			X			X	

Table 7.24.Woods used for construction.

Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A)Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
1	Anacardiaceae	Tapirira guianensis				X		X								X			X		X	X		X		X	X	X
2	Annonaceae	Bocageopsis canescens				X		X								X					X			X	X			
3	Annonaceae	Bocageopsis multiflora				X	X														X			X			X	X
4	Annonaceae	Duguetia odorata	X			X							X						X	X	X						X	
5	Annonaceae	Fusaea longifolia				X							X								X			X				
6	Annonaceae	Guatteria decurrens				X						X			X					X	X			X				X
7	Annonaceae	Guatteria kuhlmannii				X		X								X			X	X	X			X				
8	Annonaceae	Guatteria megalophylla				X											X		X	X	X	X		X		X	X	X
9	Annonaceae	Guatteria puncticulata	X			X															X	X					X	
10	Annonaceae	Guatteria recurvisepala				X															X							
11	Annonaceae	Guatteria schomburgkiana				X	X														X							X
12	Annonaceae	Guatteriella tomentosa				X						X								X							X	
13	Annonaceae	Malmea dielsiana				X													X		X	X						
14	Annonaceae	Oxandra leucodermis				X		X								X								X				
15	Annonaceae	Oxandra mediocris				X													X	X								
16	Annonaceae	Oxandra polyantha				X		X								X			X	X	X			X				
17	Annonaceae	Pseudoxandra cf. coriacea				X						X									X							
18	Annonaceae	Pseudoxandra leiophylla				X																X						
19	Annonaceae	Pseudoxandra pacifica				X		X								X			X	X				X				

Table 7.24.Woods used for construction (Continued)

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
20	Annonaceae	Unonopsis guatterioides				X		X								X			X	X	X			X				
21	Annonaceae	Unonopsis spectabilis				X							X							X	X	X						
22	Annonaceae	Unonopsis venificiorum				X									X		X											
23	Annonaceae	Xylopia sp.	X			X																						
24	Annonaceae	Xylopia amazonica	X			X									X												X	
25	Annonaceae	Xylopia benthamii				X									X												X	
26	Annonaceae	Xylopia emarginata				X	X																		X			
27	Annonaceae	Xylopia micans	X			X	X														X	X		X			X	
28	Annonaceae	Xylopia spruceana				X		X													X			X			X	X
29	Apocynaceae	Aspidosperma sp.				X	X				X		X		X													
30	Araceae	Heteropsis flexuosa				X						X							X	X	X			X			X	X
31	Araceae	Heteropsis jenmani				X	X														X							
32	Araceae	Heteropsis oblongifolia				X															X			X				
33	Araceae	Heteropsis spruceana				X	X														X	X		X			X	
34	Arecaceae	Astrocaryum aculeatum	X			X	X	X	X				X							X	X			X				
35	Arecaceae	Attalea maripa	X			X	X	X	X			X	X								X							X
36	Arecaceae	Catoblastus drudei				X		X												X								
37	Arecaceae	Dictocaryum ptarianum				X																					X	X
38	Arecaceae	Dictocaryum ptariense				X																						X
39	Arecaceae	Euterpe catinga				X							X													X		X
40	Arecaceae	Euterpe precatoria				X							X							X				X	X			X
41	Arecaceae	Geonoma deversa				X						X			X						X						X	
42	Arecaceae	Iriartea deltoidea				X							X							X	X	X					X	
43	Arecaceae	Iriartella setigera				X		X					X		X						X	X				X	X	X
44	Arecaceae	Manicaria saccifera				X							X											X				
45	Arecaceae	Mauritia flexuosa	X			X	X	X				X	X	X					X		X			X				
46	Arecaceae	Mauritiella aculeata				X							X			X				X	X	X					X	X
47	Arecaceae	Oenocarpus bataua	X			X	X	X				X	X	X							X	X				X	X	X
48	Arecaceae	Pholydostachys synanthea				X						X								X							X	

Table 7.24.Woods used for construction (Continued)

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
49	Arecaceae	Phytelephas microcarpa				X													X	X	X	X		X			X	X
50	Arecaceae	Socratea exorrhiza				X	X								X				X	X	X	X		X			X	X
51	Arecaceae	Wettinia augusta	X			X		X							X												X	
52	Bignoniaceae	Jacaranda macrocarpa				X															X	X				X	X	X
53	Bombacaceae	Catostemma commune				X															X							
54	Bombacaceae	Matisia achrocalyx				X						X							X		X	X		X			X	
55	Bombacaceae	Scleronema micranthum				X							X							X	X	X		X		X	X	X
56	Bombacaceae	Scleronema praecox				X									X						X					X	X	X
57	Burseraceae	Crepidospermum prancei				X														X	X						X	
58	Burseraceae	Dacryodes peruviana				X							X						X		X	X		X		X		
59	Burseraceae	Protium decandrum				X																						
60	Burseraceae	Protium divaricatum				X									X						X						X	
61	Burseraceae	Protium nodulosum				X							X		X				X	X	X			X				
62	Burseraceae	Tetragastris panamensis				X									X					X	X							
63	Burseraceae	Trattinnickia glaziovii				X									X						X			X			X	X
64	Cecropiaceae	Pourouma ferruginea				X							X								X	X						
65	Cecropiaceae	Pourouma ovata				X							X								X							X
66	Cecropiaceae	Pourouma tomentosa				X		X					X			X						X				X	X	X
67	Chrysobalanaceae	Licania arachnoidea			X	X							X						X	X	X	X					X	X
68	Chrysobalanaceae	Licania harlingii			X	X													X			X						X
69	Chrysobalanaceae	Licania heteromorpha				X									X				X	X	X	X					X	X
70	Chrysobalanaceae	Licania micrantha			X	X														X	X	X		X			X	
71	Chrysobalanaceae	Licania urceolaris	X			X													X								X	
72	Clusiaceae	Vismia sandwithii	X			X													X	X	X							
73	Combretaceae	Buchenavia amazonica				X													X	X	X						X	
74	Combretaceae	Buchenavia parvifolia				X															X	X					X	
75	Ebenaceae	Diospyros pseudoxylopia	X			X	X	X											X		X							
76	Elaeocarpaceae	Sloanea macroana				X													X		X						X	
77	Euphorbiaceae	Alchornea schomburgkii				X													X									

Table 7.24.Woods used for construction (Continued)

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
78	Euphorbiaceae	Asparisthmium cordatum				X												X									X	X
79	Euphorbiaceae	Gavarretia terminalis				X															X						X	X
80	Euphorbiaceae	Hyeronima oblonga	X			X													X		X						X	
81	Euphorbiaceae	Micrandra spruceana	X			X					X	X	X			X					X	X					X	X
82	Euphorbiaceae	Micradropsis scleroxylon				X																					X	
83	Euphorbiaceae	Vaupesia cataractarum	X			X							X								X	X					X	
84	Flacourtiaceae	Lindackeria maynensis				X									X													
85	Flacourtiaceae	Lindackeria paludosa	X			X													X		X					X		
86	Humiriaceae	Humiriastrum piraparanense				X									X													X
87	Lauraceae	Endlicheria formosa				X													X	X	X							
88	Lauraceae	Endlicheria multiflora				X														X					X			
89	Lauraceae	Licaria sp.(1)	X			X												X										
90	Lauraceae	Licaria sp.(2)	X			X												X										
91	Lauraceae	Licaria aurea				X																					X	
92	Lauraceae	Licaria cannella				X																					X	X
93	Lauraceae	Licaria macrophylla				X															X					X		X
94	Lauraceae	Mezilaurus itauba				X					X															X	X	X
95	Lauraceae	Nectandra cuspidata				X					X		X								X							
96	Lauraceae	Ocotea sp.				X					X	X								X	X	X				X	X	X
97	Lauraceae	Ocotea aciphylla				X												X										
98	Lauraceae	Ocotea argyrophylla				X					X																X	X
99	Lauraceae	Ocotea cymbarum				X																					X	
100	Lauraceae	Ocotea javitensis				X					X								X		X	X		X			X	X
101	Lecythidaceae	Cariniana multiflora				X															X						X	
102	Lecythidaceae	Eschweilera alata				X	X								X						X	X					X	
103	Lecythidaceae	Eschweilera bracteosa				X															X	X					X	
104	Lecythidaceae	Eschweilera chartaceifolia				X							X								X	X					X	
105	Lecythidaceae	Eschweilera coriacea			X	X	X												X	X	X	X		X			X	X
106	Lecythidaceae	Eschweilera laevicarpa				X	X														X						X	

Table 7.24.Woods used for construction (Continued)

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
107	Lecythidaceae	Eschweilera parvifolia			X	X	X												X	X		X			X		X	X
108	Lecythidaceae	Eschweilera punctata			X	X	X								X						X	X					X	X
109	Lecythidaceae	Eschweilera rufifolia			X	X	X					X			X					X	X					X	X	X
110	Lecythidaceae	Eschweilera tessmannii			X	X	X								X						X	X				X	X	X
111	Lecythidaceae	Eschweilera turbinata				X																						
112	Lecythidaceae	Lecythis chartacea				X														X							X	
113	Leguminosae	Clathrotropis nitida	X			X														X	X			X			X	X
114	Leguminosae	Diplotropis duckei				X															X	X				X		X
115	Leguminosae	Dipteryx micrantha				X	X																					
116	Leguminosae	Hydrochorea gonggrijpii				X															X			X			X	
117	Leguminosae	Hymenolobium pulcherrimum				X					X													X			X	
118	Leguminosae	Inga ciliata				X							X								X							
119	Leguminosae	Inga pruriens				X							X						X		X	X					X	
120	Leguminosae	Inga tessmanni				X							X								X							
121	Leguminosae	Swartzia cardiosperma				X													X	X	X	X		X			X	X
122	Leguminosae	Swartzia racemosa	X	X		X							X		X					X	X			X			X	
123	Leguminosae	Swartzia schomburgkii	X			X					X				X						X	X		X		X	X	X
124	Melastomataceae	Mouriri myrtifolia				X							X						X	X				X				X
125	Meliaceae	Carapa guianensis				X									X													
126	Meliaceae	Cedrela fissilis				X	X		X		X	X																
127	Meliaceae	Guarea grandifolia				X													X	X	X	X						
128	Meliaceae	Guarea macrophylla				X									X				X	X	X			X				
129	Meliaceae	Guarea purusana				X													X	X	X	X					X	
130	Meliaceae	Guarea trunciflora				X						X									X	X					X	
131	Meliaceae	Trichilia micrantha				X		X							X	X					X	X					X	X
132	Moraceae	Brosimum rubescens				X	X					X									X	X				X	X	X
133	Moraceae	Naucleopsis ulei				X	X				X									X	X						X	
134	Moraceae	Perebea mollis				X							X							X								
135	Moraceae	Perebea xanthochyma				X													X	X	X							

Table 7.24.Woods used for construction (Continued)

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
136	Moraceae	Sorocea hirtella subsp. oligotricha				X							X						X	X	X			X				
137	Myristicaceae	Iryanthera juruensis				X	X						X		X					X	X	X					X	X
138	Myristicaceae	Iryanthera laeviss				X						X	X								X	X				X		
139	Myristicaceae	Iryanthera lancifolia				X	X					X	X							X	X	X				X	X	
140	Myristicaceae	Iryanthera macrophylla				X						X									X							
141	Myristicaceae	Iryanthera obovata				X																						X
142	Myristicaceae	Iryanthera tricornis	X			X	X	X					X								X	X					X	X
143	Myristicaceae	Iryanthera ulei	X			X	X			X		X	X		X	X			X	X	X	X		X			X	X
144	Myristicaceae	Virola calophylla	X			X						X			X				X	X	X	X		X		X	X	
145	Myristicaceae	Virola divergens				X						X			X						X							
146	Myristicaceae	Virola elongata	X			X		X				X			X	X			X	X	X	X		X	X		X	X
147	Myristicaceae	Virola loretensis				X						X							X	X	X			X				
148	Myristicaceae	Virola pavonis	X			X		X				X				X			X	X	X	X		X		X		X
149	Myrtaceae	Calyptranthes pulchella				X	X																	X				X
150	Myrtaceae	Marlierea spruceana				X													X	X	X			X			X	
151	Myrtaceae	Plinia rivularis				X															X							
152	Olacaceae	Histeria barbata				X														X								
153	Olacaceae	Miniquartia guianensis	X			X	X										X		X	X	X	X		X		X		
154	Rubiaceae	Botryarrhena pendula				X															X						X	X
155	Rubiaceae	Pagamea guianensis				X															X	X		X				
156	Sabiaceae	Meliosma herbertii				X					X										X						X	X
157	Sapiandaceae	Matayba purgans				X	X														X						X	X
158	Sapiandaceae	Talisia grandifolia				X															X						X	X
159	Sapotaceae	Chrysophyllum prieurii				X							X								X	X					X	
160	Sapotaceae	Chrysophyllum sanguinolentum				X									X					X	X	X					X	X
161	Sapotaceae	Ecclinusa lanceolata				X							X						X	X	X			X				
162	Sapotaceae	Manilkara inundata				X																		X				
163	Sapotaceae	Micropholis guyanensis	X			X							X						X	X	X	X					X	X
164	Sapotaceae	Pouteria arcuata				X															X							X

Table 7.24.Woods used for construction (Continued)

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
165	Sapotaceae	Pouteria caimito				X							X		X						X							X
166	Sapotaceae	Pouteria cladantha				X														X		X						
167	Sapotaceae	Pouteria cuspidata			X	X							X						X	X	X			X			X	
168	Sapotaceae	Pouteria glauca				X														X								
169	Sapotaceae	Pouteria glomerata				X		X					X														X	
170	Sapotaceae	Pouteria hispida				X							X								X	X		X				X
171	Sapotaceae	Pouteria maguirei				X																					X	X
172	Simaroubaceae	Picramnia sellowii subsp.spruceana				X						X							X								X	
173	Simaroubaceae	Simarouba amara				X	X												X	X	X						X	X
174	Violaceae	Leonia cymosa				X						X			X						X	X					X	
175	Violaceae	Leonia glycycarpa				X													X	X	X	X		X			X	
176	Violaceae	Rinorea racemosa	X			X															X	X				X	X	X
177	Vochysiaceae	Erisma bicolor	X			X															X					X	X	X
178	Vochysiaceae	Erisma calcaratum				X															X						X	
179	Vochysiaceae	Qualea acuminata				X							X		X				X		X	X		X	X			
180	Vochysiaceae	Qualea ingens	X			X													X	X	X							X
181	Vochysiaceae	Qualea paraensis				X															X					X	X	
182	Vochysiaceae	Ruizterania cassiquiarensis				X															X							
183	Vochysiaceae	Vochysia diversa				X																						X
184	Vochysiaceae	Vochysis punctata				X																						X
185	Vochysiaceae	Vochysia venulosa				X																X					X	
186	Vochysiaceae	Vochysia vismiifolia				X															X							X
187	Vochysiaceae	Vochysia vochysiaceae				X																						

Table 7.25.Woods used to manufacture domestic artifacts.

Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A)Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
1	Annonaceae	Bocageopsis multiflora				X	X														X			X			X	X
2	Annonaceae	Guatteria ferruginea	X				X								X												X	X
3	Annonaceae	Guatteria schomburgkiana				X	X														X							X
4	Annonaceae	Oxandra euneura					X	X				X								X	X						X	
5	Annonaceae	Unonopsis stipitata					X	X													X	X				X	X	X
6	Annonaceae	Xylopia emarginata				X	X																		X			
7	Annonaceae	Xylopia micans	X			X	X														X	X		X			X	
8	Apocynaceae	Aspidosperma sp.				X	X				X		X		X													
9	Apocynaceae	Couma macrocarpa					X			X	X	X	X		X		X			X	X			X			X	
10	Araceae	Heteropsis jenmani				X	X														X							
11	Araceae	Heteropsis spruceana				X	X														X	X		X			X	
12	Arecaceae	Astrocaryum aculeatum	X			X	X	X	X				X							X	X			X				
13	Arecaceae	Attalea maripa	X			X	X	X	X			X	X								X							X
14	Arecaceae	Bactris gasipaes	X				X	X				X	X	X														
15	Arecaceae	Geonoma stricta var. piscicauda					X												X		X	X					X	X
16	Arecaceae	Mauritia flexuosa	X			X	X	X				X	X	X					X		X			X				
17	Arecaceae	Maximiliana maripa					X	X					X									X					X	
18	Arecaceae	Oenocarpus bacaba	X				X						X									X		X		X	X	X

Table 7.25.Woods used to manufacture domestic artifacts (Continued)

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
19	Arecaceae	Oenocarpus bataua	X			X	X	X				X	X	X							X	X				X	X	X
20	Arecaceae	Oenocarpus mapora	X				X						X						X	X	Z						X	
21	Arecaceae	Socratea exorrhiza				X	X								X				X	X	X	X		X			X	X
22	Bombacaceae	Ochroma pyramidale					X				X								X		X							
23	Clusiaceae	Vismia macrophylla	X				X					X			X				X	X	X			X				
24	Ebenaceae	Diospyros pseudoxylopia	X			X	X	X											X		X							
25	Euphorbiaceae	Mabea nitida					X								X	X			X	X	X			X	X			
26	Euphorbiaceae	Senefeldera karsteniana	X				X																				X	
27	Lecythidaceae	Eschweilera alata				X	X								X						X	X					X	
28	Lecythidaceae	Eschweilera andina			X		X												X	X		X		X				
29	Lecythidaceae	Eschweilera coriacea			X	X	X												X	X	X	X		X			X	X
30	Lecythidaceae	Eschweilera itayensis			X		X					X			X					X	X			X				
31	Lecythidaceae	Eschweilera laevicarpa				X	X														X						X	
32	Lecythidaceae	Eschweilera parvifolia			X	X	X												X	X		X			X		X	X
33	Lecythidaceae	Eschweilera punctata			X	X	X								X						X	X					X	X
34	Lecythidaceae	Eschweilera rufifolia			X	X	X					X			X					X	X					X	X	X
35	Lecythidaceae	Eschweilera tessmannii			X	X	X								X						X	X				X	X	X
36	Leguminosae	Dipteryx micrantha				X	X																					
37	Meliaceae	Cedrela fissilis				X	X		X		X	X																
38	Moraceae	Brosimum rubescens				X	X					X									X	X				X	X	X
39	Moraceae	Naucleopsis ulei				X	X				X									X	X						X	
40	Moraceae	Pseudolmedia laevigata					X					X	X						X		X	X					X	X
41	Myristicaceae	Iryanthera crassifolia	X				X					X								X	X	X						
42	Myristicaceae	Iryanthera juruensis				X	X						X		X					X	X	X					X	X
43	Myristicaceae	Iryanthera lancifolia				X	X					X	X							X	X	X				X	X	
44	Myristicaceae	Iryanthera tricornis	X			X	X	X					X								X	X					X	X
45	Myristicaceae	Iryanthera ulei	X			X	X			X		X	X		X	X			X	X	X	X		X			X	X
46	Myrtaceae	Calyptranthes pulchella				X	X																	X				X

Table 7.25.Woods used to manufacture domestic artifacts (Continued)

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
47	Olacaceae	Miniquartia guianensis	X			X	X										X		X	X	X	X		X		X		
48	Rubiaceae	Genipa americana	X				X				X	X							X		X			X				
49	Sapiandaceae	Matayba purgans				X	X														X						X	X
50	Simaroubaceae	Simarouba amara				X	X												X	X	X						X	X

Table 7.26.Woods used to manufacture hunting and fishing equipment.

Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A)Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
1	Anacardiaceae	Tapirira guianensis				X		X								X			X		X	X		X		X	X	X
2	Annonaceae	Bocageopsis canescens				X		X								X					X			X	X			
3	Annonaceae	Duguetia quitarensis						X													X	X						
4	Annonaceae	Duguetia stenantha						X					X								X					X		
5	Annonaceae	Ephedranthus amazonicus						X													X	X					X	X
6	Annonaceae	Guatteria kuhlmannii				X		X								X			X	X	X			X				
7	Annonaceae	Oxandra euneura					X	X				X								X	X						X	
8	Annonaceae	Oxandra leucodermis				X		X								X								X				
9	Annonaceae	Oxandra polyantha				X		X								X			X	X	X			X				
10	Annonaceae	Pseudoxandra pacifica				X		X								X			X	X				X				
11	Annonaceae	Unonopsis guatterioides				X		X								X			X	X	X			X				
12	Annonaceae	Unonopsis stipitata					X	X													X	X				X	X	X
13	Annonaceae	Xylopia cuspidata						X													X						X	
14	Annonaceae	Xylopia macrantha						X													X							
15	Annonaceae	Xylopia spruceana				X		X													X			X			X	X
16	Arecaceae	Astrocaryum aculeatum	X			X	X	X	X				X							X	X			X				
17	Arecaceae	Attalea maripa	X			X	X	X	X			X	X								X							X
18	Arecaceae	Bactris gasipaes	X				X	X				X	X	X														
19	Arecaceae	Catoblastus drudei				X		X												X								

Table 7.26.Woods used to manufacture hunting and fishing equipment (Continued)

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
20	Arecaceae	Iriartella setigera				X		X					X		X						X	X				X	X	X
21	Arecaceae	Mauritia flexuosa	X			X	X	X				X	X	X					X		X			X				
22	Arecaceae	Maximiliana maripa					X	X					X									X					X	
23	Arecaceae	Oenocarpus bataua	X			X	X	X				X	X	X							X	X				X	X	X
24	Arecaceae	Wettinia augusta	X			X		X							X												X	
25	Arecaceae	Wettinia drudei						X															X					
26	Cecropiaceae	Pourouma tomentosa				X		X					X			X						X				X	X	X
27	Ebenaceae	Diospyros glomerata						X									X				X						X	
28	Ebenaceae	Diospyros pseudoxylopia	X			X	X	X											X		X							
29	Ebenaceae	Diospyros tetranda						X																			X	
30	Euphorbiaceae	Senefeldera inclinata	X					X							X	X					X	X					X	
31	Leguminosae	Poecilanthe amazonica	X					X									X											X
32	Meliaceae	Trichilia micrantha				X		X							X	X					X	X					X	X
33	Myristicaceae	Iryanthera tricornis	X			X	X	X					X								X	X					X	X
34	Myristicaceae	Virola elongata	X			X		X				X			X	X			X	X	X	X		X	X		X	X
35	Myristicaceae	Virola pavonis	X			X		X				X				X			X	X	X	X		X		X		X
36	Myristicaceae	Virola surinamensis	X					X							X	X			X	X	X			X				
37	Myrtaceae	Myrcia revolutifolia						X																				X
38	Sapotaceae	Pouteria glomerata				X		X					X														X	

Table 7.27.Woods used to manufacture musical instruments.

Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A)Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
1	Arecaceae	Astrocaryum aculeatum	X			X	X	X	X				X							X	X			X				
2	Arecaceae	Attalea maripa	X			X	X	X	X			X	X								X							X
3	Cecropiaceae	Cecropia discolor							X			X																
4	Meliaceae	Cedrela fissilis				X	X		X		X	X																

Table 7.28. Woods related to pottery manufacture.

Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A)Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
1	Apocynaceae	Couma macrocarpa					X			X	X	X	X		X		X			X	X			X			X	
2	Cecropiaceae	Cecropia ficifolia	X							X		X							X	X	X							X
3	Chrysobalanaceae	Hirtella macrophylla								X																		
4	Chrysobalanaceae	Licania apetala	X							X										X	X	X			X		X	X
5	Chrysobalanaceae	Licania octandra	X							X											X					X		
6	Clusiaceae	Tovomita aff. spruceana	X	X						X											X						X	X
7	Melastomataceae	Adelobotrys macrophylla								X																		
8	Myristicaceae	Iryanthera ulei	X			X	X			X		X	X		X	X			X	X	X	X		X			X	X

Table 7.29.Woods used to manufacture canoes.

Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A)Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
1	Apocynaceae	Aspidosperma sp.				X	X				X		X		X													
2	Apocynaceae	Couma macrocarpa					X			X	X	X	X		X		X			X	X			X			X	
3	Bombacaceae	Ochroma pyramidale					X				X								X		X							
4	Burseraceae	Protium aracouchini	X								X										X	X					X	
5	Clusiaceae	Calophyllum longifolium									X								X	X	X			X				X
6	Euphorbiaceae	Micrandra lopezii									X	X															X	
7	Euphorbiaceae	Micrandra spruceana	X			X					X	X	X			X					X	X					X	X
8	Lauraceae	Mezilaurus itauba				X					X															X	X	X
9	Lauraceae	Nectandra cuspidata				X					X		X								X							
10	Lauraceae	Ocotea sp.				X					X	X								X	X	X				X	X	X
11	Lauraceae	Ocotea argyrophylla				X					X																X	X
12	Lauraceae	Ocotea javitensis				X					X								X		X	X		X			X	X
13	Leguminosae	Hymenolobium pulcherrimum				X					X													X			X	
14	Leguminosae	Monopteryx uaucu	X		X						X		X		X						X	X				X	X	X
15	Leguminosae	Swartzia schomburgkii	X			X					X				X						X	X		X		X	X	X
16	Leguminosae	Vatairea guianensis									X								X	X	X			X	X			
17	Meliaceae	Cedrela fissilis				X	X		X		X	X																
18	Moraceae	Clarisia racemosa									X		X								X	X					X	

Table 7.29.Woods to manufacture canoe (Continued)

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
19	Moraceae	Naucleopsis ulei				X	X				X									X	X						X	
20	Rubiaceae	Genipa americana	X				X				X	X							X		X			X				
21	Rubiaceae	Warszewiczia coccinea									X				X				X	X	X			X				X
22	Sabiaceae	Meliosma herbertii				X					X										X						X	X

Table 7.30. Woods related to the manufacture of ornaments and ritual objects.

Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A)Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.

	FAMILY	GENUS/PECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
1	Annonaceae	Guatteria decurrens				X						X			X					X	X			X				X
2	Annonaceae	Guatteriella tomentosa				X						X								X							X	
3	Annonaceae	Oxandra euneura					X	X				X								X	X						X	
4	Annonaceae	Pseudoxandra cf. coriacea				X						X									X							
5	Apocynaceae	Couma macrocarpa					X			X	X	X	X		X		X			X	X			X			X	
6	Araceae	Heteropsis flexuosa				X						X							X	X	X			X			X	X
7	Arecaceae	Astrocaryum gynacanthum	X									X	X														X	
8	Arecaceae	Attalea maripa	X			X	X	X	X			X	X								X							X
9	Arecaceae	Bactris gasipaes	X				X	X				X	X	X														
10	Arecaceae	Geonoma deversa				X						X			X						X						X	
11	Arecaceae	Mauritia flexuosa	X			X	X	X				X	X	X					X		X			X				
12	Arecaceae	Oenocarpus bataua	X			X	X	X				X	X	X							X	X				X	X	X
13	Arecaceae	Pholydostachys synanthea				X						X								X							X	
14	Bombacaceae	Matisia achrocalyx				X						X							X		X	X		X			X	
15	Cecropiaceae	Cecropia discolor							X			X																
16	Cecropiaceae	Cecropia ficifolia	X							X		X							X	X	X							X
17	Celastraceae	Goupia glabra	X									X			X	X					X	X				X	X	X
18	Clusiaceae	Vismia macrophylla	X				X					X			X				X	X	X			X				
19	Euphorbiaceae	Micrandra lopezii									X	X															X	

Table 7.30. Woods related to the manufacture of ornaments and ritual objects (Continued)

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
20	Euphorbiaceae	Micrandra spruceana	X			X					X	X	X			X					X	X					X	X
21	Euphorbiaceae	Sandwithia heterocalyx	X									X									X	X		X			X	X
22	Lauraceae	Ocotea sp.				X					X	X								X	X	X				X	X	X
23	Lauraceae	Ocotea rubrinervis										X									X						X	
24	Lecythidaceae	Eschweilera itayensis			X		X					X			X					X	X			X				
25	Lecythidaceae	Eschweilera rufifolia			X	X	X					X			X					X	X					X	X	X
26	Leguminosae	Clathrotropis macrocarpa	X									X			X		X				X	X					X	X
27	Melastomataceae	Miconia sp.		X								X															X	
28	Meliaceae	Cedrela fissilis				X	X		X		X	X																
29	Meliaceae	Guarea trunciflora				X						X									X	X					X	
30	Meliaceae	Trichilia septentrionalis	X									X								X						X	X	
31	Moraceae	Brosimum rubescens				X	X					X									X	X				X	X	X
32	Moraceae	Pseudolmedia laevigata					X					X	X						X		X	X					X	X
33	Myristicaceae	Iryanthera crassifolia	X				X					X								X	X	X						
34	Myristicaceae	Iryanthera laeviss				X						X	X								X	X				X		
35	Myristicaceae	Iryanthera lancifolia				X	X					X	X							X	X	X				X	X	
36	Myristicaceae	Iryanthera macrophylla				X						X									X							
37	Myristicaceae	Iryanthera ulei	X			X	X			X		X	X		X	X			X	X	X	X		X			X	X
38	Myristicaceae	Virola calophylla	X			X						X			X				X	X	X	X		X		X	X	
39	Myristicaceae	Virola divergens				X						X			X						X							
40	Myristicaceae	Virola elongata	X			X		X				X			X	X			X	X	X	X		X	X		X	X
41	Myristicaceae	Virola loretensis				X						X							X	X	X			X				
42	Myristicaceae	Virola pavonis	X			X		X				X				X			X	X	X	X		X		X		X
43	Rubiaceae	Alibertia edulis	X									X												X			X	
44	Rubiaceae	Duroia eriophila	X									X	X								X							
45	Rubiaceae	Genipa americana	X				X				X	X							X		X			X				
46	Simaroubaceae	Picramnia sellowii subsp.spruceana				X						X							X								X	
47	Violaceae	Leonia cymosa				X						X			X						X	X					X	

Table 7.31. Trees from which fruits are used as food.

Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A)Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
1	Annonaceae	Duguetia odorata	X			X							X						X	X	X						X	
2	Annonaceae	Duguetia stenantha						X					X								X					X		
3	Annonaceae	Fusaea longifolia				X							X								X			X				
4	Annonaceae	Unonopsis spectabilis				X							X							X	X	X						
5	Apocynaceae	Aspidosperma sp.				X	X				X		X		X													
6	Apocynaceae	Couma macrocarpa					X			X	X	X	X		X		X			X	X			X			X	
7	Arecaceae	Astrocaryum aculeatum	X			X	X	X	X				X							X	X			X				
8	Arecaceae	Astrocaryum gynacanthum	X									X	X														X	
9	Arecaceae	Attalea maripa	X			X	X	X	X			X	X								X							X
10	Arecaceae	Bactris gasipaes	X				X	X				X	X	X														
11	Arecaceae	Euterpe catinga				X							X													X		X
12	Arecaceae	Euterpe precatoria				X							X							X				X	X			X
13	Arecaceae	Iriartea deltoidea				X							X							X	X	X					X	
14	Arecaceae	Iriartella setigera				X		X					X		X						X	X				X	X	X
15	Arecaceae	Manicaria saccifera				X							X											X				
16	Arecaceae	Mauritia flexuosa	X			X	X	X				X	X	X					X		X			X				
17	Arecaceae	Mauritiella aculeata				X							X			X				X	X	X					X	X
18	Arecaceae	Maximiliana maripa					X	X					X									X					X	
19	Arecaceae	Oenocarpus bacaba	X				X						X									X		X		X	X	X

Table 7.31. Trees from which fruits are used as food (Continued)

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
20	Arecaceae	Oenocarpus bataua	X			X	X	X				X	X	X							X	X				X	X	X
21	Arecaceae	Oenocarpus mapora	X				X						X						X	X	Z						X	
22	Bombacaceae	Scleronema micranthum				X							X							X	X	X		X		X	X	X
23	Burseraceae	Dacryodes peruviana				X							X						X		X	X		X		X		
24	Burseraceae	Protium nodulosum				X							X		X				X	X	X			X				
25	Cecropiaceae	Pourouma ferruginea				X							X								X	X						
26	Cecropiaceae	Pourouma ovata				X							X								X							X
27	Cecropiaceae	Pourouma tomentosa				X		X					X			X						X				X	X	X
28	Chrysobalanaceae	Licania arachnoidea			X	X							X						X	X	X	X					X	X
29	Chrysobalanaceae	Parinari parilis			X								X						X	X								
30	Euphorbiaceae	Micrandra spruceana	X			X					X	X	X			X					X	X					X	X
31	Euphorbiaceae	Vaupesia cataractarum	X			X							X								X	X					X	
32	Lauraceae	Nectandra cuspidata				X					X		X								X							
33	Lecythidaceae	Eschweilera chartaceifolia				X							X								X	X					X	
34	Leguminosae	Inga ciliata				X							X								X							
35	Leguminosae	Inga pruriens				X							X						X		X	X					X	
36	Leguminosae	Inga tessmanni				X							X								X							
37	Leguminosae	Monopteryx uaucu	X		X						X		X		X						X	X				X	X	X
38	Leguminosae	Swartzia racemosa	X	X		X							X		X					X	X			X			X	
39	Melastomataceae	Mouriri cauliflora	X										X								X	X					X	
40	Melastomataceae	Mouriri myrtifolia				X							X						X	X				X				X
41	Moraceae	Clarisia racemosa									X		X								X	X					X	
42	Moraceae	Perebea mollis				X							X							X								
43	Moraceae	Pseudolmedia laevigata					X					X	X						X		X	X					X	X
44	Moraceae	Sorocea hirtella subsp. Oligotricha				X							X						X	X	X			X				
45	Myristicaceae	Iryanthera juruensis				X	X						X		X					X	X	X					X	X
46	Myristicaceae	Iryanthera laeviss				X						X	X								X	X				X		
47	Myristicaceae	Iryanthera lancifolia				X	X					X	X							X	X	X				X	X	
48	Myristicaceae	Iryanthera polyneura	X										X						X	X	X	X					X	

Table 7.31. Trees from which fruits are used as food (Continued)

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
49	Myristicaceae	Iryanthera tricornis	X			X	X	X					X								X	X					X	X
50	Myristicaceae	Iryanthera ulei	X			X	X			X		X	X		X	X			X	X	X	X		X			X	X
51	Rubiaceae	Duroia eriophila	X									X	X								X							
52	Sapotaceae	Chrysophyllum prieurii				X							X								X	X					X	
53	Sapotaceae	Ecclinusa lanceolata				X							X						X	X	X			X				
54	Sapotaceae	Micropholis guyanensis	X			X							X						X	X	X	X					X	X
55	Sapotaceae	Pouteria caimito				X							X		X						X							X
56	Sapotaceae	Pouteria cuspidata			X	X							X						X	X	X			X			X	
57	Sapotaceae	Pouteria glomerata				X		X					X														X	
58	Sapotaceae	Pouteria hispida				X							X								X	X		X				X
59	Sapotaceae	Pouteria retinervis	X										X								X	X					X	
60	Vochysiaceae	Qualea acuminata				X							X		X				X		X	X		X	X			
61	Vochysiaceae	Vochysia lomatophylla	X										X		X				X	X	X							

Table 7.32. Woods used for rearing Coleoptera.

Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A)Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
1	Arecaceae	Bactris gasipaes	X				X	X				X	X	X														
2	Arecaceae	Mauritia flexuosa	X			X	X	X				X	X	X					X		X			X				
3	Arecaceae	Oenocarpus bataua	X			X	X	X				X	X	X							X	X				X	X	X

Table 7.33. Woods used for medicinal purposes.

Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A)Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
1	Annonaceae	Guatteria decurrens				X						X			X					X	X			X				X
2	Annonaceae	Guatteria ferruginea	X				X								X												X	X
3	Annonaceae	Unonopsis [illegible]				X									X		X											
4	Annonaceae	Xylopia amazonica	X			X									X												X	
5	Annonaceae	Xylopia benthamii				X									X												X	
6	Apocynaceae	Aspidosperma sp				X	X				X		X		X													
7	Apocynaceae	Couma macrocarpa					X			X	X	X	X		X		X			X	X			X			X	
8	Arecaceae	Geonoma deversa				X						X			X						X						X	
9	Arecaceae	Iriartella setigera				X		X					X		X						X	X				X	X	X
10	Arecaceae	Socratea exorrhiza				X	X								X				X	X	X	X		X			X	X
11	Arecaceae	Wettinia augusta	X			X		X							X												X	
12	Bombacaceae	Scleronema praecox				X									X						X					X	X	X
13	Burseraceae	Protium divaricatum				X									X						X						X	
14	Burseraceae	Protium nodulosum				X							X		X				X	X	X			X				
15	Burseraceae	Protium subserratum	X												X						X	X					X	X
16	Burseraceae	Protium urophyllidium	X												X												X	
17	Burseraceae	Tetragastris panamensis				X									X					X	X							
18	Burseraceae	Trattinnickia glaziovii				X									X						X			X			X	X
19	Celastraceae	Goupia glabra	X									X			X	X					X	X				X	X	X

Table 7.33. Woods used for medicinal purposes (Continued)

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
20	Chrysobalanaceae	Licania heteromorpha				X									X				X	X	X	X					X	X
21	Chrysobalanaceae	Licania parvifolia			X										X									X				
22	Clusiaceae	Vismia macrophylla	X				X					X			X				X	X	X			X				
23	Euphorbiaceae	Mabea nitida					X								X	X			X	X	X			X	X			
24	Euphorbiaceae	Senefeldera inclinata	X					X							X	X					X	X					X	
25	Flacourtiaceae	Lindackeria maynensis				X									X													
26	Flacourtiaceae	Mayna grandiflora													X				X		X					X		
27	Humiriaceae	Humiriastrum piraparanense				X									X													X
28	Lecythidaceae	Eschweilera alata				X	X								X						X	X					X	
29	Lecythidaceae	Eschweilera itayensis			X		X					X			X					X	X			X				
30	Lecythidaceae	Eschweilera punctata			X	X	X								X						X	X					X	X
31	Lecythidaceae	Eschweilera rufifolia			X	X	X					X			X					X	X					X	X	X
32	Lecythidaceae	Eschweilera tessmannii			X	X	X								X						X	X				X	X	X
33	Leguminosae	Clathrotropis macrocarpa	X									X			X		X				X	X					X	X
34	Leguminosae	Monopteryx uaucu	X		X						X		X		X						X	X				X	X	X
35	Leguminosae	Swartzia racemosa	X	X		X							X		X					X	X			X			X	
36	Leguminosae	Swartzia schomburgkii	X			X					X				X						X	X		X		X	X	X
37	Meliaceae	Carapa guianensis				X									X													
38	Meliaceae	Guarea macrophylla				X									X				X	X	X			X				
39	Meliaceae	Trichilia micrantha				X		X							X	X					X	X					X	X
40	Myristicaceae	Iryanthera juruensis				X	X						X		X					X	X	X					X	X
41	Myristicaceae	Iryanthera ulei	X			X	X			X		X	X		X	X			X	X	X	X		X			X	X
42	Myristicaceae	Virola calophylla	X			X						X			X				X	X	X	X		X		X	X	
43	Myristicaceae	Virola divergens				X						X			X						X							
44	Myristicaceae	Virola elongata	X			X		X				X			X	X			X	X	X	X		X	X		X	X
45	Myristicaceae	Virola surinamensis	X					X							X	X			X	X	X			X				
46	Rubiaceae	Warszewiczia coccinea									X				X				X	X	X			X				X
47	Sapotaceae	Chrysophyllum sanguinolentum				X									X					X	X	X					X	X

Table 7.33. Woods used for medicinal purposes (Continued)

	FAMILY	GENUS/PECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
48	Sapotaceae	Pouteria caimito				X							X		X						X							X
49	Violaceae	Leonia cymosa				X						X			X						X	X					X	
50	Vochysiaceae	Qualea acuminata				X							X		X				X		X	X		X	X			
51	Vochysiaceae	Vochysia lomatophylla	X										X		X				X	X	X							

Table 7.34. Trees from which fruits are used as bait for fishing and hunting.

Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A)Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
1	Anacardiaceae	Tapirira guianensis				X		X								X			X		X	X		X		X	X	X
2	Annonaceae	Bocageopsis canescens				X		X								X					X			X	X			
3	Annonaceae	Guatteria kuhlmannii				X		X								X			X	X	X			X				
4	Annonaceae	Oxandra leucodermis				X		X								X								X				
5	Annonaceae	Oxandra polyantha				X		X								X			X	X	X			X				
6	Annonaceae	Pseudoxandra pacifica				X		X								X			X	X				X				
7	Annonaceae	Unonopsis guatterioides				X		X								X			X	X	X			X				
8	Arecaceae	Mauritiella aculeata				X							X			X				X	X	X					X	X
9	Cecropiaceae	Pourouma tomentosa				X		X					X			X						X				X	X	X
10	Celastraceae	Goupia glabra	X									X			X	X					X	X				X	X	X
11	Euphorbiaceae	Mabea nitida					X								X	X			X	X	X			X	X			
12	Euphorbiaceae	Micrandra spruceana	X			X					X	X	X			X					X	X					X	X
13	Euphorbiaceae	Senefeldera inclinata	X					X							X	X					X	X					X	
14	Meliaceae	Trichilia micrantha				X		X							X	X					X	X					X	X
15	Myristicaceae	Iryanthera ulei	X			X	X			X		X	X		X	X			X	X	X	X		X			X	X
16	Myristicaceae	Virola elongata	X			X		X				X			X	X			X	X	X	X		X	X		X	X
17	Myristicaceae	Virola pavonis	X			X		X				X				X			X	X	X	X		X		X		X
18	Myristicaceae	Virola surinamensis	X					X							X	X			X	X	X			X				

Table 7.35. Trees from which hunting and fishing poisons are made.

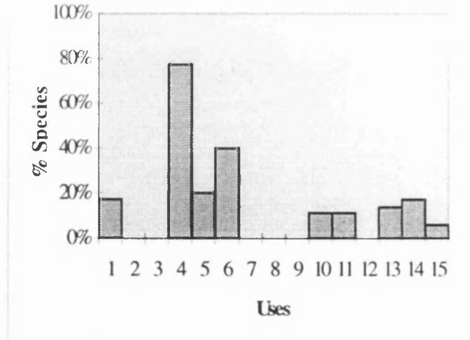
Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A)Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.

	FAMILY	GENUS/SPECIES	USES															Landscape units										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
1	Annonaceae	Guatteria megalophylla				X											X		X	X	X	X		X		X	X	X
2	Annonaceae	Unonopsis venificiorum				X									X		X											
3	Apocynaceae	Couma macrocarpa					X			X	X	X	X		X		X			X	X			X			X	
4	Ebenaceae	Diospyros glomerata						X									X				X						X	
5	Leguminosae	Clathrotropis macrocarpa	X									X			X		X				X	X					X	X
6	Leguminosae	Poecilanthe amazonica	X					X									X											X
7	Olacaceae	Miniquartia guianensis	X			X	X										X		X	X	X	X		X		X		

Table 7.36 Annonaceae family in the middle Caquetá region. Ecological and Ethnographic information.

Number of genera	16	Genera used for wood	11
Number of species	81	Species used for wood	35

Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A)Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.



GENUS/SPECIES	USES															LANDSCAPE UNITS										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
Bocageopsis canescens				X		X								X					X			X	X			
Bocageopsis multiflora				X	X														X			X			X	X
Duguetia odorata	X			X							X						X	X	X						X	
Duguetia quitarensis						X													X	X						
Duguetia stenantha						X					X								X					X		
Ephedranthus amazonicus						X													X	X					X	X
Fusaea longifolia				X							X								X			X				
Guatteria decurrens				X						X			X					X	X			X				X
Guatteria ferruginea	X				X								X												X	X
Guatteria kuhlmannii				X		X								X			X	X	X			X				
Guatteria megalophylla				X											X		X	X	X	X		X		X	X	X
Guatteria puncticulata	X			X															X	X					X	
Guatteria recurvisepala				X															X							
Guatteria schomburgkiana				X	X														X							X
Guatteriella tomentosa				X						X								X							X	
Malmea dielsiana				X													X		X	X						

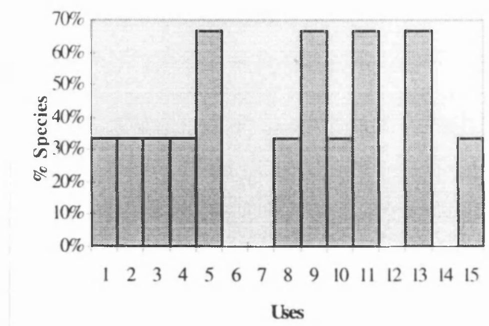
Table 7.36 Annonaceae family in the middle Caquetá region. Ecological and Ethnographic information (Continued)

GENUS/PECIES	USES															LANDSCAPE UNITS										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
Oxandra euneura					X	X				X								X	X						X	
Oxandra leucodermis				X		X								X								X				
Oxandra mediocris				X													X	X								
Oxandra polyantha				X		X								X			X	X	X			X				
Pseudoxandra cf. coriacea				X						X									X							
Pseudoxandra leiophylla				X																X						
Pseudoxandra pacifica				X		X								X			X	X				X				
Unonopsis guatterioides				X		X								X			X	X	X			X				
Unonopsis spectabilis				X							X							X	X	X						
Unonopsis stipitata					X	X													X	X				X	X	X
Unonopsis venificiorum				X									X		X											
Xylopia sp.	X			X																						
Xylopia amazonica	X			X									X												X	
Xylopia benthamii				X									X												X	
Xylopia cuspidata						X													X						X	
Xylopia emarginata				X	X																		X			
Xylopia macrantha						X													X							
Xylopia micans	X			X	X														X	X		X			X	
Xylopia spruceana				X		X													X			X			X	X
Total	6			27	7	14				4	4		5	6	2											
% of total (=35) number of species used for wood	17%	0%	0%	77%	20%	40%	0%	0%	0%	11%	11%	0%	14%	17%	6%											

Table 7.37 Apocynaceae family in the middle Caquetá region. Ecological and Ethnographic information.

Number of genera	17	Genera used for wood	2
Number of species	42	Species used for wood	3

Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A)Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.

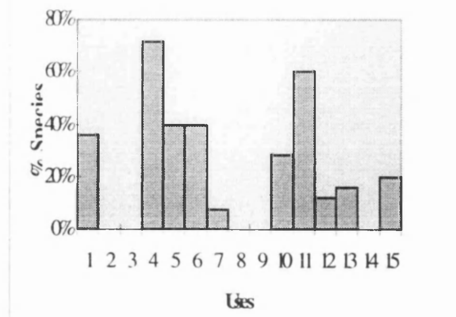


GENUS/SPECIES	USES															LANDSCAPE UNITS										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
Aspidosperma sp.				X	X				X		X		X			X										
Aspidosperma cf. excelsum	X	X	X													X										
Couma macrocarpa					X			X	X	X	X		X		X			X	X			X			X	
Total	1	1	1	1	2			1	2	1	2		2		1											
% of total (=3) number of species used for wood	33%	33%	33%	33%	67%	0%	0%	33%	67%	33%	67%	0%	67%	0%	33%											

Table 7.38 Arecaceae family in the middle Caquetá region. Ecological and Ethnographic information.

Number of genera	23	Genera used for wood	18
Number of species	64	Species used for wood	25

Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A)Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.



GENUS/SPECIES	USES															LANDSCAPE UNITS										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
Astrocaryum aculeatum	X			X	X	X	X				X					X	X			X						
Astrocaryum gynacanthum	X									X	X												X			
Attalea maripa	X			X	X	X	X			X	X						X							X		
Bactris gasipaes	X				X	X				X	X	X														
Catoblastus drudei				X		X										X										
Dictocaryum ptarianum				X																			X	X		
Dictocaryum ptariense				X																				X		
Euterpe catinga				X							X											X		X		
Euterpe precatoria				X							X					X				X	X			X		
Geonoma deversa				X						X			X				X						X			
Geonoma stricta var. piscicauda					X										X		X	X					X	X		
Iriartea deltoidea				X							X					X	X	X					X			
Iriartella setigera				X		X					X		X				X	X				X	X	X		
Manicaria saccifera				X							X									X						
Mauritia flexuosa	X			X	X	X				X	X	X			X		X			X						
Mauritiella aculeata				X							X					X	X	X					X	X		

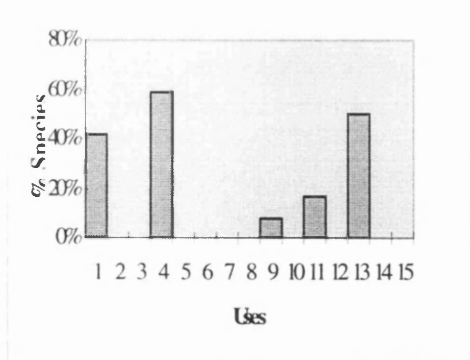
Table 7.38 Aracaceae family in the middle Caquetá region. Ecological and Ethnographical information.(Continued)

GENUS/SPECIES	USES															LANDSCAPE UNITS										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
Maximiliana maripa					X	X					X							X					X			
Oenocarpus bacaba	X				X						X							X		X		X	X	X		
Oenocarpus bataua	X			X	X	X				X	X	X					X	X				X	X	X		
Oenocarpus mapora	X				X						X				X	X	X						X			
Pholidostachys synanthea				X						X						X							X			
Phytelephas microcarpa				X											X	X	X	X		X			X	X		
Socratea exorrhiza				X	X								X		X	X	X	X		X			X	X		
Wettinia augusta	X			X		X							X										X			
Wettinia drudei						X													X							
Total	9			18	10	10	2			7	15	3	4		5											
% of total (=25) number of species used for wood	36%	0%	0%	72%	40%	40%	8%	0%	0%	28%	60%	12%	16%	0%	20%											

Table 7.39 Burseraceae family in the middle Caquetá region. Ecological and Ethnographic information.

Number of genera	5	Genera used for wood	5
Number of species	47	Species used for wood	12

Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A)Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.

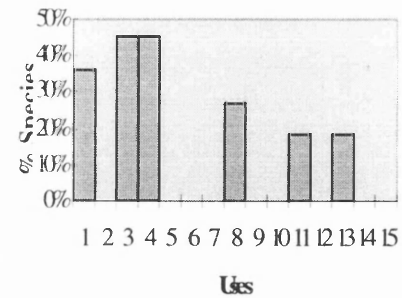


GENUS/SPECIES	USES															LANDSCAPE UNITS										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
Crepidospermum prancei				X														X	X						X	
Crepidospermum rhoifolium	X																			X					X	X
Dacryodes peruviana				X							X						X		X	X		X		X		
Protium aracouchini	X								X										X	X					X	
Protium decandrum				X																						
Protium divaricatum				X									X						X						X	
Protium krukoffii	X																X					X				
Protium nodulosum				X							X		X				X	X	X			X				
Protium subserratum	X												X						X	X					X	X
Protium urophyllidium	X												X												X	
Tetragastris panamensis				X									X					X	X							
Trattinnickia glaziovii				X									X						X			X			X	X
Total	5			7					1		2		6													
% of total (=12) number of species used for wood	42%	0%	0%	58%	0%	0%	0%	0%	8%	0%	17%	0%	50%	0%	0%											

Table 7.40 Chrysobalanaceae family in the middle Caquetá region. Ecological and Ethnographic information.

Number of genera	4	Genera used for wood	3
Number of species	39	Species used for wood	11

Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A)Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.

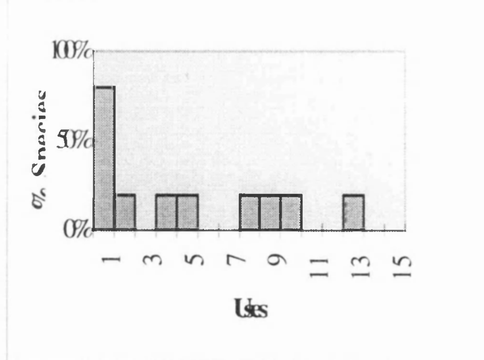


GENUS/SPECIES	USES															LANDSCAPE UNITS										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
Hirtella macrophylla								X																		
Licania apetala	X							X										X	X	X			X		X	X
Licania arachnoidea			X	X							X						X	X	X	X					X	X
Licania cf. longipedicellata	X																		X							
Licania harlingii			X	X													X			X						X
Licania heteromorpha				X									X				X	X	X	X					X	X
Licania micrantha			X	X														X	X	X		X			X	
Licania octandra	X							X											X					X		
Licania parvifolia			X										X									X				
Licania urceolaris	X			X													X								X	
Parinari parilis			X								X						X	X								
Total	4		5	5				3			2		2													
% of total (=11) number of species used for wood	36%	0%	45%	45%	0%	0%	0%	27%	0%	0%	18%	0%	18%	0%	0%											

Table 7.41 Clusiaceae family in the middle Caquetá region. Ecological and Ethnographic information.

Number of genera	14	Genera used for wood	3
Number of species	61	Species used for wood	5

Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A) Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.

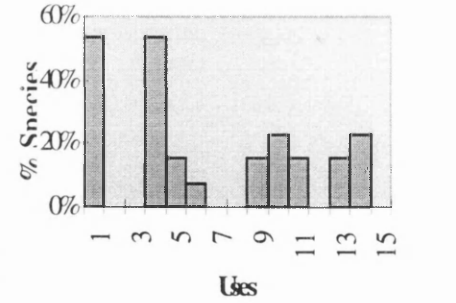


GENUS/SPECIES	USES															LANDSCAPE UNITS										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
Calophyllum longifolium									X								X	X	X			X				X
Tovomita schomburgkii	X																X	X		X		X			X	
Tovomita aff. spruceana	X	X						X											X						X	X
Vismia macrophylla	X				X					X			X				X	X	X			X				
Vismia sandwithii	X			X													X	X	X							
Total	4	1		1	1			1	1	1			1													
% of total (=5) number of species used for wood	80%	20%	0%	20%	20%	0%	0%	20%	20%	20%	0%	0%	20%	0%	0%											

Table 7.42 Euphorbiaceae family in the middle Caquetá region. Ecological and Ethnographic information.

Number of genera	35	Genera used for wood	11
Number of species	68	Species used for wood	13

Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A)Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.

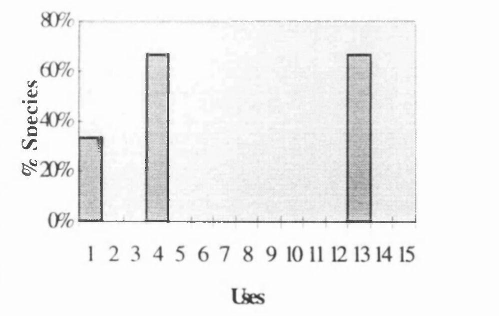


GENUS/SPECIES	USES															LANDSCAPE UNITS										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
Alchornea schomburgkii				X													X									
Asparisthmium cordatum				X												X									X	X
Gavarretia terminalis				X															X						X	X
Hyeronima oblonga	X			X													X		X						X	
Mabea nitida					X								X	X			X	X	X			X	X			
Micrandra lopezii									X	X															X	
Micrandra spruceana	X			X					X	X	X			X					X	X					X	X
Micradropsis scleroxylon				X																					X	
Nealchornea yapurensis	X																	X	X	X					X	
Sandwithia heterocalyx	X									X									X	X		X			X	X
Senefeldera inclinata	X					X							X	X					X	X					X	
Senefeldera karsteniana	X				X																				X	
Vaupesia cataractarum	X			X							X								X	X					X	
Total	7			7	2	1			2	3	2		2	3												
% of total (=13) number of species used for wood	54%	0%	0%	54%	15%	8%	0%	0%	15%	23%	15%	0%	15%	23%	0%											

Table 7.43 Flacourtiaceae family in the middle Caquetá region. Ecological and Ethnographic information.

Number of genera	9	Genera used for wood	2
Number of species	20	Species used for wood	3

Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A)Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.

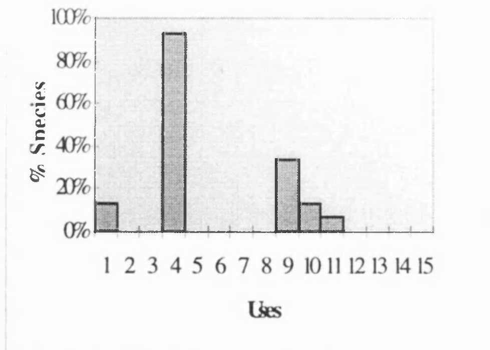


GENUS/SPECIES	USES															LANDSCAPE UNITS										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
Lindackeria maynensis				X									X													
Lindackeria paludosa	X			X													X		X					X		
Mayna grandiflora													X				X		X					X		
Total	1			2									2													
% of total (=3) number of species used for wood	33%	0%	0%	67%	0%	0%	0%	0%	0%	0%	0%	0%	67%	0%	0%											

Table 7.44 Lauraceae family in the middle Caquetá region. Ecological and Ethnographic information.

Number of genera	10	Genera used for wood	5
Number of species	56	Species used for wood	15

Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A)Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.

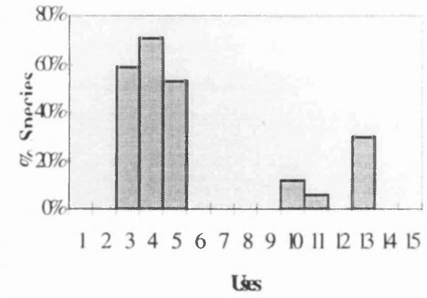


GENUS/SPECIES	USES															LANDSCAPE UNITS										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
Endlicheria formosa				X													X	X	X							
Endlicheria multiflora				X														X					X			
Licaria sp.(1)	X			X												X										
Licaria sp.(2)	X			X												X										
Licaria aurea				X																					X	
Licaria cannella				X																					X	X
Licaria macrophylla				X															X					X		X
Mezilaurus itauba				X					X															X	X	X
Nectandra cuspidata				X					X		X								X							
Ocotea sp.				X					X	X								X	X	X				X	X	X
Ocotea aciphylla				X												X										
Ocotea argyrophylla				X					X																X	X
Ocotea cymbarum				X																					X	
Ocotea javitensis				X					X								X		X	X		X			X	X
Ocotea rubrinervis										X																
Total	2			14					5	2	1															
% of total (=15) number of species used for wood	13%	0%	0%	93%	0%	0%	0%	0%	33%	13%	7%	0%	0%	0%	0%											

Table 7.45 Lecythidaceae family in the middle Caquetá region. Ecological and Ethnographic information.

Number of genera	5	Genera used for wood	3
Number of species	27	Species used for wood	17

Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A)Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.

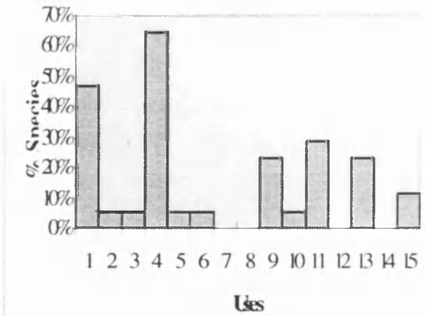


GENUS/SPECIES	USES															LANDSCAPE UNITS										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
Cariniana multiflora				X															X						X	
Eschweilera alata				X	X								X						X	X					X	
Eschweilera albiflora			X														X	X	X			X				
Eschweilera andina			X		X												X	X		X		X				
Eschweilera bracteosa				X															X	X					X	
Eschweilera chartaceifolia				X							X								X	X					X	
Eschweilera coriacea			X	X	X												X	X	X	X		X			X	X
Eschweilera gigantea			X																	X						
Eschweilera itayensis			X		X					X			X					X	X			X				
Eschweilera laevicarpa				X	X														X						X	
Eschweilera parvifolia			X	X	X												X	X		X			X		X	X
Eschweilera punctata			X	X	X								X						X	X					X	X
Eschweilera revoluta			X																	X						
Eschweilera rufifolia			X	X	X					X			X					X	X					X	X	X
Eschweilera tessmannii			X	X	X								X						X	X				X	X	X
Eschweilera turbinata				X																						
Lecythis chartacea				X														X							X	
Total			10	12	9					2	1		5													
% of total (=17) number of species used for wood	0%	0%	59%	71%	53%	0%	0%	0%	0%	12%	6%	0%	29%	0%	0%											

Table 7.46 Leguminosae family in the middle Caquetá region. Ecological and Ethnographic information.

Number of genera	58	Genera used for wood	11
Number of species	204	Species used for wood	17

Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A)Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.

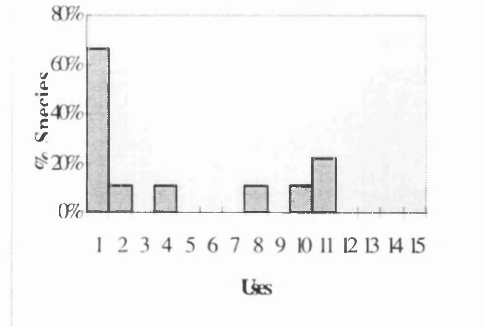


GENUS/SPECIES	USES															LANDSCAPE UNITS										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
Clathrotropis macrocarpa	X									X			X		X				X	X					X	X
Clathrotropis nitida	X			X														X	X			X			X	X
Diplotropis duckei				X															X	X				X		X
Dipteryx micrantha				X	X																					
Heterostemon conjugatus	X																X			X					X	X
Hydrochorea gonggrijpii				X															X			X			X	
Hymenolobium pulcherrimum				X					X													X			X	
Inga ciliata				X							X								X							
Inga pruriens				X							X						X		X	X					X	
Inga tessmanni				X							X								X							
Monopteryx uaucu	X		X						X		X		X						X	X				X	X	X
Poecilanthe amazonica	X					X									X											X
Swartzia cardiosperma				X													X	X	X	X		X			X	X
Swartzia racemosa	X	X		X							X		X					X	X			X			X	
Swartzia schomburgkii	X			X					X				X						X	X		X		X	X	X
Vatairea guianensis									X								X	X	X			X	X			
Zygia latifolia	X																X	X	X			X				
Total	8	1	1	11	1	1			4	1	5		4		2											
% of total (=17) number of species used for wood	47%	6%	6%	65%	6%	6%	0%	0%	24%	6%	29%	0%	24%	0%	12%											

Table 7.47 Melastomataceae family in the middle Caquetá region. Ecological and Ethnographic information.

Number of genera	23	Genera used for wood	4
Number of species	103	Species used for wood	9

Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A)Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.

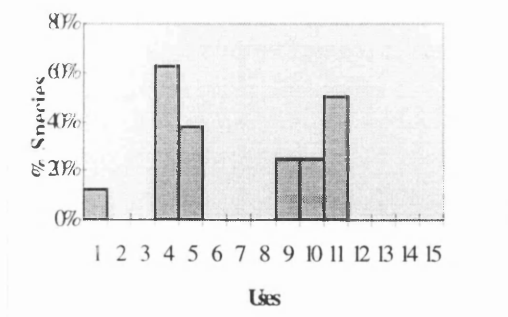


GENUS/SPECIES	USES															LANDSCAPE UNITS										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
Adelobotrys macrophylla								X																		
Bellucia grossularioides	X																	X	X							X
Miconia dispar	X																X	X	X							
Miconia phaeophylla	X																		X						X	
Miconia prasina	X																		X							
Miconia pubipetala	X																								X	
Miconia sp.		X								X															X	
Mouriri cauliflora	X										X								X	X					X	
Mouriri myrtifolia				X							X						X	X				X				X
Total	6	1		1				1		1	2															
% of total (=9) number of species used for wood	67%	11%	0%	11%	0%	0%	0%	11%	0%	11%	22%	0%	0%	0%	0%											

Table 7.48 Moraceae family in the middle Caquetá region. Ecological and Ethnographic information.

Number of genera	12	Genera used for wood	6
Number of species	56	Species used for wood	8

Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A)Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.

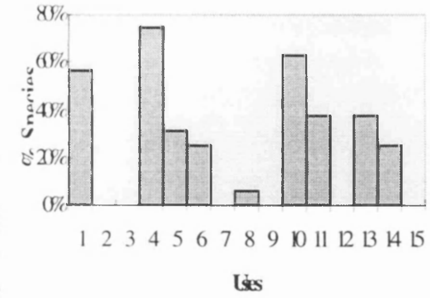


GENUS/SPECIES	USES															LANDSCAPE UNITS										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
Brosimum rubescens				X	X					X									X	X				X	X	X
Clarisia racemosa									X		X								X	X					X	
Naucleopsis imitans	X																X		X	X				X		X
Naucleopsis ulei				X	X				X									X	X						X	
Perebea mollis				X							X							X								
Perebea xanthochyma				X													X	X	X							
Pseudolmedia laevigata					X					X	X						X		X	X					X	X
Sorocea hirtella subsp. oligotricha				X							X						X	X	X			X				
Total	1			5	3				2	2	4															
% of total (=8) number of species used for wood	13%	0%	0%	63%	38%	0%	0%	0%	25%	25%	50%	0%	0%	0%	0%											

Table 7.49 Myristicaceae family in the middle Caquetá region. Ecological and Ethnographic information.

Number of genera	4	Genera used for wood	2
Number of species	31	Species used for wood	16

Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A)Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.

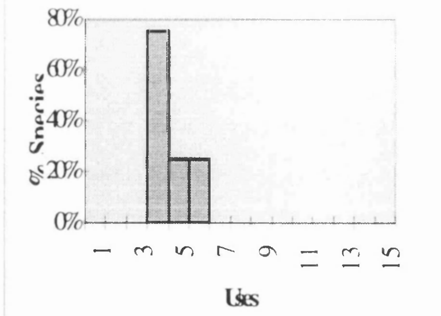


GENUS/SPECIES	USES															LANDSCAPE UNITS										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
Iryanthera crassifolia	X				X					X								X	X	X						
Iryanthera juruensis				X	X						X		X					X	X	X					X	X
Iryanthera laeviss				X						X	X								X	X				X		
Iryanthera lancifolia				X	X					X	X							X	X	X				X	X	
Iryanthera macrophylla				X						X									X							
Iryanthera obovata				X																						X
Iryanthera polyneura	X										X						X	X	X	X					X	
Iryanthera tricornis	X			X	X	X					X								X	X					X	X
Iryanthera ulei	X			X	X			X		X	X		X	X			X	X	X	X		X			X	X
Virola calophylla	X			X						X			X				X	X	X	X		X		X	X	
Virola divergens				X						X			X						X							
Virola elongata	X			X		X				X			X	X			X	X	X	X		X	X		X	X
Virola loretensis				X						X							X	X	X			X				
Virola multinervia	X																			X					X	
Virola pavonis	X			X		X				X				X			X	X	X	X		X		X		X
Virola surinamensis	X					X							X	X			X	X	X			X				
Total	9			12	5	4		1		10	6		6	4												
% of total (=16) number of species used for wood	56%	0%	0%	75%	31%	25%	0%	6%	0%	63%	38%	0%	38%	25%	0%											

Table 7.50 Myrtaceae family in the middle Caquetá region. Ecological and Ethnographic information.

Number of genera	8	Genera used for wood	4
Number of species	46	Species used for wood	4

Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A)Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.

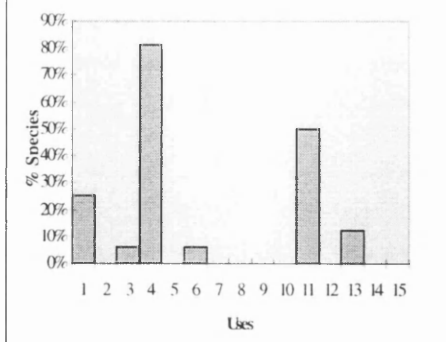


GENUS/SPECIES	USES															LANDSCAPE UNITS										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
Calyptranthes pulchella				X	X																	X				X
Marlierea spruceana				X													X	X	X			X			X	
Myrcia revolutifolia						X																				X
Plinia rivularis				X															X							
Total				3	1	1																				
% of total (=4) number of species used for wood	0%	0%	0%	75%	25%	25%	0%	0%	0%	0%	0%	0%	0%	0%	0%											

Table 7.51 Sapotaceae family in the middle Caquetá region. Ecological and Ethnographic information.

Number of genera	8	Genera used for wood	5
Number of species	57	Species used for wood	16

Key for uses: (1) firewood; (2) smoking; (3) lighting; (4) construction; (5) domestic artefacts; (6) weapons; (7) musical instruments; (8) pottery manufacture; (9) canoe manufacture; (10) ornaments/ritual; (11) food; (12) rearing of larvae; (13) medicinal; (14) fishing/hunting bait; (15) fishing/hunting poison. Key for landscape units: (AC) Alluvial plain of Caquetá river; (A)Frequently inundated flood plain of the Caquetá river; (E) Rarely inundated flood plain of the Caquetá river; (T) Low terraces of the Caquetá river; (H) High terraces of the Caquetá river; (AA) Alluvial plain of Amazonian rivers; (C) Flood plain of clear-water rivers; (B) Flood plain of black-water rivers; (D) Terraces of Amazonian rivers; (S) Tertiary sedimentary plain; (R) Hard rock forms.



GENUS/SPECIES	USES															LANDSCAPE UNITS										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	AC	A	E	T	H	AA	C	B	D	S	R
Chrysophyllum prieurii				X							X								X	X					X	
Chrysophyllum sanguinolentum				X									X					X	X	X					X	X
Ecclinusa guianensis	X																			X					X	
Ecclinusa lanceolata				X							X						X	X	X			X				
Manilkara inundata				X																		X				
Micropholis guyanensis	X			X							X						X	X	X	X					X	X
Micropholis obscura	X																		X							X
Pouteria arcuata				X															X							X
Pouteria caimito				X							X		X						X							X
Pouteria cladantha				X														X		X						
Pouteria cuspidata			X	X							X						X	X	X			X			X	
Pouteria glauca				X														X								
Pouteria glomerata				X		X					X														X	
Pouteria hispida				X							X								X	X		X				X
Pouteria maguirei				X																					X	X
Pouteria retinervis	X										X								X	X					X	
Total	4		1	13		1					8		2													
% of total (=16) number of species used for wood	25%	0%	6%	81%	0%	6%	0%	0%	0%	0%	50%	0%	13%	0%	0%											

8. MODEL FOR THE CHARACTERISATION OF CHARCOAL ASSEMBLAGES IN THE COLOMBIAN AMAZON REGION

The first part of this chapter contains some definitions and explanations of the terms and concepts used to build the model. Then the model is presented and explained. Later the ethnographic data is presented in detail. In the last part of the chapter the model will be applied to the test sample of archaeological charcoals from Peña Roja.

The model proposed here provides a means of interpreting the processes by which wood is used and then might be found at archaeological sites. Ethnographical data concerning traditional indigenous wood use, published or collected during the field trip, have been used to build the model. These data may be biased inasmuch that it may include only a part of the wood used at present by people, or could be biased by the particular emphasis of each ethnobotanical investigation. This information does not include quantitative data on the use of wood at present; therefore the information on which the model is based has a qualitative character.

Wood and charcoal can be brought to a site as a result of both cultural and natural mechanisms. These factors can operate before, during and after the human occupation of a site. Natural mechanisms include natural fires, transport of wood and charcoal into a site by runoff water and burrowing animals (Shay and Shay 1978: 49). Earthworm and root hole disturbance can remove or disperse charcoal fragments in an archaeological site (Wood and Johnson 1978, Stein 1983, Lopinot 1984: 99-101; quoted by Smart and Hoffman 1988: 170). People bring wood to a site for different purposes. Selection of a particular woody taxon depends on physical characteristics such as shape, size, heat content, smoke produced when burning (Osgood 1940), as well as cultural reasons (Osgood 1958), local availability (Collier 1975, Alcorn 1981) and ease of collection. The importance of each of these factors varies amongst particular cases (see Smart and Hoffman 1988: 170).

Firewood selection involves several aspects including shape and size of wood. Specific purposes of fires such as for removing scales, fur or feathers from animals, grilling small game or heating stones for baking ovens affect the woods chosen by Australian indigenous peoples (Nicholson 1981: 63 quoted by Smart and Hoffman 1988: 170). Today people usually prefer to collect dead wood for firewood (Heizer 1963: 189, Openshaw 1974: 271 quoted by Smart and Hoffman 1988: 170). This preference affects taxa selected because some trees drop branches more readily than others (Godwin and Tansley 1941, Asch *et al.* 1972). Young trees are felled when no dead trees or branches are available (Heizer 1963, Devres Inc. 1980, Openshaw 1974 quoted by Smart and Hoffman 1988: 170).

Intentional burning of wood is the most likely source of charcoals on archaeological sites (Miller 1982 quoted by Smart and Hoffman 1988). Understanding why wood is burnt aids researchers in defining how wood was used and to investigate cultural preferences for selection and use of different woods. Detailed studies of specific archaeological contexts is very important; hearths, ovens and roasting pits indicate intentional burning of wood and secondary deposits such as ash dumps and middens will add information on intentional burning of fuel. Variation in taxa recovered from different archaeological contexts may indicate selection of specific firewood for specific purposes (Minnis 1978: 359, Miller 1985: 4, Cowan and Smart 1981: 27, quoted by Smart and Hoffman 1988).

There are different processes by which seeds and charcoal can be incorporated in archaeological deposits. Pearsall (1983: 122) says that deliberate burning of wood directly reflects the function of woods as fuels, whilst the charring of other botanical remains, including seeds, does not reflect their function because charring is accidental. Wood and charcoal properties including fracturing patterns, hardness and ashing must be considered to correct under-and over-representation of different taxa in the archaeological record when firewood patterns are considered.

However woods may become burnt by chance and seeds, leaves and other plant parts might be also used as fuels (see below in this chapter). Archaeological charcoal assemblages may derive from the collapse of campsites, houses and other wooden structures by burning, from intentional or accidental burning of wood and wooden artefacts or from forest firing for agricultural activities. Charcoal has been studied in rain forest soils from the upper Rio Negro area in the Venezuelan Amazon. Fires (mostly natural, sometimes resulting from human activities) were common since mid-Holocene times in this region. Climatic changes and human activities could have caused the fires (Sanford *et al.* 1985).

According to Shay and Shay (1978) the amount of charcoal derived from different human activities is not easily estimated. This is affected by a number of factors including the type of wood, moisture content and conditions of burning. Observations made of different activities involving wood fuel in Karpofora (Greece) showed that pottery firing in an outdoor kiln, lime burning in an outdoor kiln and metal working outdoors (with high temperatures) produced very little charcoal. Shay and Shay (1978) also observed other activities such as heating/cooking in an indoor hearth and roasting meat on an outdoor spit, produced variable amounts of charcoal, whilst baking/cooking in an outdoor oven produced very little charcoal. Disposal patterns of ash and charcoal in the above cases were different. Sometimes charcoal may be left in the places where it was formed, on other occasions it is scattered on garden plots or on household refuse dumps. Sources of charcoal are also difficult to determine taking into account the fragmentation and scattering processes and the post-depositional activities of burrowing animals (Shay and Shay 1978: 49).

8.1. Nature of the model

The purpose of the model is to investigate and characterise charcoal assemblages from archaeological sites in the Colombian Amazon forest. The model is based on ethnographic data about traditional indigenous uses of wood. Two different types of societies were considered: foragers (Nukak people) and sedentary groups (all the other societies cited).

The ethnohistorical data in the model refer to information concerning the uses of woods recorded in written sources from the colonial period in the area, i.e., between the sixteenth and nineteenth centuries (Acuña 1874/1641, Vásquez 1909/1561, Carvajal 1934/1542, Vásquez de Espinosa 1948/1629, Llanos and Pineda 1982, Useche Losada 1987) The model also incorporates ecological data reflecting the spectrum of woods from the area (Schultes 1971, 1988, Páez 1990, Schultes and Raffauf 1990, Galeano 1991, Duivenvoorden and Lips 1993a,b, Murillo Aldana and Franco Roselli 1995, Richards 1996, Sánchez Sáenz 1997, Duivenvoorden *et al.* 1998) and other aspects such as topography, hydrology, geology and soils (Junk 1984, Urrego 1997). Archaeological and palaeobotanical data (Van der Hammen *et al.* 1991a,b, Van der Hammen 1992, Hooghiemstra and Van der Hammen 1998, Behling *et al.* 1999, Berrio and Hooghiemstra 1999) are considered when the model is applied.

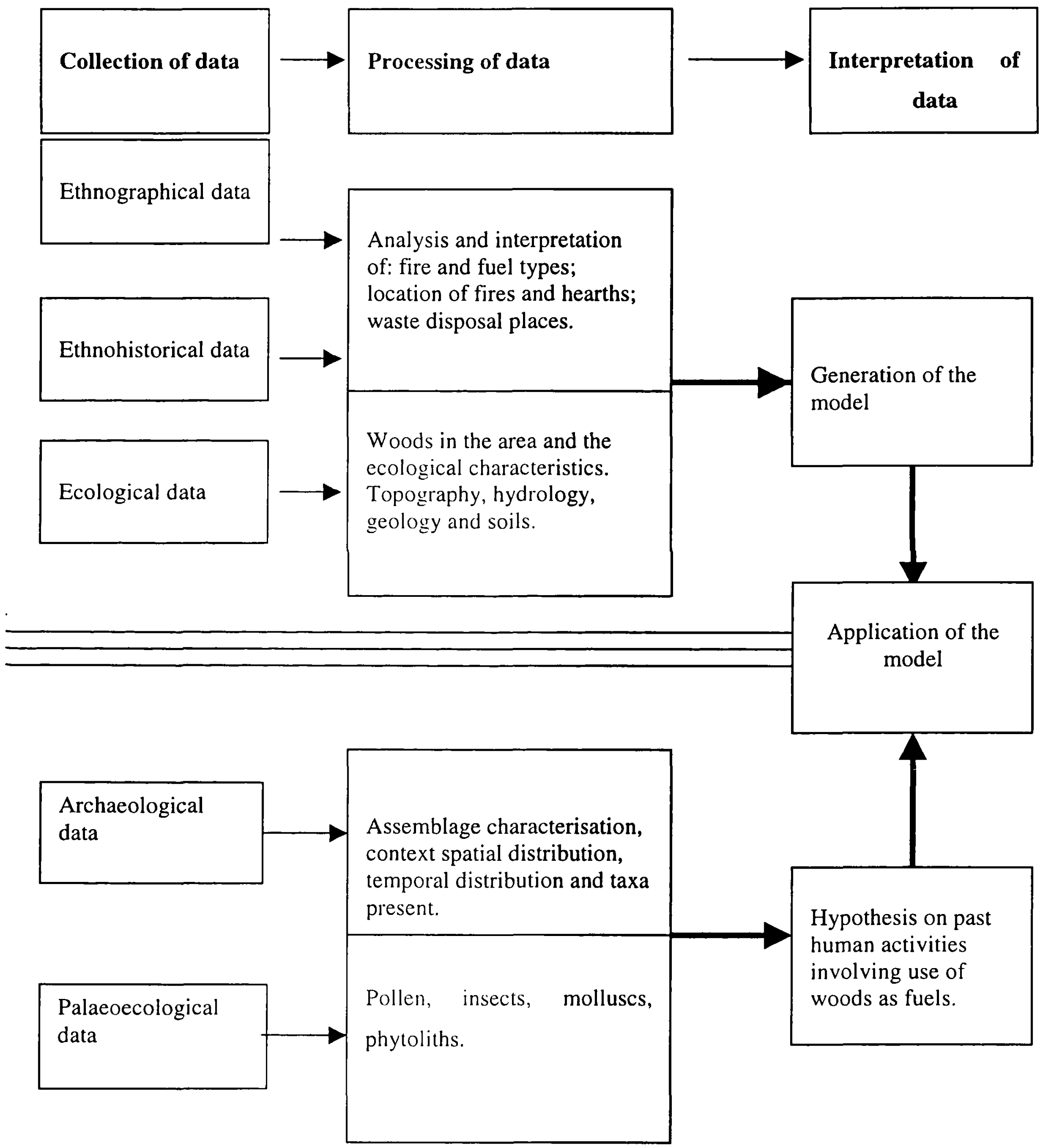
The ethnographical data considered in the model include fire and fuel types, hearth/fire locations and waste disposal places where charcoal is commonly found. Historical descriptions about past uses of woods that are mentioned by present day indigenous inhabitants from the area are included in the ethnographical data. The archaeological information used for the model refers to the location of charcoal assemblages and to the contexts related to the charcoal assemblages. Palaeoecological data may be based on pollen, insects, molluscs and phytoliths analyses carried out to reconstruct past ecological conditions.

The model explains in broad terms how present indigenous communities from the area use wood. It also illustrates the charcoal assemblages derived from different activities which involve the use of wood as fuel. It is a helpful tool in generating hypotheses concerning the past human selection of wood. These hypotheses will help in the interpretation of archaeological assemblages.

The charcoal assemblages found in archaeological contexts comprise only a part of the woods used by people in the past. This is because of not all the wood used became burnt and in the Colombian Amazon, wood remains are mostly only preserved as charred wood. Consequently, the model is a useful framework to address charcoal analysis and species variation within particular charcoal assemblages from the region. The model also contributes to an understanding of why human selection is an important factor for the study of charcoal assemblages.

Figure 8.1 summarises graphically the model and its application. The diagram includes the collection, the processing and the interpretation of data. On the top left side of the diagram, the different types of data are illustrated: ethnographical, ethnohistorical and ecological components of the model. In some cases one of these groups of data is dominant over the others according to the available information. These data are then processed to generate a model which will characterise the nature of charcoal assemblages. Below the model are the archaeological and palaeoecological data. These data are processed to form hypotheses on past human activities which involve the use of woods as fuels. The model can then be applied to these hypotheses and data relating to archaeological wood is interpreted.

Figure 8.1 Graphic representation of the model and its application.



8.2. Components of the model

8.2.1 Ethnographical data

These aspects answer the basic questions: why people make fires, what are the fuels they use, when and where they make the fires and what they do with waste from fires.

8.2.1.1. Fire types

The type of fires refers to the intention of the people in making a fire or a hearth. These purposes may include cooking, providing of light, heating, smoking or roasting meat and fish, burning fur of game, manufacturing domestic artefacts, manufacturing hunting and fishing equipment, firing pottery, manufacturing canoes and clearance of forest for agricultural fields and domestic gardens.

The distinction between single and multiple events can be very difficult to determine on archaeological sites. For example, a fire made in order to fire pottery may use only one of the taxa reported as firewood. However, if residues from several different fires are deposited together in the same context the taxa that will be eventually found and identified will include a range of different woods.

8.2.1.2. Fuel types

8.2.1.2.1. Firewood

Different woods are used as fuels for different activities that include cooking (Table 7.21), smoking meat and/or fish (Table 7.22), lighting (Table 7.23) and firing pottery (Table 7.28). Amongst Muinane people inhabiting the Peña Roja site today, men, women and children collect firewood. When people require specific woods for purposes such as smoking fish or meat and for building houses, the men fell the appropriate trees. Men also bring large trunks to the houses occasionally when they find them in the forest. Most of the firewood for domestic hearths is collected daily by the women in the terra firme forest located approximately 1 km away from Peña Roja (see map in Figure 8.29). The women collect dead wood within the terra firme forest but they are able to select specific taxa within the dead wood (Inés Cavelier pers. comm. 1994). Amongst Nukak people, the men collect the firewood, consisting mainly in palm trunks but they also collect other woods (Cabrera *et al.* 1994).

8.2.1.2.2. Residues of woods used for purposes other than firewood

Residues or wood-working waste of woods used to build houses (Table 7.24) or to manufacture domestic artefacts (Table 7.25), hunting/fishing equipment (Table 7.26), musical instruments (Table 7.27) and ornaments and other artefacts associated with rituals (Table 7.30) may be used as firewood.

8.2.1.2.3. Residues of woods used to manufacture canoes

Residues of woods used during the process of manufacturing canoes may be burnt in the fires made to widen them. Table 7.29 includes the trees used in the Colombian Amazon to manufacture canoes.

8.2.1.2.4. Palm taxa

Trunks and leaves of different palms are used as fuels sometimes. Specific references to palm taxa used as fuel will be explained later in this chapter (sub-sections 8.7.1, 8,7,5 and 8.7.9). Table 7.21 includes the species from the Arecaceae family used as fuels.

8.2.1.2.5. Randomly selected woody taxa

This category of fuel is used here to refer to non specific woods used as fuel. Amongst Muinane people, women sometimes collect any wood as firewood when they cannot travel to the terra firme forest to collect firewood. They also collect any wood from the dead wood in the terra firme forest when they do not have enough time to look for the woods they prefer (Inés Cavelier pers. comm. 1999).

8.2.1.2.6. Other vegetal and animal materials

These materials include dry leaves, palm and tree seeds, bark from trees and ant nests. Later in this chapter references to these materials used as fuels will be explained (sub-sections 8.7.1, 8.7.3, 8.7.4 and 8.7.9,).

8.2.1.3. Location of the fire and hearths

The location of the fires and hearths indicates where people make the fires and hearths to carry out different activities. These places include indoor hearth places, outdoor hearths and fires, agricultural fields, house garden areas, forest paths, river shores and the area surrounding salt lakes.

8.2.1.4. Location of fires and hearth waste

The location of fires and hearth waste refers to the contexts where charcoals and ashes derived from fires and hearths might be found. These contexts may be primary or secondary deposits. Primary deposits are contexts where charcoal assemblages accumulate after burning and are not redeposited. These include permanent and non-permanent domestic hearths, hearths for smoking fish and/or meat, hearths for toasting coca leaves, and hearths for baking manioc bread. Secondary deposits are contexts where residues from primary deposits have accumulated or been dumped.

The distinction between primary deposits and secondary disposal areas may be very difficult to assess in archaeological sites. Ethnoarchaeological research focused on this problem could help us to understand site formation processes and to formulate hypotheses on different patterns of primary and secondary depositional events in the tropical soils. At present there are no available studies on this topic for the middle Caquetá region. Siegel and Roe (1986) have undertaken a study that evaluates the necessary conditions to distinguish secondary disposal areas from primary activity areas in two house compounds of the Shipibo indigenous people from the Central Ucayali area in the Peruvian Amazon. They conclude that by means of careful analysis of the spatial distribution and associations of the artefacts from an on-going context, primary and secondary deposition of refuse can be distinguished. They also showed that occupational intensity of a settlement is not the most important criterion when evaluation of the correspondence between use and discard areas is intended. The specific activities carried out in a settlement affect the spatial relationship between use and disposal areas (see also Roe and Siegel 1983, De Boer and Lathrap 1979 and Murray 1980).

Amongst the Muinane people, women occasionally clean the permanent domestic hearths, removing waste which is thrown outside the houses in their surrounding area, 2 or 3 m from the external walls. They avoid the circulation areas which are kept always clean. Sometimes ash and charcoal from the domestic hearths are used as fertiliser for specific plants such as chilli peppers (*Capsicum* sp.) within domestic gardens (Inés Cavelier pers. comm. 1999).

Amongst the Nukak people, women sweep the campsites and each domestic group has a specific place within the campsite to dispose of waste. Generally, these places are at the edges of their campsites (Cabrera *et al.*1994. See below Figure 8.6).

8.2.2. Ethnohistorical data

The writings of explorers and missionaries, from the sixteenth and seventeenth centuries who dealt with the Amazon region are brief and contradictory. The difficulties encountered in traveling throughout the region did not allow the earliest travellers (Vásquez 1909/1561, Carvajal 1934/1542, Vásquez de Espinosa 1948/1629) to accurately observe the indigenous societies. The information from the seventeenth century (Acuña 1874/1641, Cruz 1900/1653, Heriarte 1975/1662) was written mainly by missionaries and officers who lived for long periods among indigenous populations already under a process of acculturation (Porro 1994). This information describes general socio-political aspects of the indigenous societies who lived in the upper and middle Amazon river.

Ethnohistorical data from the Colombian Amazon concern mainly the indigenous populations who inhabited the upper Putumayo and Caquetá rivers during the sixteenth and seventeenth centuries. Recently published studies (e.g. Llanos and Pineda 1982, Useche Losada 1987, Gómez 1996-1997) deal with the territories of the main societies from the area and with demographic aspects of these populations. Brief descriptions about their socio-political organisation, subsistence practices, main cultivated crops, clothes and ornaments and physical appearances of the indigenous peoples are included in the studies (see for example Llanos and Pineda 1982).

The investigation of Useche Losada (1987) deals with the history of the colonial period from the area of the upper Orinoco and Negro rivers. The area studied in this investigation is located *c.* 700 km northeast from the middle Caquetá river (see Useche Losada 1987:12).

The sources used to the ethnohistorical investigation from the Colombian Amazon consist of early reports of travellers, officers and archive documents from the Spanish colonial administration.

Some descriptions of hunting equipment (e.g. wood blowpipes) and musical instruments (drums) used by indigenous people from the sixteenth and seventeenth centuries correspond to artefacts still used at present by the indigenous communities from the region (see Llanos and Pineda 1982). Unfortunately, the published information does not contain specific details of daily indigenous ways of life that will add data to the model characterising archaeological charcoal assemblages such as firewood collection patterns, fuel types used, and the purposes and location of the fires.

A specific study on the ethnohistorical data not yet published (archive documents and early travellers reports) from the Colombian Amazon could produce specific information about ancient uses of woods in the area. These data may be used to complement the ethnographical data in the model.

8.2.3. Ecological data

The ecological information useful to the model includes environmental requirements of different woods reported as used by indigenous peoples. The combination of other aspects such as topography, hydrology, geology and soils are important to understand the ecological characteristics of an area. Spatial distribution of different taxa is also useful to understand firewood collection patterns. Tables 7.21 to 7.35 include the current available information for the wood taxa found in the middle Caquetá river.

8.3. Archaeological data

8.3.1 Definition of different charcoal assemblages

This definition refers to the location of different assemblages of charcoals within an excavation and their relation to the different contexts in the excavation. Two different types of charcoal assemblages can be found: concentrated and scattered. Concentrated charcoal assemblages include those assemblages found at archaeological contexts clearly delimited such as hearths, pits, furnaces and dumps.

Concentrated charcoal assemblages may be found as primary deposits if, for instance, the residues of domestic hearths are not redeposited. If these hearths are cleaned and their waste is removed the charcoal assemblages would be redeposited in secondary deposits such as specific pits and rubbish accumulation areas created by dwellers. Secondary deposits could include remains of single or multiple events as well as remains of different types of fires. Concentrated charcoal assemblages can be found both inside and outside houses and campsites.

Scattered charcoal assemblages will be found on ancient floor surfaces of dwelling places and in their surrounding areas. Charred wood remains from these contexts may include woody taxa used for different activities. Distinction of specific activities or events of deposition and redeposition of these charcoal assemblages can only be investigating after careful stratigraphic excavations.

Spatial distribution of charcoal assemblages comprises two types of information: chronological and contextual. The first one places the assemblages within a time scale and the second one relates the assemblage to a wider set of inter-related data which include many other cultural remains.

8.3.2 Sampling of charcoals

Usually sampling of charcoals is carried out in the laboratory after the different charcoal assemblages are defined. As in the case of other plant macro-remains, the sampling strategy depends on the research purposes. There are two main aspects of sampling to take into account: from which contexts the samples have to be taken and the number of fragments to be identified.

For instance, an aim of an archaeological project might be to compare firewood collection patterns throughout time. In this case, it will be necessary to take sub-samples of charcoals from different chronological periods and from all the contexts defined in the excavation that contain charred wood fragments such as indoor and outdoor hearths, ovens, pits and dumps. Charcoals contained in sediments from different occupation levels and house floors may contain charred wood fragments of taxa that could have been used as firewood. Therefore, a sub-sample of charcoals from different occupation levels would be helpful in the investigation of ancient patterns of firewood collection.

The appropriate size of charcoal sub-samples, either involving number of fragments or weight of fragments, relates to the index of abundance of archaeological charcoals within assemblages. Unfortunately, an ideal index of abundance for archaeological charcoal assemblages is very difficult to establish because of the taxonomic composition contained in an assemblage and the preservation of charcoals. The last two aspects affect the reliability of counts and weight of charcoals. For example, if a particular species produces fragile charcoal fragments, their presence or sizes do not relate to the relative importance of that taxon within the assemblage. The presence of such taxon might be over-estimated. If one chose to weigh charcoal sub-samples, specific gravities for wood and charcoals have to be studied because these can vary between taxa and therefore can affect relative abundance of different taxa (Thompson 1994: 17 and see chapter 4 sub-heading 4.1.4 for details on quantification of charcoals).

According to Popper (1988) ubiquity, or presence, analysis considers the number of samples in which each taxon identified is present within a group of samples. Scores of presence or absence are given to each taxon in each sample. If a taxon is scored as present it means that it is within the sample but the number of fragments of that particular taxon are not considered. "The frequency of a taxon is the number of samples in which the taxon is present expressed as a percentage of the total number of samples in the group" (Popper 1988: 61).

If quantification of charcoals would involves ubiquity analysis special attention is paid to the sampling of different contexts, the size of samples and the recovery methods employed to collect the samples. Because ubiquity analysis does not assess the amount of each taxon in a sample but its presence, this analysis avoids the problems related to fragmentation and different density of charcoals. However, comparisons between samples from different types of contexts (e.g. hearths, pits) or from different recovery strategies are difficult (see Popper 1988, Smart and Hoffman 1988 and chapter four, sub-heading 4.1.4).

In the case of this investigation, there are no pilot studies about relative abundance estimations of taxa within archaeological assemblages from the area. Consequently, it was difficult to know what is the appropriate number of fragments or weight of samples required to represent the high variability and abundance of the woody taxa from the area. Taking into account that one of the aims of this study was to assess the applicability of the current methodology of charcoal analysis a test sample of 200 fragments from three different contexts at Peña Roja was chosen for analysis. The analysis of this small sample allowed identifications to Family and to Genus levels (see Chapter five sub-heading 5.4.4.1). Future investigations would aim to estimate statistically appropriate sizes of archaeological samples from the area and develop a sampling strategy for those charcoal assemblages.

Future investigations of charcoal assemblages from Peña Roja or other archaeological sites from the Colombian Amazon must take into account the estimation of the appropriate sample size (number of fragments). The estimation of this sample size would be made following the method proposed by Smart and Hoffman (1988). They advise to examine all the fragments of charcoal in the first few samples. Then the cumulative number of identified taxa is plotted for each additional fragment of charcoal examined. The process would be repeated for each sample analysed. The number of identifications required to obtain all the taxa contained in a particular sample will be indicated at the point where the curve levels off. The similarity between the curves obtained from different samples would determine if the number of fragments indicated by the leveling-off point of the curves is the appropriate to be selected in other samples (Smart and Hoffman 1988: 176).

Special attention must be taken if the samples selected to determine the appropriate sample size come from different contexts because the charcoal diversity may vary within a site (Smart and Hoffman 1988). The different sizes of the charcoal fragments must be considered because different fragmentation rates might affect the composition of the different charcoal assemblages. In the case of Peña Roja an effort must be made to define different contexts and to detect probable stratigraphic and taphonomic disturbances.

8.3.3 Identification of charcoals

Several factors affect the identification of archaeological charred wood fragments. These include: variety of woody taxa in the studied area, preservation of wood as charred fragments, the process of deposition and redeposition of the fragments, changes over time in diagnostic anatomical characteristics or changes in anatomy due to different ecological characteristics of the environment, size of the fragments and the accuracy of the knowledge on variability between genera and species.

The greater the variety of taxa, the more difficult is the specificity of the identifications (Smart and Hoffman 1988). Because most of the preserved wood comprises charred fragments, it is not possible to consider any two fragments identified as the same taxon to be from the same plant. The fragmentation of charred wood may also affect the interpretation of the relative importance of each taxon within an assemblage. Modern ecological conditions are not necessarily the same as in past times and we do not know to what extent different ecological conditions could have affected the anatomical structure of woods. In addition, the atlases and keys used in identification of archaeological charcoals are those developed to identify unknown modern wood specimens. Charring of wood may affect the reliability and sometimes the possibility of identification because of changes caused in the micro-anatomical structure of woods. The size of the fragments may also affect the reliability of archaeological identifications, particularly when the key elements are certain anatomical features such as parenchyma distribution.

In the case of the archaeological charcoal assemblages from Peña Roja, identifications to Family level were considered successful taking into account the huge range of woody taxa present in the Colombian Amazon (see Chapter six, sub-heading 6.3.3 for details on the levels of identification of charcoals).

Quantification of archaeological charred wood fragments depends on the aims of the investigation, the amount of remains studied and the chronology of the site. The methods employed by archaeobotanists include ubiquity analysis, relative frequencies expressed as percentages by weight of samples floated or sieved or relative percentages according to the volume of standard samples. Quantitative analysis of charcoals has been also made by counting fragments and calculating relative percentages of the different taxa presented in the samples.

Both methods, of quantification counting fragment number and calculation of percentages by weight, present disadvantages. Several factors affect charcoal fragmentation rates such as charring, deposition and redeposition, flotation, sorting, packing and the examination processes. Calculation of percentages by weight of the fragments has to take into account the highly variable specific gravity of woods and charcoals (see Thompson 1994). This variability may affect the weights of charred wood fragments and therefore percentages showing relative abundance of different taxa within assemblages.

Comparisons between charcoal data from different contexts and sites may be made by using ubiquity scores that show each taxon in an assemblage as a percentage of the total number of samples analysed (Thompson 1994). However, comparisons have to be made between samples from the same type and between samples recovered with the same methods.

8.4. Palaeoecological data

Palaeoecological information may derive from several sources of information which include pollen, phytolith, mollusc or insect analysis.

8.5. Analysis and interpretation of the information

An understanding of the specific inter-relationships between different types of data is necessary for processing the information. The type of information provided by the ethnographical data may include firewood collection patterns and other traditional uses of wood such as the manufacture of domestic artefacts, building of houses and other structures, manufacture of hunting or fishing equipment, canoes and ornaments. This information may be biased by changes that occur in the ways traditional indigenous communities exploit wood resources today. Ethnographical data may include details about the type of fires, fuels, location of hearths or fires and disposal places for waste which may be related to the identified taxa within an assemblage and to the archaeological contexts.

The ethnohistorical data may contain information about past human exploitation of woody resources in the past. This information may complement the ethnographical data or help in the understanding of changes in the patterns of woody resources exploitation through time. However, in some cases the ethnohistorical information lacks specific details of woody exploitation patterns. In the case of the Colombian Amazon, the ethnohistorical information recorded in writings of early travellers, consists mainly of reports about the geographical location of groups and the creation and functioning of the catholic missions in the area. However, it is possible that unpublished archive documents provide details about the specific uses of resources or the patterns of their exploitation. This type of information is more commonly found in ethnohistorical sources from the colonial times when the administrative institutions were well established.

Archaeological data provide information on the specific contexts within excavations and about the content of these contexts. Archaeology would also inform us about other cultural materials such as ceramics, lithics and so on. The spatial distribution and chronological position of the archaeological materials would add information to the interpretation of specific charcoal assemblages.

The ecological data provide the relevant information about woody taxa present in the study area and about their spatial distribution which in turn, may be used to understand different patterns of wood resource exploitation at present. If palaeoenvironmental information is available it may be used to formulate hypotheses about past wood availability.

8.6 Generation and Application of the model

8.6.1 Characterisation of charcoal assemblages

This characterisation comprises the identification and quantification of different taxa contained in the charcoal assemblages, the analysis of the ecological or palaeo-ecological distribution of those taxa in the studied area and the spatial distribution of the charcoal assemblages within the archaeological sites.

8.6.2. Informing project director archaeologists about contexts by identification of charcoals

Project directors rely on the data given by specialists to inform their final interpretations of the specific archaeological contexts within archaeological sites. In turn, specialists such as archaeobotanists rely on the quality of the information about context interpretation. In the particular case of charcoal analysis, this two-way dialogue between the project directors and the specialists may be enriched when the identified taxa are related to the nature of the archaeological contexts. This information may include not only lists of identified taxa but also suggestions on the probable past human activities related to the different archaeological contexts from where the materials analysed came. The model developed in this thesis allows suggestions on specific past human activities related to the use of woods as fuels.

8.6.3. Hypotheses on past human activities involving use of woods as fuels

These hypotheses would add information about different contexts through the identification of charcoals especially when context-related variation is present. The taxa contained in different contexts relate to different human activities carried out in the past.

8.7 Ethnographic information from the Colombian Amazon used in the model

This section explains the ethnographic information used in the model. Most of this information comes from published sources, however, unpublished information collected by the author of this thesis or by other investigators is also mentioned. Table 8.1 presents a summary of this information. The current available ethnographical data include fuel types, fire/hearth locations and places for disposal of waste from different types of fires. Diagrams summarise this information for each type of fire (Figures 8.2, 8.7-8.9, 8.11-8.14,8.19).

Table 8.1. Summary of the ethnographic information used in the model

	FIRE TYPES											
	perm. dom. hearths	occas. dom. hearths	smoking meat/fish	firing pottery	manufacture hunting/fishing	manufacture domestic	manufacture ornaments/ritual	manufacture canoe	burning peccaries fur	clearance domestic garden	clearance agriculture field	burning weeds in agric. fields
FUEL TYPES												
firewood for cooking	X	X										
firewood for smoking meat/fish	X	X	X									
firewood for lighting	X	X										
firewood for firing pottery				X								
Woods to manufacture canoe								X				
Residues of wood used for diff. purposes	X	X			X	X	X					
Randomly selected woody taxa	X	X			X	X	X	X		X	X	X
Other vegetal/animal materials	X	X										
Palm taxa	X	X							X			
FIRE/HEARTH LOCATION												
inside houses	X		X		X	X		X				
outside houses	X	X	X	X	X	X		X				
domestic garden										X		
agricultural field											X	X
surrounding salt lick areas									X			
river shores								X				
forest paths		X										
forest								X				
LOCATION OF FIRE/HEARTH WASTE												
concentrated ch. ass. inside houses	X		X		X	X	X					
concentrated ch. ass. outside houses	X	X	X	X	X	X	X					
scattered ch. ass. inside houses	X		X		X	X	X					
scattered ch. ass. outside houses	X		X	X	X	X	X					
concentrated ch. ass. In pits	X		X	X	X	X	X					
scattered ch. ass. in domestic gardens	X									X		
scattered ch. ass. in agricultural fields											X	X
concentrated ch.ass. in agricultural fields												X
concentrated ch. ass.in forest paths		X										
concentrated ch. ass. In surrounding salt licks areas									X			
concentrated ch. ass. On river shores								X				
concentrated ch. ass. In the forest								X				

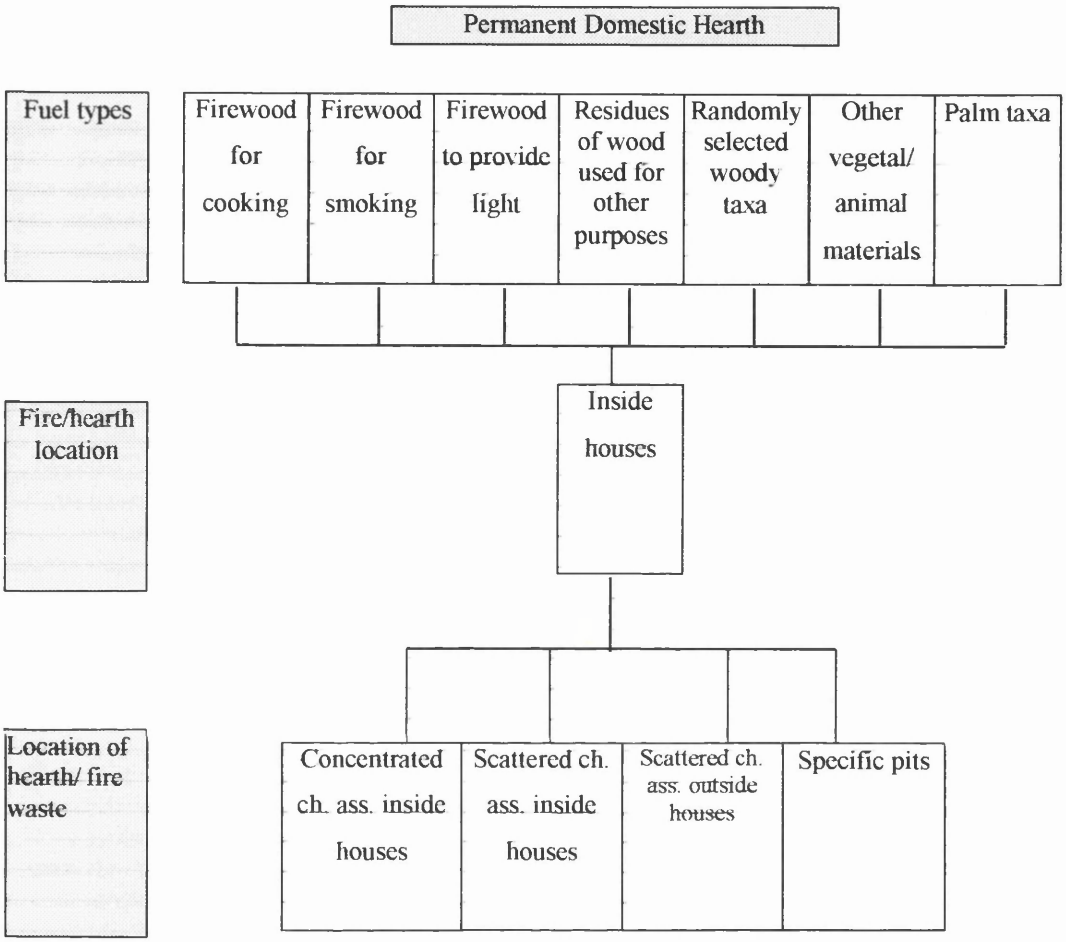
8.7.1. Permanent domestic hearths

Permanent domestic hearths are those which are used throughout the span of time of the occupation of a house or a campsite. This period of time may vary. These hearths comprise part of the habitation site. Their purpose is cooking, heating and to repel insects. Fuel can be bark, seeds and firewood. Such remains are commonly found on archaeological sites. Primary sources of fuel for permanent domestic hearths are taxa intentionally selected as firewood, smoking fish/meat and lighting. Secondary sources of fuel for these hearths include woods used for construction, manufacture of domestic artefacts, weapons and musical instruments.

Construction wood may became burnt in a domestic hearth when waste wood is discarded or, by accident, if a building collapses into the fire. There are no published data on excavations of collapsed houses in the Amazon region or ethnographic data on fires in houses or other buildings. Woods used for other purposes such as manufacturing domestic artefacts, hunting/fishing equipment, ornaments or musical instruments are likely to end up as fuel after the original purpose has been achieved.

Hearths can be located inside or outside houses. Charcoal assemblages derived from permanent domestic hearths may be left "in situ" after the abandonment of a house or campsite. However the charcoal assemblages derived from these hearths may also be periodically removed and be redeposited in pits, ash/waste dumps or can be swept outside houses or campsites. Figure 8.2 shows a diagram of the charcoal assemblages derived from permanent domestic hearths.

Figure 8.2 Diagram showing the charcoal assemblages from permanent domestic hearths.



Indigenous groups from the Colombian Amazon make permanent domestic hearths directly on the floor whether in a traditional communal house (Figure 8.3) or sometimes in the individual houses, which are the commonest dwelling places today in the area. Hearths are made in the centre of the individual houses or in the peripheral area if it is a communal house and the number of permanent hearths will depend on the number of nuclear families inhabiting the communal house (see Figure 8.4). However for the Tukuna people from the southern Colombian Amazon (see Figure 2.12), the permanent domestic hearth consists of a low rectangular platform constructed from a frame of planks of *Cedrela fissilis* (Meliaceae) and filled with mud. The hearth may be used directly on the floor or may be raised above the floor.

When people want to dry or smoke fish or meat a platform is supported above the hearth by using four stakes (Glenboski 1983: 73). This type of hearth is potentially visible in an archaeological excavation if careful analysis of the soil sediments in a house floor is carried out. Figure 8.5 shows an example of these hearths from Peña Roja.

Figure 8.3 Communal house from the Mirití river. Colombian Amazon.

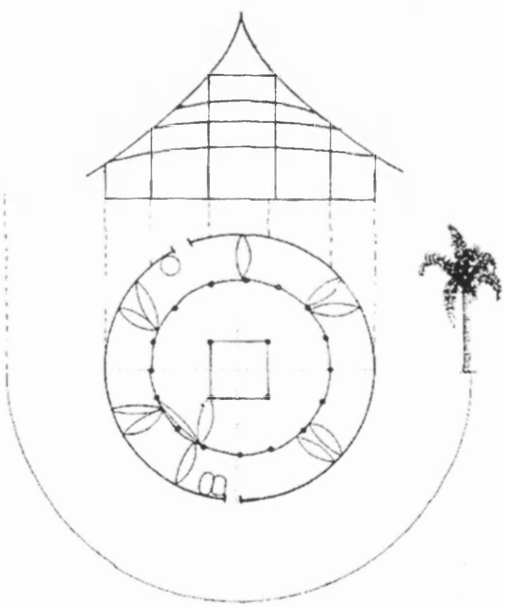


Figure 8.4 Schematic representation of a communal Yukuna house. Small dots in the inner circle show location of hearths. After Van der Hammen M. C. 1992: 144

At present Muinane people inhabit two storey houses (Figure 8.6). They have two different permanent domestic hearths. One is located on the ground floor and is used daily for baking manioc bread (Figure 8.7). Sometimes ceramic fire-dogs are used for these hearths or a low platform of mud is built to shape the hearth. The other hearth is located in the first floor and is used for cooking meals.

Communal houses have been studied by several authors and some aspects of them, such as their cultural meaning and economical and political roles have been studied in particular (see for example Pineda 1975, 1987, Hugh-Jones S. 1978, Hugh-Jones C. 1979, Reichel-Dolmatoff E. and Hildebrand 1984, Van der Hammen M.C. 1992). In general the communal houses are round or oval in shape and a space exists for each nuclear family in the peripheral area. Here each family hangs their hammocks around their own hearth (see Figure 8.4).

Figure 8.5 Hearth raised above the floor.

Figure 8.6. An indigenous two-storey house.

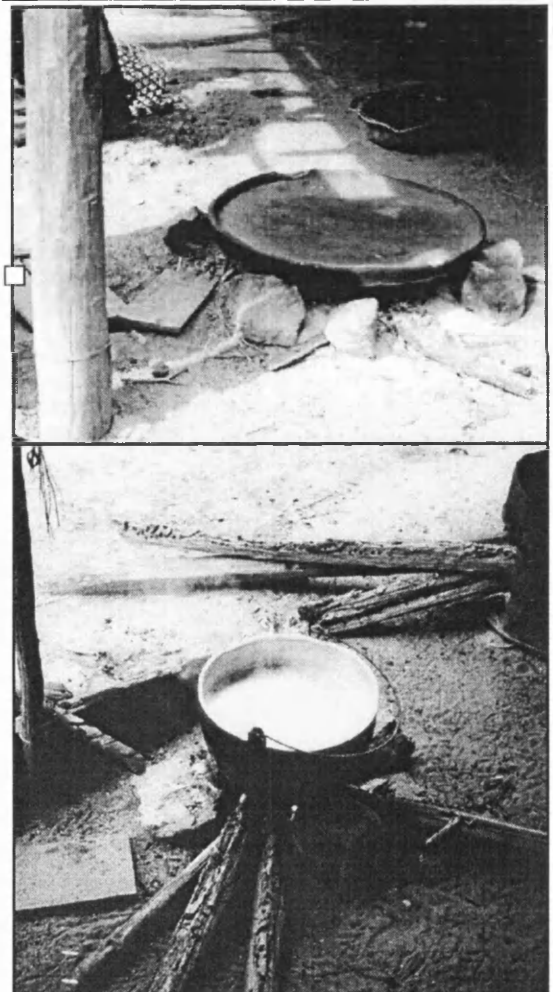


Figure 8.7 Hearths on the ground floor. One is to bake manioc bread.

Women from each family cook meals in these hearths for their families every day. Among the Yukuna people there is also a central communal space where some dances and songs are performed by the elders during certain ceremonies, and where communal food is served and consumed by the members of the community. There is another hearth located in the area between the central and secondary pillars where some communal activities are carried out such as the processing of coca leaves by men and the processing of bitter manioc by women (see Van der Hammen M.C. 1992: 142-147. See Figures 8.8 and 8.9 of this thesis).

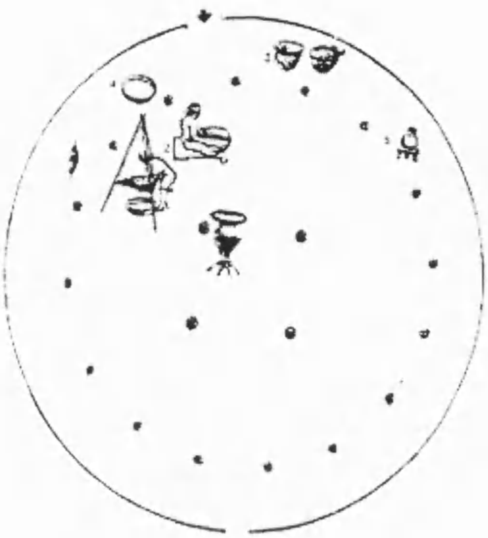


Figure 8.8. Schematic representation of a Yukuna communal house showing locations of the hearths and utensils associated with the processing of manioc. After Van der Hammen M.C.1992: 233.

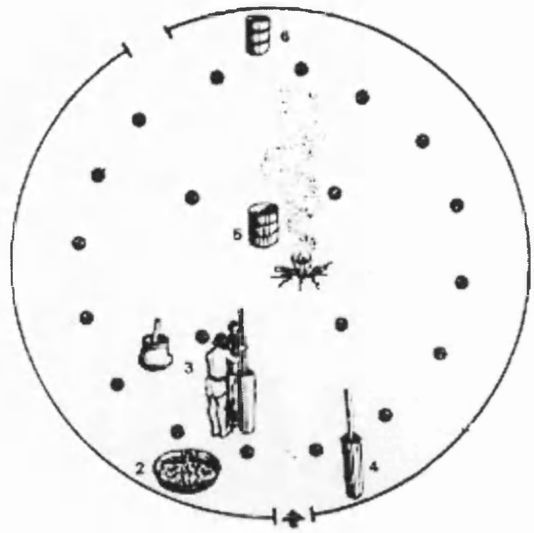


Figure 8.9. Schematic representation of a Yukuna communal house showing locations of the hearths and utensils associated with the processing of coca. After Van der Hammen M.C. 1992: 234.

Yukuna people have particular places within the communal house to prepare manioc. Because it is a female task, it is carried out in the female domestic area of the communal house, close to the back entrance of the house. Figure 8.8 shows the location of the different artefacts associated with processing of manioc as well as the location of the hearth where the manioc bread is baked. In Yukuna communal houses there are two entrances: one female (back) and another male (front) which are also associated with the processing of manioc and coca leaves respectively. In the Yukuna case the east side of the communal house corresponds to the female area of the house and the west to the male area (Van der Hammen M.C. 1992: 235). The possibility of locating an archaeological hearth for cooking manioc bread might be possible if a complete communal house is located and excavated.

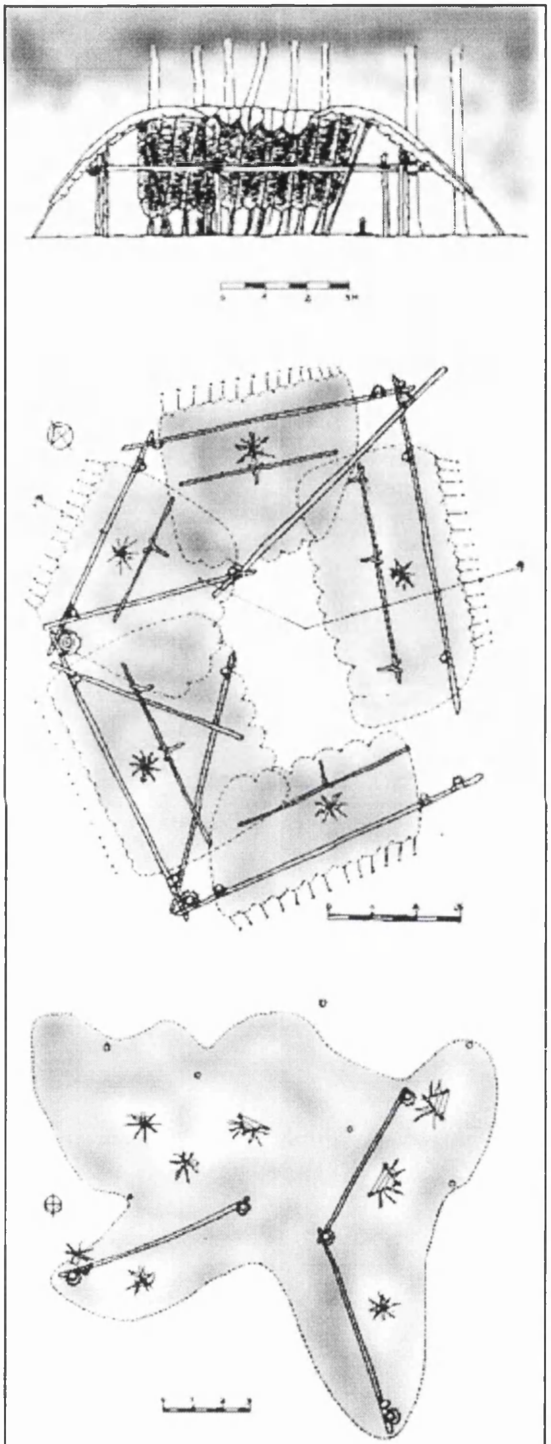


Figure 8.10 Schematic representation of Nukak campsites (rainy and dry seasons) showing location of permanent domestic hearths. Adapted from Politis (1996b: 96, 97).

In the case of the Nukak foragers permanent domestic hearths are located in the central area of each residential unit within their campsites (Figure 8.10). The residential campsites vary with the season. During the rainy season Nukak people build their campsites using leaves from the palm *Phenakospermun guyanense*, to roof a covered area. The smoke from hearths helps to repel insects. During the dry season, campsites are uncovered and so there is no permanent smoke inside campsites. Sometimes, in addition to the firewood, shells from fruits of the palm *Phenakospermum guyanense* are used as fuel for these hearths because they produce a relatively long lasting flame (Politis 1996b: 59, 95, 184). Within Nukak campsites there are basically two areas of waste accumulation (animal bones, fruit seeds and so on). The most important one is the area surrounding the hearths. The other area of waste accumulation is the peripheral inner area of the campsites where people dispose of animal bones and where waste from the surrounding hearths are swept (see figure 8.10).

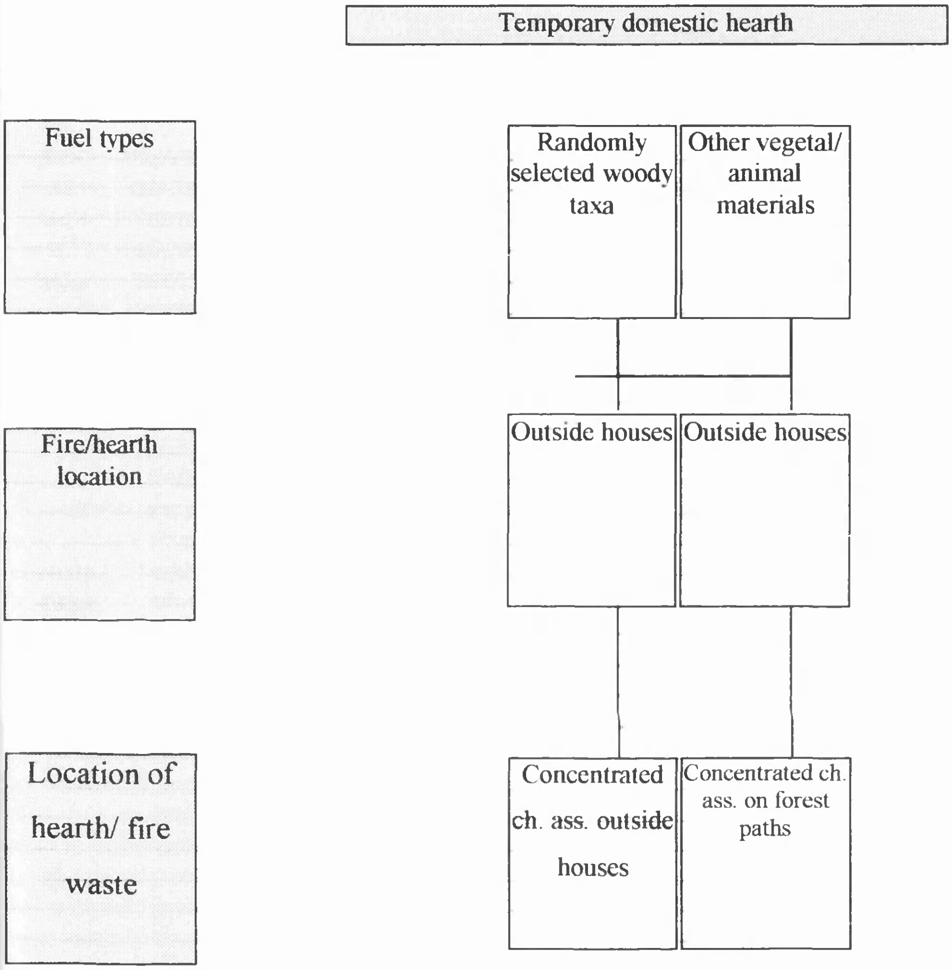
The residential mobility of Nukak people is thought to be one of the highest in the world. Traditional bands (formed by groups up to five families) change their campsites between 70 and 80 times per year. Their mobility is the result of a sophisticated and successful strategy to exploit the concentrated forest resources. It involves permanent abandonment of a campsite and the construction of a new one. Nukak people avoid reoccupation of campsites for cultural reasons (death of people at the site and fear of diseases), but also because of the economic value of abandoned campsites as future areas of high resource concentration. When the Nukak leave a campsite, thousands of seeds from the fruits eaten during of occupation of the site remain in the soil. Plants from these seeds will germinate in high densities and the reoccupation of the site would destroy its potential as an area of high resource concentration (Politis 1996b: 59, 118). This extreme mobility makes the archaeological detection of this type of campsite unlikely.

According to Morcote *et al.* (1998: 64), the fuel used by Nukak people in their campsite hearths includes leaves and trunks from palms. The species include *Astrocaryum aculeatum*, *Astrocaryum gynacanthum*, *Attalea maripa*, *Bactris gasipaes*, *Mauritia flexuosa*, *Oenocarpus bacaba*, *Oenocarpus bataua* and *Oenocarpus mapora*. Both trunks and leaves from these palms are used as fuel except in the case of *Astrocaryum gynacanthum* from which only the leaves are used.

8.7.2. Temporary domestic hearths

Temporary domestic hearths are those made in order to cook an evening meal, repel insects and other animals, and for heating when Nukak people travelling through the forest decide to stay for the night. Fuels used in these fires probably consist of dead woody and other dry vegetal material found on the floor of the forest. This type of fire would be difficult to locate because of the low visibility of occasional campsites of hunter gatherers in the tropical Amazon forest. Figure 8.11 presents a diagram showing the charcoal assemblages derived from occasional domestic hearths.

Figure 8.11 Diagram showing the charcoal assemblages from temporary domestic hearths



Nukak people build a transitory campsite when groups of 10 or fewer people are travelling through the forest with specific purpose such as a visit to another residential campsite or a trip to get a particular resource. Other types of transitory campsites are built when people from a different band are visiting a residential campsite. They build a campsite, with an area that is less than 10 m^2 in the peripheral area of the main campsite and make a hearth. Children sometimes build small campsites for play in areas near to the residential campsite and make a fire during the day (Politis 1996b: 123). The most likely wood used for this kind of hearth are small branches and other light material easily found in the surrounding area of the chosen site of the campsite. Unfortunately, sources consulted (see

Politis and Rodríguez 1994, Cabrera *et al.* 1994, Politis 1996a,b, 1998,) did not report the taxa used for that purpose.

Other temporary fires are made by Nukak people such as those for cooking or barbecueing fish or crabs *in situ* when they find them (Cabrera *et al.* 1994: 220); the visibility of such remains is very low.

Sometimes when Nukak people abandon a campsite during the summer season they burn piles of rubbish and the dry leaves of roofs which still remain in the campsite. These fires create a layer of fine ash which increases soil fertility (Politis 1996b: 115).

8.7.3. Hearths made for smoking meat and/or fish

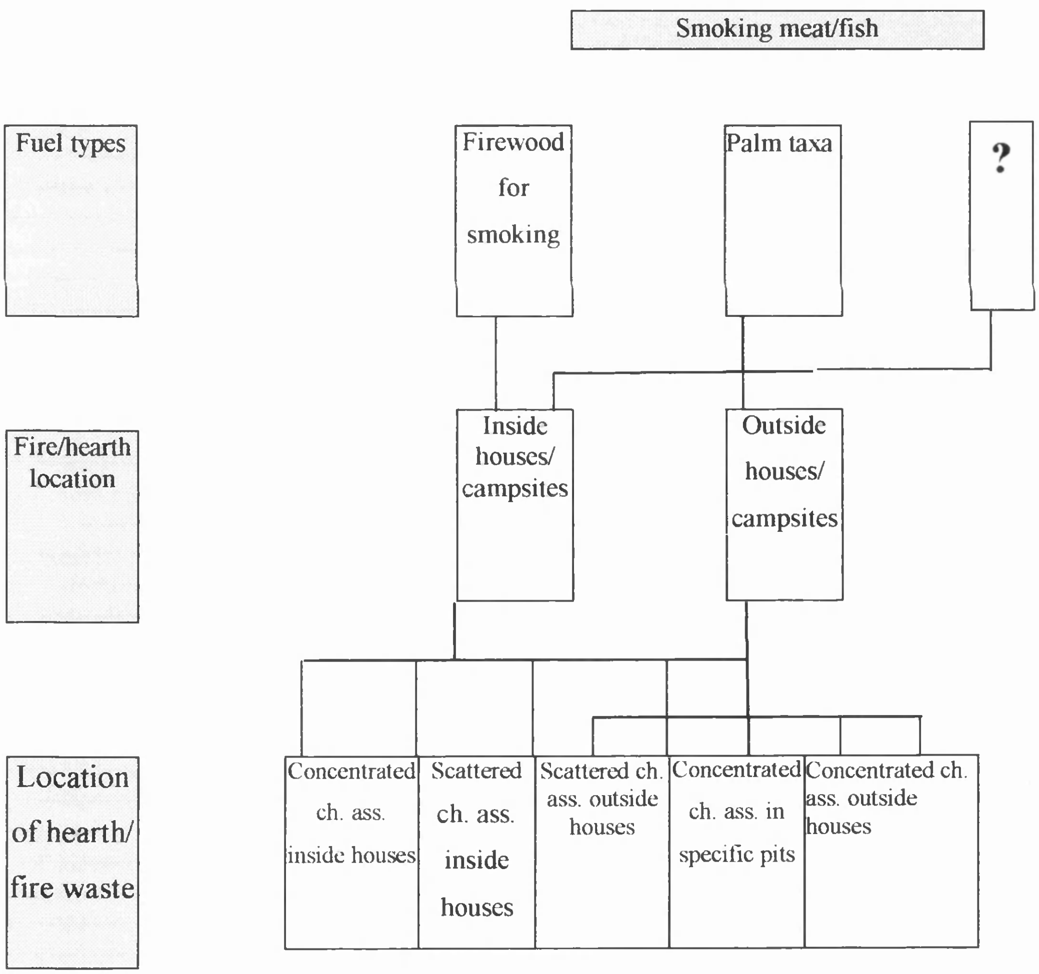
Our fieldwork showed an example of a hearth for smoking fish which was observed outside a house of a Huitoto family in the Araracuara plateau. The firewood used in this hearth was *Miconia* sp. (see Table 6.2). The hearth was made directly on the soil, very close to one of the side walls of the house. Other trees used as firewood for smoking meat and fish in the Colombian Amazon are shown in Table 7.22.

Nukak people make big fires in order to cook and smoke peccaries in the surrounding area of the campsites. These fires have to last for two and a half days while the meat is smoked. When Nukak people cook monkeys they use the central or main hearth of the campsite where they first burn off their hair, butcher and then cook the monkeys (Politis 1996: 241). Fuel for the hearths can be dried leaves from the *Oenocarpus bataua* palm, dried wood from other trees and palm trunks preferably dried (Politis 1996b: 319).

The place where the fish is smoked by most of the indigenous groups in the area is not specified in ethnographical descriptions. This could mean that this process is carried out inside the house in the same hearths used for cooking other food.

When Yukuna men hunt big game, they can bring it back in joints after burning its skin or women may burn the skins of the game over a hearth made in the path where they moored their boats. Surplus meat is smoked or barbecued to preserve it. These processes probably occur in the hearths used for cooking other foods. Figure 8.12 shows a schematic representation of the charcoal assemblages derived from hearths made for smoking meat and/or fish.

Figure 8.12 Diagram showing the charcoal assemblages from hearths made to smoke meat and fish



8.7.4. Hearths made for firing pottery

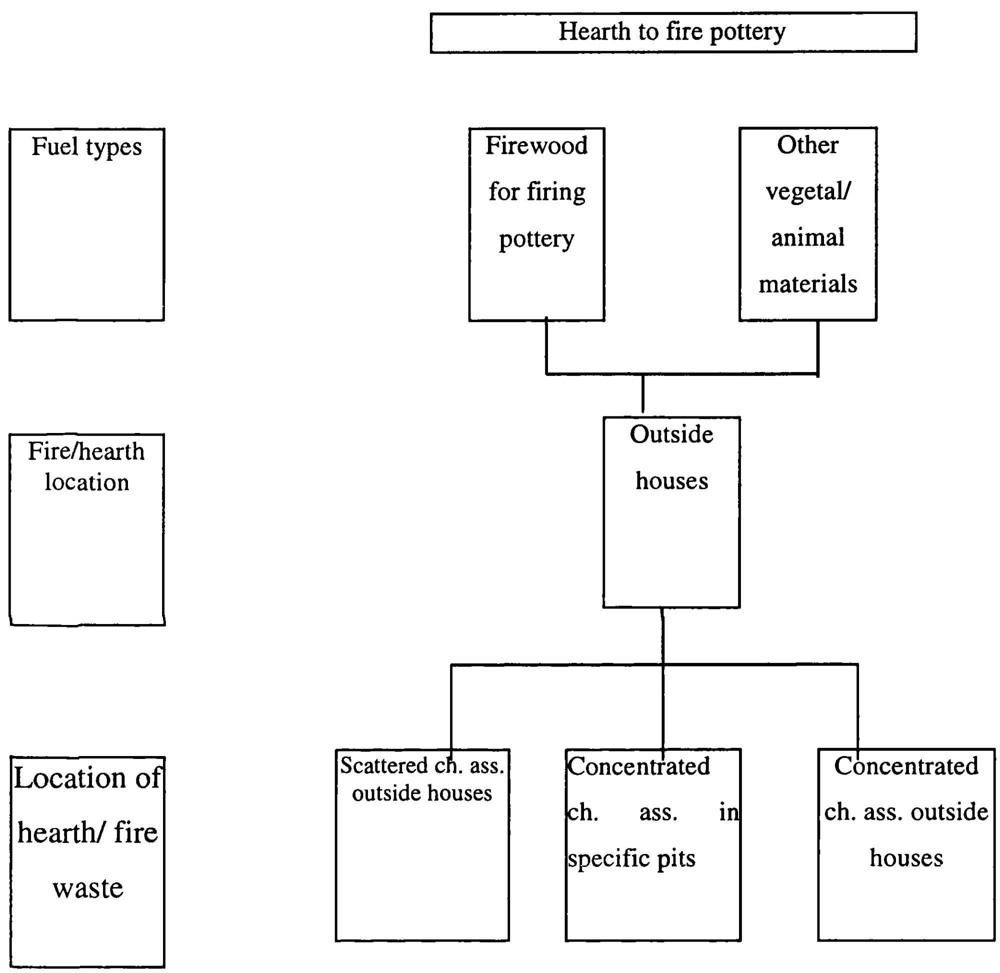
Hearths used for the purpose of firing pottery can be made in the area surrounding the houses. Specific woods, other plant materials and ant nests are used as fuel. These fires can potentially be located and identified in archaeological sites. Different woods are used during the process of firing pottery (see Table 7.28). In chapter 5 a case study by Herrera *et al.* (1989) was presented regarding a contemporary pottery manufacture in the area.

Table 7.28 includes all the plants reported to be used during the process of pottery manufacture even if they are not woody taxa or if the part used is not the wood. For example, leaves from the palm *Lepidocaryum gracile* are used to collect the latex of the *Couma macrocarpa* tree to be added to the clay in order to make it plastic. Leaves from a herb of the Heliconiaceae family are used to wrap the clay pieces after mixing with the liquid extracted from a liana that was soaked in water after two hours. Latex from the *Couma macrocarpa* tree and crushed bark probably from the *Licania* aff. *octandra* tree are also added to the clay (see chapter five for information on the complete process of pottery manufacturing reported by Herrera *et al.* 1989).

Wood from the species *Hirtella macrophylla* (Chrysobalanaceae) and *Adelobotrys macrophylla* (Melastomataceae) are reported to be used during the pottery manufacturing process (Schultes and Raffauf 1990: 131, 294). The wood of these trees is reduced to ashes to be added to the clay in order to make it more plastic and therefore easy to work. The other 15 species reported as being involved in pottery manufacture are used for their bark, leaves or latex, but for this, the trees are not felled. According to the information collected during our field trip, Nonuya people use the wood of *Tovomita* cf. *spruceana* (Clusiaceae) and *Licania octandra* (Chrysobalanaceae) to fire pottery.

Waste deposition of pottery manufacturing hearths is not mentioned in the ethnographic literature reviewed. According to these sources, in some communities there are still women who learnt the technique from their mothers (Herrera *et al.* 1989). Sherds are commonly found in archaeological sites from the Amazon region. Pits containing remains associated with pottery manufacturing such as shards, lithic polishers and charred plant macro-remains are relatively common in the region (Herrera *et al.* 1980-1981, Herrera 1981, Herrera *et al.* 1989; see chapter five where descriptions of these deposits, Pit 5, are given). The Pit 5 deposit at the archaeological site of Peña Roja is thought to be discarded pottery manufacturing waste (Herrera 1989). Hearths for firing pottery could potentially be found if potters houses and/or their surrounding areas were excavated. If a settlement of several houses was excavated perhaps it will be possible to locate hearths associated with pottery manufacture. Currently, hearths for pottery manufacture have not been reported for any of the settlements studied in the region. However deposits containing residues of pottery manufacturing activities have been studied such as Pit 5 from Peña Roja archaeological site (see Herrera *et al.* 1989: 203).

Figure 8.13. Diagram showing the charcoal assemblages from hearths made for firing pottery.



8.7.5. Hearths for making hunting/fishing equipment

An example of a hearth made specifically for manufacturing hunting equipment has been observed amongst the Nukak people. They make a fire next to their campsites to heat canes (*Bactris monticola*) from which blowpipes are made. Sometimes the ends are cut from the cane during the manufacture. However, these small pieces were reported to be cut near the central hearth of the house of the man who was making the blowpipe (Politis 1996b: 331), so these fragments could become incorporated into the permanent domestic hearth but not necessarily into the hearth made with the specific purpose of making the blowpipe. The fuel used for these occasional hearths is not specified in the literature, nor whether the waste is removed from the hearths. Figure 8.14 shows the areas used by a Nukak man within his campsite during the process of manufacturing a blowpipe.

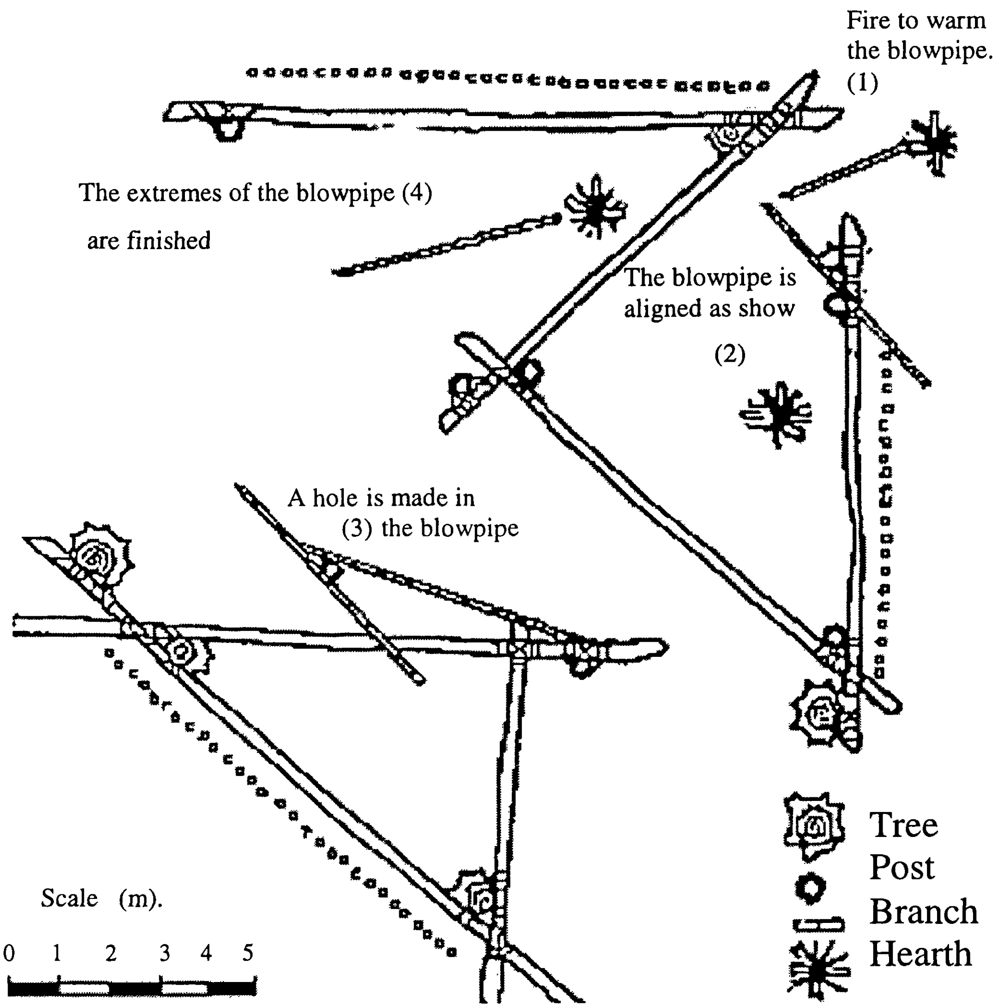
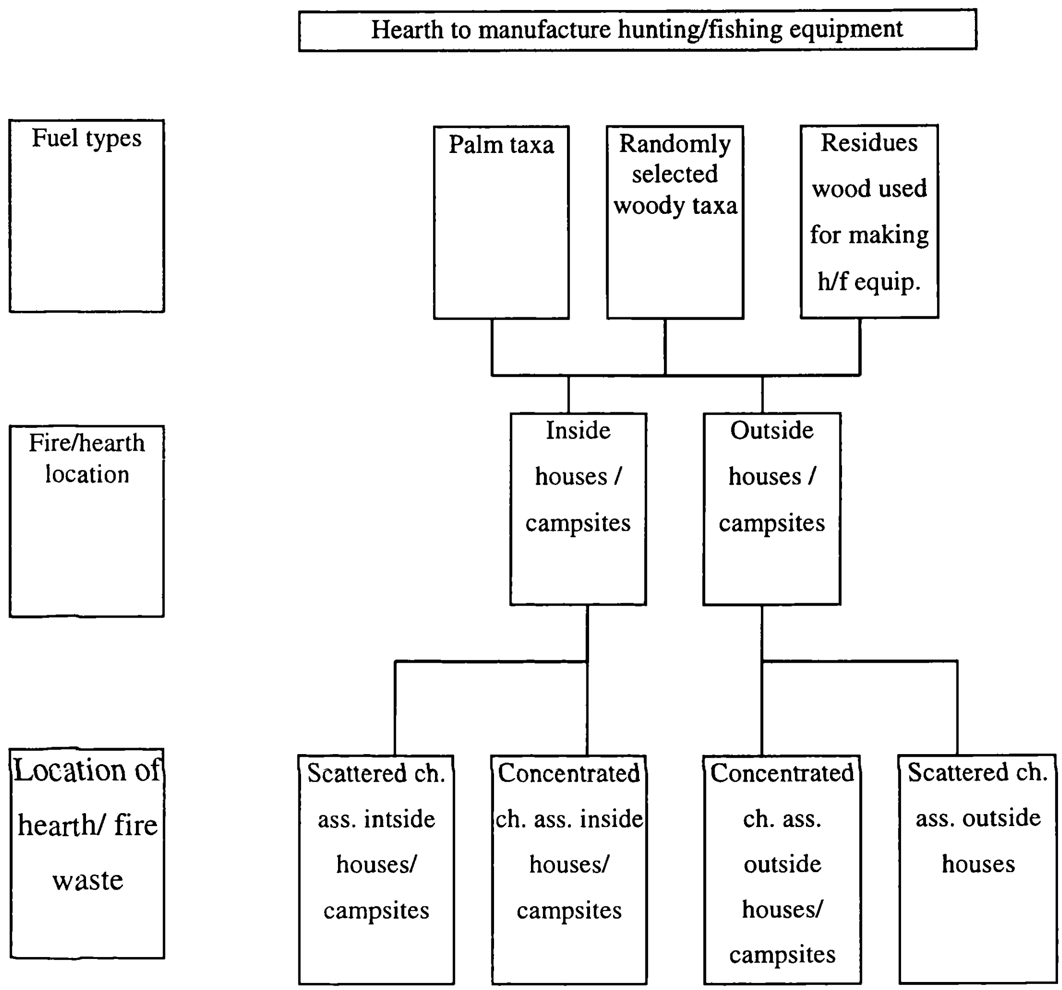


Figure 8.14 Schematic graphic of the areas in a Nukak campsite during the manufacture process of a blowpipe. After Politis 1996b: 287

Nukak wooden spears are made from longitudinal strips of bark from the *Socratea exhorriza* palm. These spears have fire-hardened conical points at both ends. The hearth used to harden the spears is the domestic unit of the person manufacturing the weapon (Politis 1996b: 298). Fuel for the domestic hearths in Nukak campsites includes leaves and trunks from palms. Pieces of wood of *Socratea exhorriza* may end up into the domestic hearths and it might be possible to identify them if a campsite is excavated.

From 38 different plants used to manufacture weapons, 14 are from the Annonaceae family and 10 from the Arecaceae family. The remaining 14 taxa come from nine different families. The 11 families to which these 38 species belong can be found in the forest covering the Tertiary sedimentary plain landscape unit, with the exception of *Poecilante amazonica* (Leguminosae) and *Myrcia revolutifolia* (Myrtaceae). From these 38 species eight taxa (belonging to four different families) are used exclusively for making weapons. Trunks from the species *Duguetia quitarensis* and *Ephedranthus amazonicus* (Annonaceae family) are used to make blowpipes and bows respectively (Sánchez Sáenz 1997: 50,51). Young trunks from the species *Xylopia cuspidata* and *Xylopia micrantha* (Annonaceae family) are used as fishing rods (Sánchez Sáenz 1997: 59,60). Trunks from the *Wettinia drudei* palm are used to manufacture blowpipes (Sánchez Sáenz 1997: 91). Trunks from the species *Diospyros glomerata*, *Diospyros tetranda* (Ebenaceae family), and *Myrcia revolutifolia* (Myrtaceae family) are used to manufacture bows. Figure 8.15 includes a diagram showing the type of charcoal assemblages derived from hearths made to manufacture hunting/fishing equipment in the Colombian Amazon.

Figure 8.15. Diagram showing the charcoal assemblages from hearths made to manufacture hunting/fishing equipment.



8.7.6. Fires associated with manufacture of domestic artefacts

Amongst the Andoque people, a drum ("maguare"), used to communicate with other communities, is manufactured from a trunk of the *Parinari montana* tree (Chrysobalanaceae). In order to hollow the trunk, Andoque people burn it (La Rotta 1983: 39).

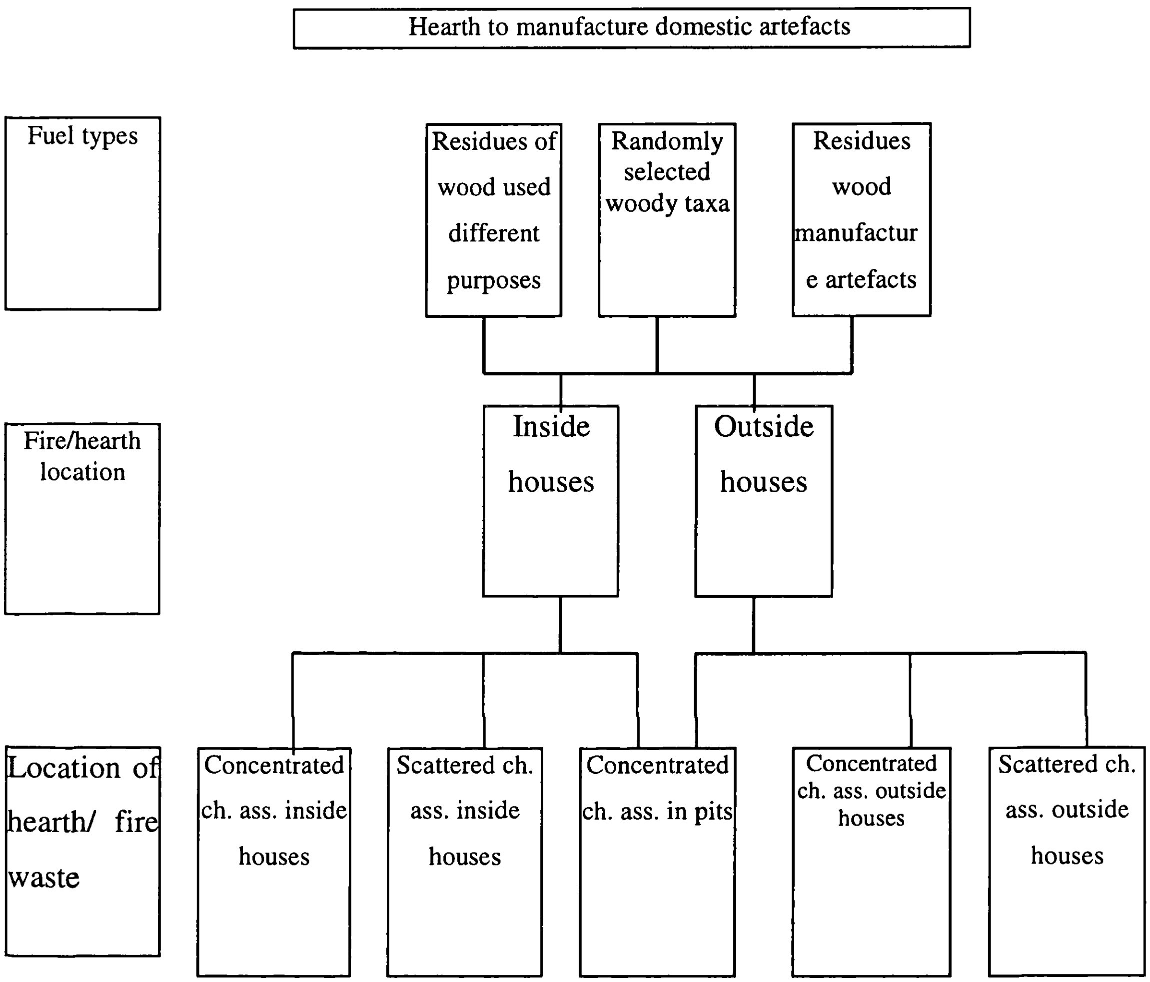
Wooden mortars are manufactured by Nukak women from trunks (approximately 25-30 cm in diameter and 50-70 cm long) of the tree *Couma macrocarpa*

(Apocynaceae). The central part of the trunk is burnt and the burnt interior is scraped with the aid of a machete. The fire in the interior of the trunk is kept alive by blowing it with a small cane obtained from the petiole of the *Astrocaryum aculeatum* palm. These mortars are used to macerate fruits from the *Oenocarpus bataua* palm or from the banana-like tree *Phenakospermum guyanense* (Strelitziaceae). There is no reported information on the particular site where these artefacts are manufactured (Politis 1996b: 308), but presumably these types of domestic items are made in the proximity of the campsites. It is probable that charred pieces of wood used to manufacture mortars may become incorporated into the soil matrix of a dwelling place and its surrounding area. The possibility of finding this type of remains depends on the size of the area excavated within a prehistoric settlement. It is also possible that fragments of the wood, both charred and non-charred, which are used for making these and other domestic utensils, may become incorporated into the fuels used in permanent or occasional domestic hearths. Figure 8.16 shows indigenous women within a communal house working with wooden mortars.

Figure 8.16 Women grinding with wooden mortars.

It can be observed that from the 50 different wood taxa used for making domestic artefacts only three species are used exclusively for this purpose. The root from the palm *Geonoma stricta* var. *piscicauda* is used to make hand mills (Sánchez Sáenz 1997: 86). This thesis does not consider the study of root wood, however it is possible that charred fragments of root wood could be preserved be found on archaeological sites from the region. According to Murillo and Franco (1995: 93), domestic utensils are manufactured from wood of *Mabea nitida* tree (Euphorbiaceae), though the specific function of these artefacts is not mentioned by the authors. In addition to this use, Miraña people use fruits from this tree as bait for fishing and Huitoto people apply the sap from the trunk to the skin to kill insect larvae (Sánchez Sáenz 1997: 175). Wood from tree *Pseudolmedia laevigata* (Moraceae) is used to manufacture mortars to mill coca leaves and its fruits are eaten by Miraña, Muinane and Matapí people (Sánchez Sáenz 1997: 292). Broken or non-useful domestic artefacts such as axe handles, hand mills, graters, hands of mortars may be discarded into permanent domestic hearths. This wood from domestic utensils may be found in permanent domestic hearths as well as in those made specifically for their manufacture. Figure 8.17 shows a diagram indicating the type of charcoal assemblages derived from fires involved in the manufacture of domestic artefacts.

Figure 8.17 Diagram showing the charcoal assemblages from hearths made to manufacture domestic artefacts.



8.7.7. Hearths associated with rituals

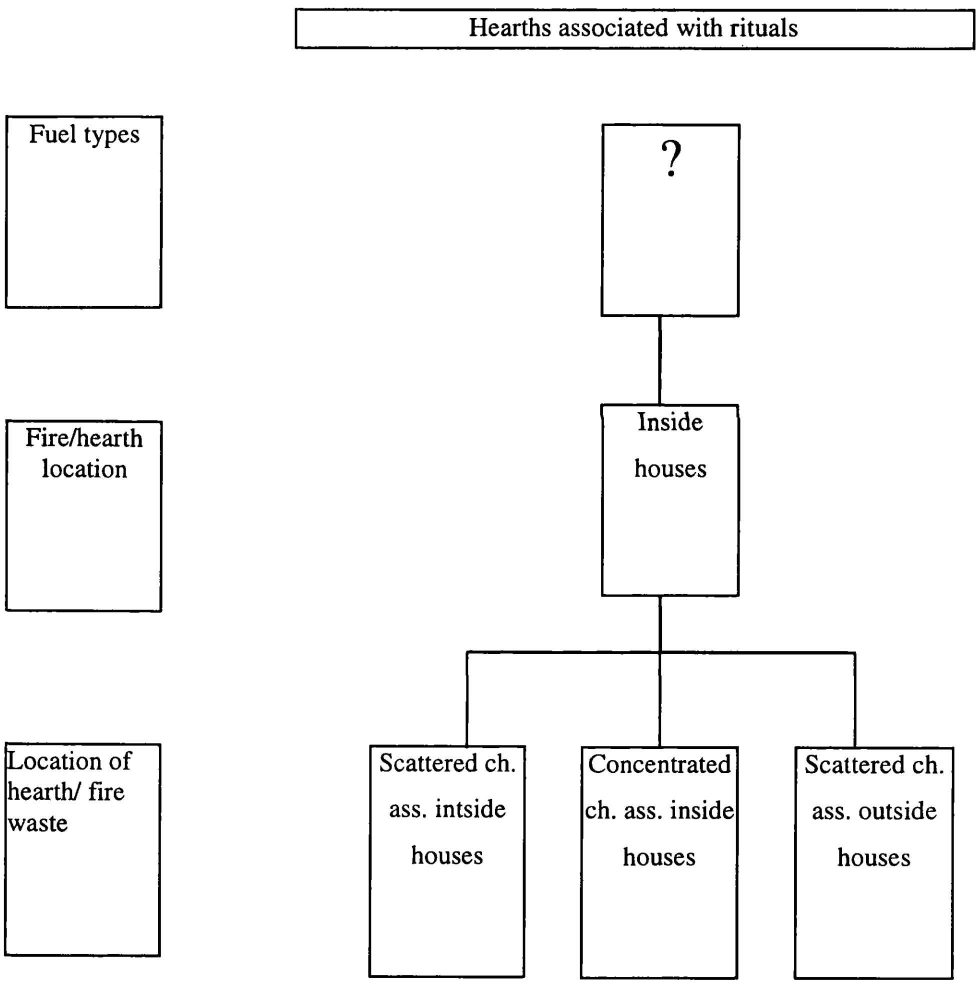
Hearths associated with rituals include those in ceremonial houses or "malocas" made for toasting coca leaves. Ethnographic sources consulted do not mention if people use specific woods as fuel or other types of plant material for those hearths. Such fires are not going to be easy to recognise archaeologically. It would involve the complete excavation of communal house in order to draw inferences about artefacts and plant remains.

Figure 8.8 shows, schematically, the west side of a Yukuna communal house, the distribution of the utensils associated with the processing of coca leaves and the location of the hearth in which the leaves are toasted. Orientation of entrances, postholes, hearths and other features should be useful for the interpretation. Figure 8.18 shows a hearth where coca leaves are toasted by an indigenous man from a different community. This hearth differs from the ones used by the Yukuna people. It is raised above the ground and the coca leaves are toasted in a tin tray.

Figure 8.18. Coca leaves toasted in a tin tray.

There are other occasions where people use fire during the processing of coca powder but these occasional fires seem less likely to produce remains which could be located and identified on an archaeological site. Many of the indigenous groups from the Colombian Amazon region use leaves of *Cecropia* sp. (Cecropiaceae), reduced into ashes as an alkaline additive to coca powder. Leaves are put on the floor in the central area of the communal house and a man sets fire to them in order to reduce them to ashes. The ashes are then sifted and mixed with the coca powder (Schultes and Raffauf 1990: 169). This is a fire that does not use firewood and would be very difficult to detect on an archaeological site. However a detailed study of the micro-stratigraphy of an archaeological dwelling area or a house, potentially could associate thin ash layers with occasional fires of this type. In addition, phytolith studies could add information on plant material such as *Cecropia* sp. leaves which are not preserved in the macrobotanical record of the area.

Figure 8.19 Diagram showing the charcoal assemblage from hearths associated with rituals.



8.7.8. Fires associated with canoe manufacture

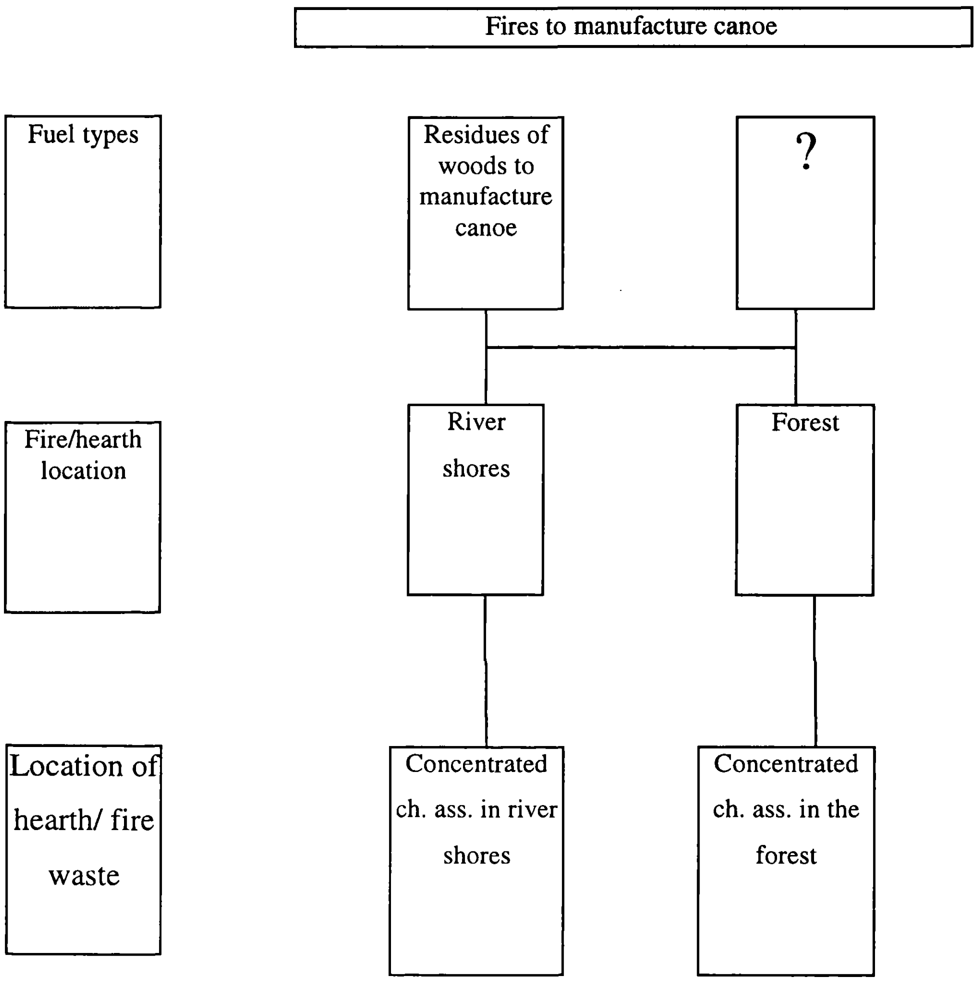
Once the trunk has been hollowed-out the dugout canoe has a fire made inside it in order to open it up, or widen the cavity. A brief description of this complicated process is given by Schultes (1998: 290). Unfortunately there is no mention of the place where the process is carried out but presumably it could occur either close to the river or in the forest where trees used for this purpose are found. There is no information either on the particular woods used to make the fire to widen the canoe. Presumably, the wood from which the canoe has been made is most likely to be used in this fire. However, any available piece of wood could be used.

Figure 8.20. Canoe in process of manufacture. Peña Roja

Table 7.29 lists the 22 species of wood reported by ethnographers and ethnobotanists as used to manufacture canoes. The species mentioned belong to 11 different families. In addition, there are several trees from which people collect latex or resin which are used to repair canoes. For example, *Couma macrocarpa* and *Protium aracouchini* were included in Table 7.29 because their latex and resin respectively are used to repair canoes but their fruits, bark and wood are also used for other purposes such as food, medicine, pottery manufacture, firewood and so on. Taxa used to actually manufacture canoes are: *Calophyllum longifolium* (Clusiaceae), *Mezilaurus itauba*, *Nectandra cuspidata*, *Ocotea aciphylla*, *Ocotea argyrophylla* and *Ocotea javitensis* (Lauraceae), *Hymenolobium pulcherrimum* and *Vatairea guianensis* (Leguminosae), *Clarisia racemosa* (Moraceae) and *Meliorma herbertii* (Sabiaceae). Stilt roots from the species *Micrandra lopezii* and *Micrandra spruceana* (Euphorbiaceae), *Ocotea aciphylla* (Lauraceae), *Monopterys uaucu* and *Swartzia schomburgkii* (Leguminosae), *Genipa americana* and *Warzewiczia coccinea* (Rubiaceae) are used to make oars.

The probability of finding pieces of wood from trees used to make canoes or oars is low taking into account that canoes are probably made either in the forest or on the river bank. However one could suppose that small pieces of wood left after hollowing trunks or when making paddles could be brought later to the house and be used as fuels in domestic hearths. Figure 8.21 shows a diagram indicating the charcoal assemblages potentially derived from fires associated with canoe manufacture.

Figure 8.21 Diagram showing the charcoal assemblages from hearths associated with canoe manufacture process.



8.7.9 Hearths made for burning the fur of peccaries

Hearths for burning the fur (prior to skinning) of white-lipped peccary (*Tayassu pecari*) are made in the vicinity of salt lakes where the animals are hunted. The fuel used consists of dried leaves from the *Oenocarpus bataua* palm, which produce a quick fire with high flames. Dried wood from other trees is also used with palm trunks, preferably dried (Politis 1996b: 183, 319). The chances of locating them is low, as it would require the survey of a wide area surrounding swamps. Figure 8.22 illustrates the steps between the hunting of a white-lipped peccary and the smoking of its meat, according to the information collected about Nukak people by Politis (1996b). The residues of such fires are not removed. Figure 8.23 presents a diagram of the charcoal assemblages derived from such hearths .

Figure 8.22 Schematic diagram of the areas used by Nukak men during the process of hunting, butchering, burning fur, dismembering and smoking of pecaries. After Politis (1996b: 261).

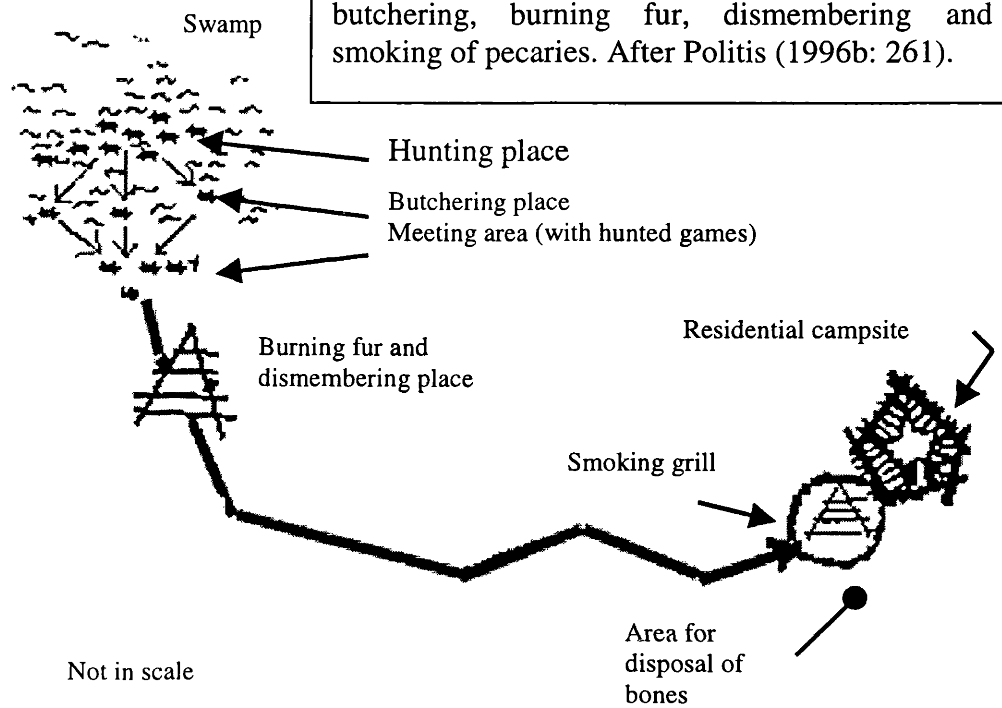
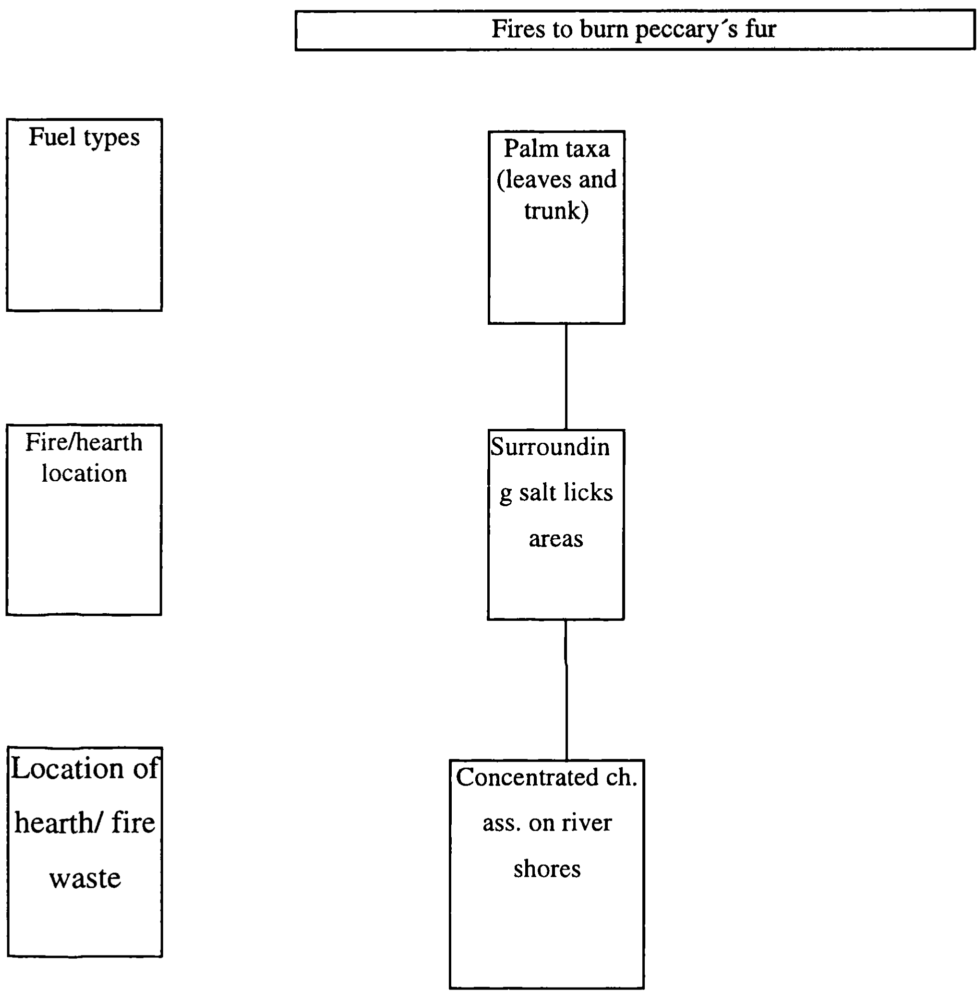


Figure 8.23 Diagram showing the charcoal assemblages from hearths made for burning peccary's fur.

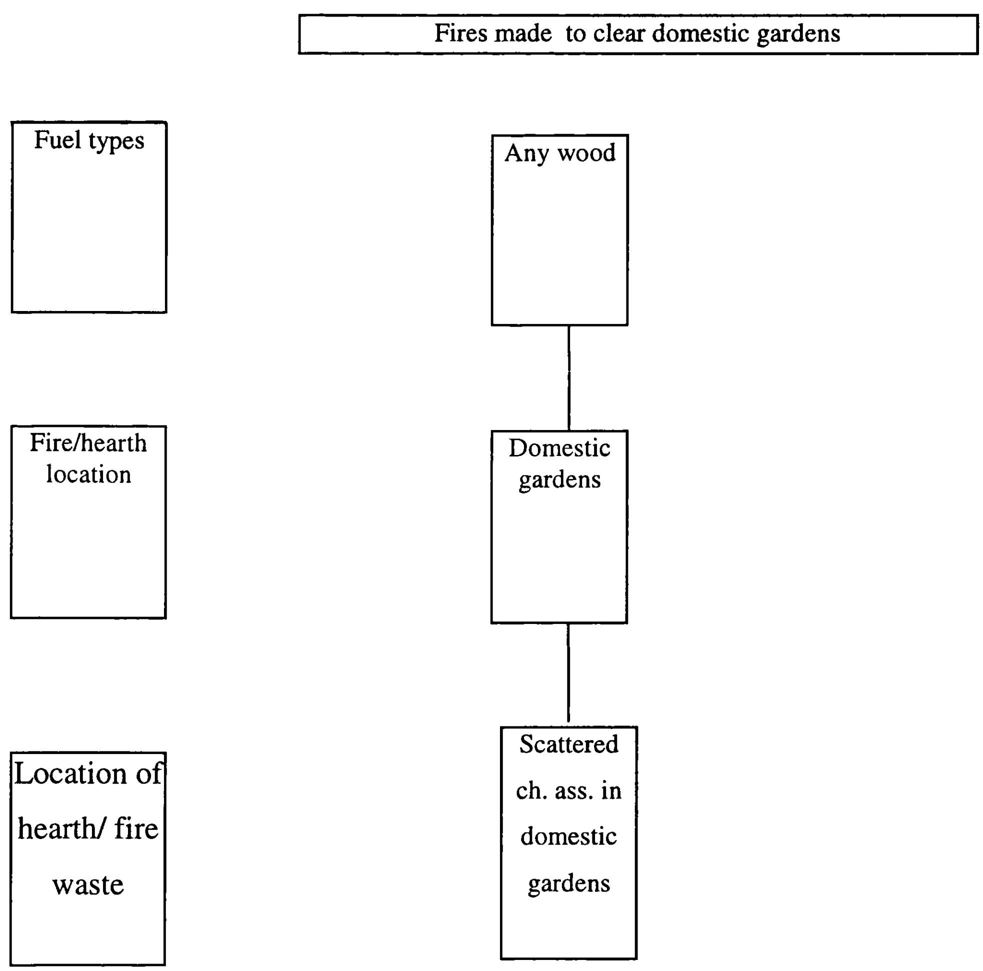


8.7.10. Fires made to clear forest for domestic gardens

Fires are often made in the vicinity of houses in order to clear vegetation for cultivation. The areas of domestic gardens are difficult to delimit, but where it can be achieved it will be possible to locate scattered archaeological charcoal assemblages. Mora *et al.* (1991: 43) suggested that the presence of cultivated fruit trees and chilli peppers in the pollen records of Araracuara plateau archaeological sites could be due to the presence of house gardens in the area.

Taxa burnt in a house garden area when it is first cleared will include all those trees in the destroyed forest. If fires are made later either for burning weed or for other purposes, a charcoal assemblage from a house garden area could include woods of fruit trees and other cultivars. This assemblage could also include wood taxa involved in other activities if ashes and charcoals from hearths are distributed on domestic gardens as in the modern ethnographical cases form Greece reported by Shay and Shay (1978: 49). Unfortunately there is no available information on this possibility in the literature studied for the Colombian Amazon. Figure 8.24 shows a diagram of the charcoal assemblages potentially formed in a domestic garden.

Figure 8.24 Diagram showing the charcoal assemblages from fires made for clearing of forest for domestic gardens.



8.7.11 Fires made to clear forest for agricultural fields

Fire has been traditionally used in tropical regions for clearance of ground for cultivation (see for example Maloney 1994 for the Southeast Asia and Haberle 1994 for New Guinea, and for the South American tropical area see for example Mora *et al.* 1991, Piperno 1994, Piperno and Pearsall 1998,). Although natural fires are less common in evergreen tropical areas than in dry zones, distinction between human and natural fires is difficult to establish. Natural fires can occur through several events including lighting strike, volcanic activity, severe droughts and so on (Maloney 1994: 160-161, Haberle 1994: 191). In the tropical areas of Central and South America, counts of microscopic charcoal in pollen cores have been used as evidence of fires in forested areas and commonly this has been correlated with human activities. Sanford *et al.* (1985) showed evidence of mid-Holocene fires in the upper Rio Negro river in the Venezuelan Amazon. They suggest that the fires may be associated with climatic change and/or human disturbance.

It is very difficult to differentiate between natural and horticultural fires in the archaeological record in the Amazon region. It is also difficult to estimate the time that has elapsed between fallow periods in a given agricultural field. Soils in these areas are known as "terra petras", which are black or brown in colour and are usually called anthrosols or anthropic soils by archaeologists. Usually the depth of terra petra deposits as well as the high concentration of cultural remains such as shards and lithic artefacts have been taken to suggest long periods of occupation of these sites.

There are many studies on several aspects related to agricultural fields or "chagras" of present day indigenous inhabitants of the Colombian Amazon region (see for example Schroeder *et al.* 1987, Walschburger 1987, Walschburger and Von Hildebrand 1988, Van der Hammen M.C. 1992, Rodríguez and Van der

Hammen M.C. 1993, Dufour 1993, Andrade 1993). The aspects that will be mentioned here are those related to fire practices within these fields and the possibility of detecting these fires on archaeological sites.

Figure 8.25 Trees being felled.

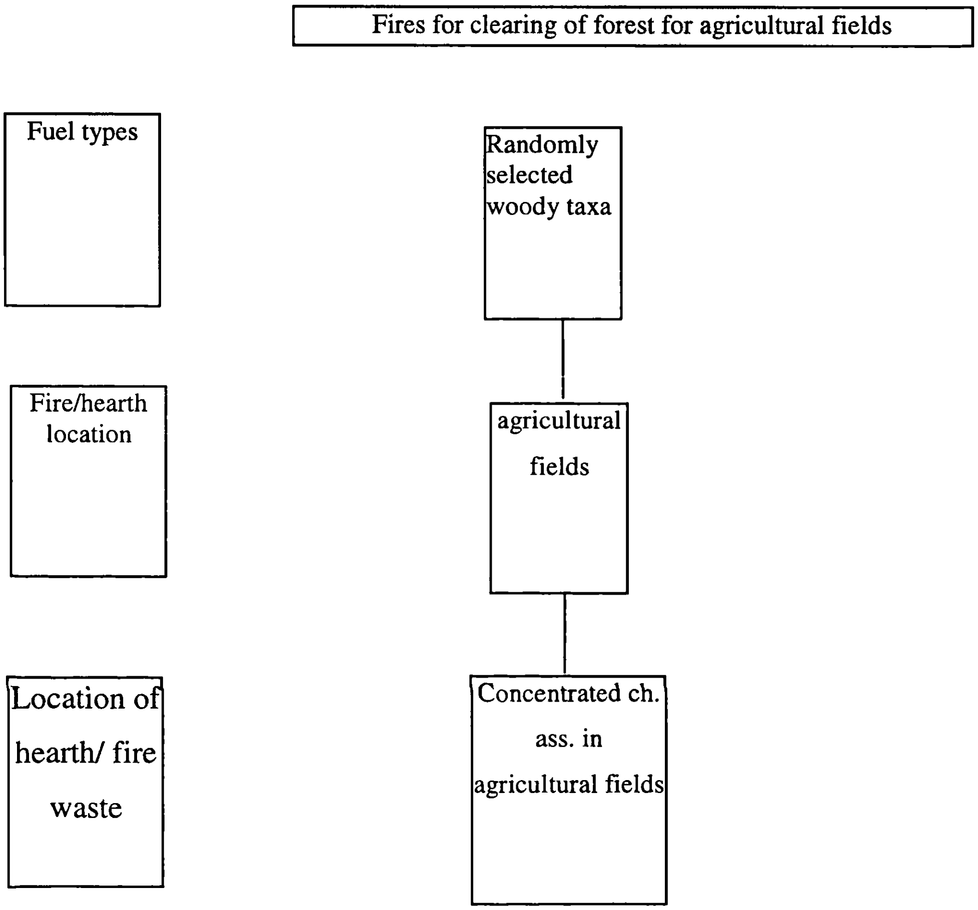
Figure 8.26 Partially burnt trees

Areas for agricultural fields are chosen according to both cultural and physical aspects and their sizes depend on how big the indigenous group is and the availability of land. For the Yukuna people from the Mirití and Pedrera areas (see Figure 2.12 of this thesis for geographical location of the group in the Colombian Amazon and Walschburger 1987: 26 for the Yukuna data), agricultural fields are approximately 1 ha in area and are located 2 km away from the house of their owners. Once the site has been chosen, the scrub and small trees are felled (Figure 8.25). Big trees are felled by all of the men from the community and a special feast is made for the occasion. This communal work is called "minga". The felled vegetation and trees are left for three months until it has dried and then it is burnt (Figure 8.26). This will be the first fire made in a new agricultural field.

Because agricultural fields are made in the terra firme forest they are likely to have a high variety of woody taxa. Archaeological research carried out in the Araracuara region has located agricultural areas associated with prehistoric settlements. Mora *et al.* (1991) located and delimited areas with “terra petra” soils which were used during the different periods of occupation of several sites (see Chapter five).

From the available archaeological data recovered in the Colombian Amazon region it is clear that in order to locate ancient agricultural fields, dwelling places also have to be investigated. In theory, it should be possible to distinguish fallow fields from newly-cleared forest areas by means of the identification of the charcoal assemblages in such areas, because some taxa are very characteristic of fallow areas (e.g. Euphorbiaceae , *Alchornea,* Melastomataceae, Arecaceae, Mimosaceae, *Vismia*, Moraceae, Verberanaceae, Piperaceae and Lecythidaceae. See Mora *et al.* 1991: 63-65 and Toro and Saldarriaga 1990). Recovery of the forest occurs at different rates depending on several factors but according to present day studies, it could take between 50 and 200 years. However it is a challenge in an area such as the Amazon forest where survey is difficult within the evergreen areas. Most of the time survey has to be confined to the lower terraces of main rivers and streams. Figure 8.27 illustrates the charcoal assemblages derived from fires made to clear forest for agricultural fields.

Figure 8.27 Diagram showing the charcoal assemblage from fires made for the clearing of forest for agricultural fields.



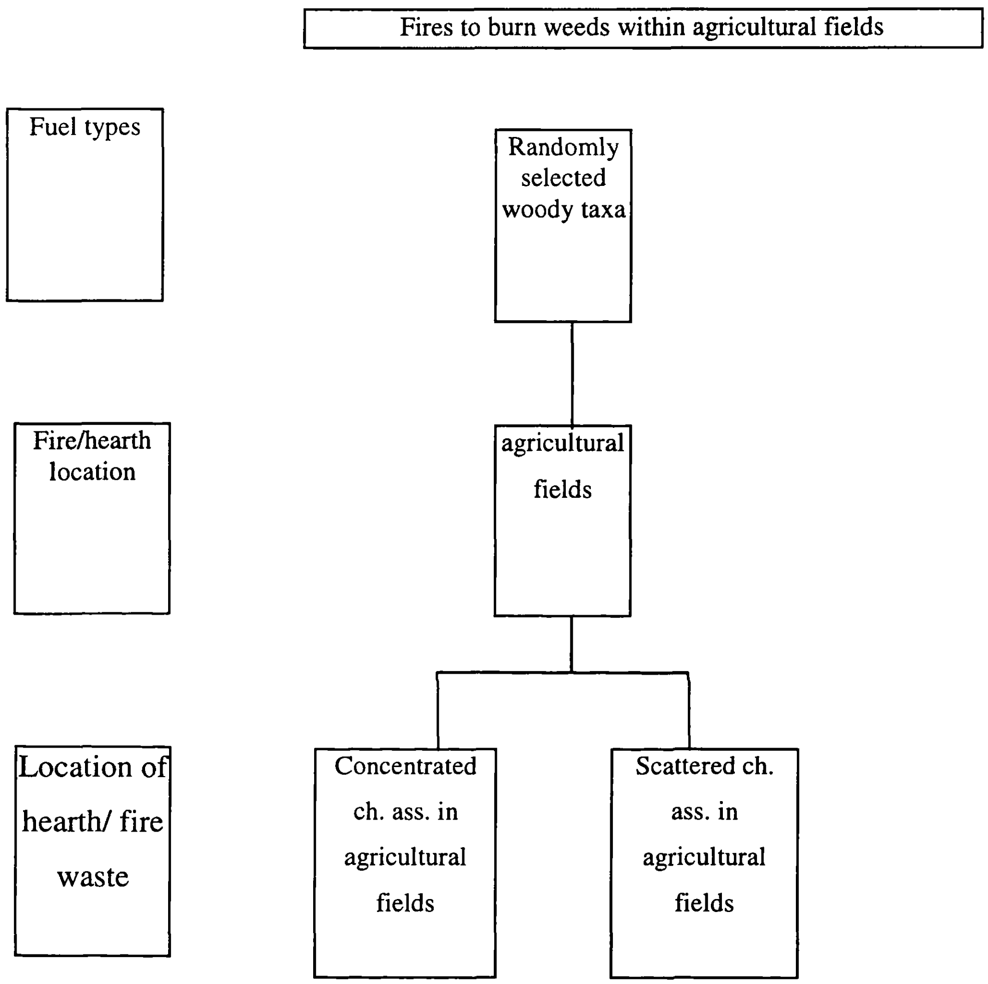
8.7.12. Fires made to burn weeds within agricultural fields

Within agricultural fields, a stage of burning piles of small trunks, tree branches and detritus which were not totally burnt with the first fire form the preferred places to sow the crops which have high nutrient requirements such as tobacco (*Nicotiana tabacum*), yota (*Colocasia esculenta*), ñame (*Dioscorea trifida*).

According to an experimental study made by Schroder *et al.* (1987) about traditional agriculture practised by Huitoto people in the area of Araracuara, a third group of fires is made within an agricultural field once all the crops have been sown but weeds have to be removed and burnt. These fires were made within 12 to 15 months of the first burning of the vegetation in the field. The number of such fires depends on how often the field is cleared of weeds. During the dry season it may be done every day. Weeds include *Cecropia* spp. (Cecropiaceae), *Miconia minutiflorum* (Melastomataceae), *Solanum sessiliflorum* (Solanaceae), *Aegiphila glandulifera* (Verbenaceae), *Scleria* sp. (Cyperaceae), *Aparistchmium cordatum* (Euphorbiaceae), *Vismia* sp. (Clusiaceae), *Phytolacca rhivinoides* (Phytolaccaceae), *Doliocarpus* sp. (Dilleniaceae), and plants from the Gramineae family.

Other fires may be made in the fields when the women harvest manioc tubers. They accumulate waste piles of harvested plants and weeds and then these piles of plant material are burnt. Cuttings of the harvested manioc plants are re-planted three times, after the field is left. These are not truly fallow because they are continuously visited in order to harvest other plants still in production, such as coca plants and also to collect firewood for cooking. Unfortunately the consulted study (Van der Hammen M.C. 1992: 172), does not explain if the firewood collected consists of dead wood or if people felled trees. Figure 8.28 illustrates the charcoal assemblages derived from fires made to burn weeds within agricultural fields.

Figure 8.28 Diagram showing the charcoal assemblage from fires made to burn weeds within agricultural fields.



8.8. Application of the model. The case of Peña Roja site

Taking into account the limitations of the archaeological contexts and the limitations of the charcoal assemblages in terms of the number of pieces of wood identified and the number of archaeological contexts, the most pragmatic interpretation of the charcoal assemblages is firewood or lighting. However, it must bear in mind that this interpretation is not necessarily correct. It is possible that with more archaeological information and a larger sample of charcoals analysed, the model will be very helpful in the interpretation of past human activities involving firewood patterns and the use of wood for other purposes. On the other hand, it has to be taken into account that the archaeological deposit from Peña Roja was probably affected by mixing. We do not know to what extent the taphonomy of the site affected the vertical distribution of the charred wood fragments in the deposit. Therefore the comments on different uses of woods during pre-ceramic and ceramic periods at Peña Roja have to be taken with caution.

The above circumstances limit the application of the model but in order to explain how it operates, other activities involving the use of firewood and woods are described and helps in formulating hypotheses on the past uses of the identified woods.

8.8.1. Archaeological data

8.8.1.1. Charcoal assemblages distribution at Peña Roja

Charcoal from the archaeological site of Peña Roja was recovered from trenches 9 and 10 and Pit 5. Three charcoal assemblages were taken as a test sample for identification. The first group, or sub-sample 1, comes from the ceramic occupation levels of the site reported in trenches 9 and 10. The second sub-sample comes from the pre-ceramic occupation levels of the site excavated also in trenches 9 and 10. The third assemblage comes from Pit 5. Sub-sample 1 is associated with the latest prehistoric occupation period of the site; i.e. between 1900 and 400 years BP. Sub-sample 2 is associated with the earliest period dated to about 9000 years BP. A radiocarbon date from organic material collected from Pit 5 resulted in a date of 585 ± 30 years BP (GrN 14993).

8.8.1.2. Archaeological contexts of the charcoal assemblages

The archaeological context of sub-sample 1 consists of the remains of pottery vessels, lithic artefacts and plant macro-remains found in the ceramic levels during the excavation of trenches 9 and 10.

The context of the charcoal assemblage sub-sample 2, includes lithic artefacts and charred seeds found in the levels corresponding to the earliest occupation of the site. It is believed that the place was occupied at that time by hunter gatherer groups. The excavation was an area of human activity but not in a house or campsite floor according to the excavators (Inés Cavelier pers. comm. 1999).

The lithics from the pre-ceramic levels of Peña Roja were probably used to process meat and fish (unretouched flakes and perforators) and to work wood (concave scrapers, notches and wedges). Consumption and processing of nuts is suggested by the presence of a fractured milling stone, flat mortars and grinding stones (Gnecco and Mora 1997: 688). Adzes might have been used to dig up tubers (Cavelier *et al.* 1995).

Taking into account the type of cultural materials found in the deposit, and the current information from the excavators, the area of the site excavated probably corresponds to a midden formed by the deposition of general household waste which included sherds, lithics and charred plant macro-remains as well as charcoal from hearth fires.

Sub-sample 3 contained stones for making lithic tools used in the manufacture of pottery and the sherds of 20 different pottery vessels. Pit 5 also contained abundant charred wood fragments and some charred seeds.

At present it is unknown if the excavated area was used by inhabitants of the site as a place to discard wastes from domestic hearths. If it was an area to discharge wastes it is possible that charred fragments of lighting woods were deposited together with other materials. Excavations covering a wide area in the terrace are needed in order to have an overall picture of archaeological remains and contexts.

8.8.2 Ecological and Palaeoecological data

Following Herrera *et al.* (1989: 208), the catchment area for the necessary resources to make pottery at the site of Peña Roja during prehistoric times covered an area of 40 km along the Caquetá river. A map of the Middle Caquetá river (Fig. 8.29) indicates the different landscape units at present in the area. According to the available palaeobotanical data, it is probable that much the same landscape and vegetation cover existed in the area during the prehispanic occupation of the site (see chapter two and five for details on the palaeoenvironment of the middle Caquetá river). The further landscape unit from Peña Roja site is located 35 km away from the site and corresponds to a flood plain of black-water rivers. The closest hardrock formations are located 28 km away from Peña Roja. The rest of the landscape units are low and high terraces of the Caquetá river, the alluvial plain of the Caquetá river, the flood plain of the Amazonian clear-water rivers, terraces from the Amazonian rivers and Tertiary sedimentary plain and are all located between 1 and 4 km away from Peña Roja site (see map in Figure 8.29).

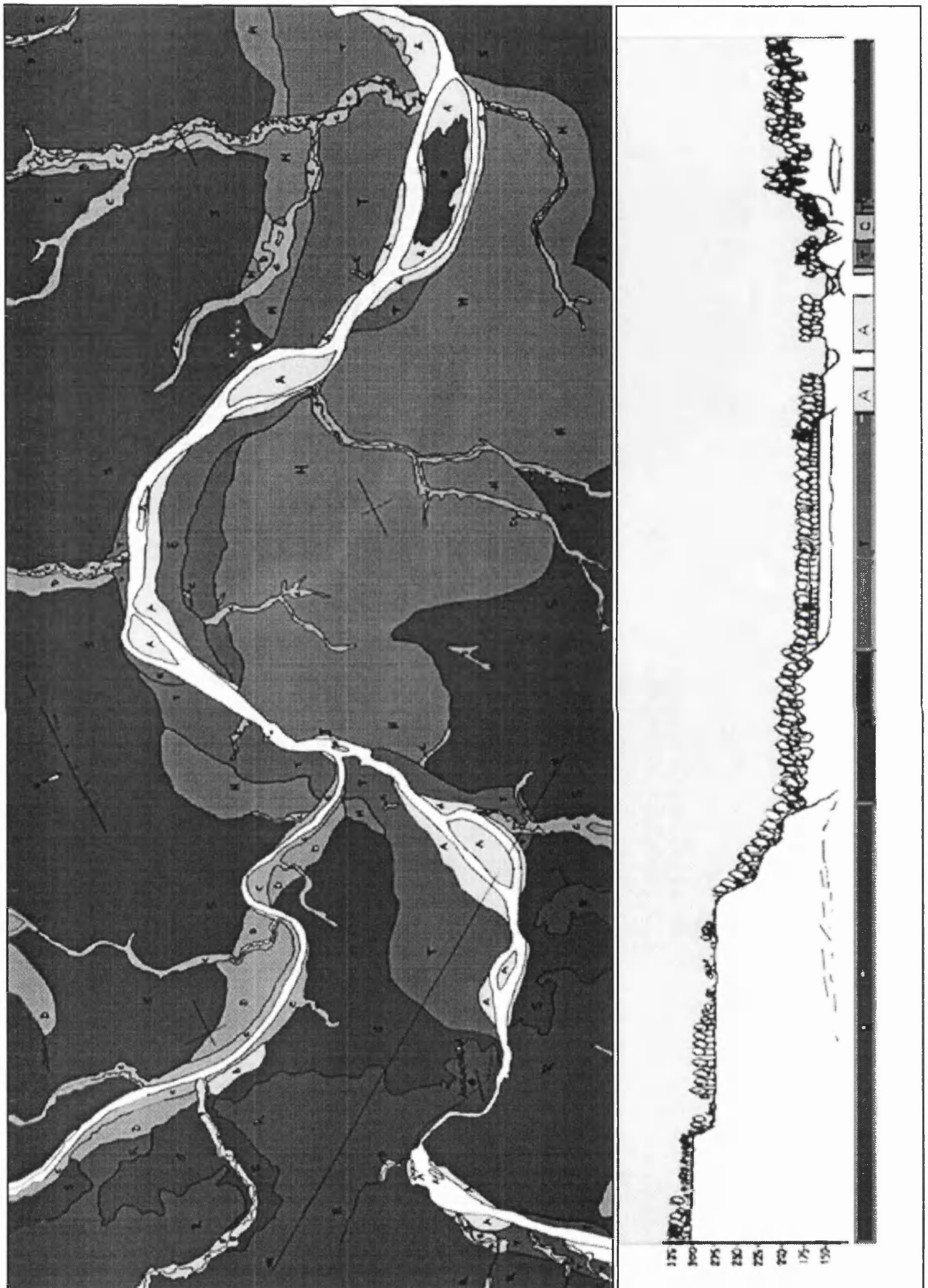


Figure 8.29 Map of the middle Caquetá river showing different landscape units. (adapted from Duivenvoorden and Lips 1993b: Landscape Ecological Map of the middle Caquetá Basin, Sheet Araracuara-Mariñame).
Key: Alluvial plains (A); Flood plain of black-water rivers (B); Flood plain of clear-water rivers (C); Terraces of Amazonian rivers (D); Rarely inundated flood plain of the Caquetá river (E); High terraces of the Caquetá river (H); Hard rock forms (R); Tertiary sedimentary plain (S); and Low terraces of the Caquetá river.

Tables 7.36 to 7.51 show the location of particular woody species from each of the identified families in the archaeological charcoal assemblages. As can be seen, most of the families can be found in the landscape units closest to the archaeological site.

8.8.3 Analysis and interpretation of the information

Tables 7.3 and 7.4 show the identified taxa in each sub-sample taken from the charcoal fragments recovered at different contexts at Peña Roja site. Here the ethnographic and ethnobotanical information on wood use at present in the Colombian Amazon region will be used as a framework to formulate hypotheses that help to interpret the archaeological charcoal assemblages. However, proposed uses of wood during the past have to be taken with caution and not as direct analogies between present day indigenous utilisation of the forest and forest use many thousand of years ago. Several factors have to be taken into account when comparing present day information with the archaeological past. For example, indigenous societies may have adapted many of their traditional ways of life in order to use modern technology and tools. These technological changes could also have affected the type of trees used for construction and other purposes.

On the other hand, the small size of the test sample of charcoals from Peña Roja may affect the taxonomic composition of the charcoal assemblages analysed. Therefore, any interpretation of the prehistoric wood uses must be taken with caution. A fundamental problem for the interpretation is that samples of 75, 25 and 50 fragments of charcoals are not comparable or statistically significant. For this reason comparison between the identified taxa from the pre-ceramic and ceramic periods is not attempted in depth. When more archaeological excavations take place in the region, and detailed studies on specific archaeological contexts can carried out, the hypotheses formulated here could eventually be tested. At present, these hypotheses are the only way of proposing specific uses of woods during prehistoric times in the Colombian Amazon region.

According to the palaeoenvironmental information from the middle Caquetá region, the present landscape units and their vegetation cover are thought to have existed in the region since the Pleistocene (see palaeoenvironmental data in Chapters two and five).

8.8.3.1.Sub-sample 1: Ceramic occupation

The charcoal fragments identified from ceramic occupation levels at Peña Roja site belong to the Annonaceae, Apocynaceae, Arecaceae, Chrysobalanaceae, Clusiaceae, Euphorbiaceae, Leguminosae, Moraceae, Myristicaceae, Myrtaceae and Sapotaceae families (see Table 7.3).

At present most of the Annonaceae trees reported in the literature are employed in construction. Table 7.24 shows the relationship between construction and the other uses for these trees. Most of the species reported in Table 7.24 are found on the lower terraces of the Caquetá river as well as in other landscape units such as the flood plain and high terraces of the Caquetá river, flood plains of clear-water rivers and on tertiary sedimentary plains. At present none of the landscape formations mentioned are found more than 2.5 km away from the archaeological site of Peña Roja (see map of the area in Figure 8.29).

Trunks of trees from the Annonaceae family and from the genera *Bocageopsis*, *Duguetia*, *Guatteria*, *Oxandra*, *Pseudoxandra*, *Unonopsis* and *Xylopia* are used as beams and crossbeams in house building. The Annonaceae genera used as firewood are *Duguetia*, *Guatteria* and *Xylopia.* Carry bags and string are manufactured from bark of the species *Bocageopsis multiflora*, *Guatteria schomburgkiana*, *Unonopsis spitata*, *Xylopia emarginata* and *Xylopia micans* (Sánchez Sáenz 1997). Other domestic artefacts include axe handles made from trunks of *Oxandra euneura.* Fishing rods are made from thin stems of *Bocageopsis* genera and from the species *Oxandra euneura*, *Unonopsis guatterioides*, *Unonopsis stipitata*, *Xylopia cuspidata*, *X. Macrantha* and *X. spruceana.* Weapons made from wood include blowpipes (*Duguetia quitarensis* and *Duguetia stenantha*), and hunting bows (*Ephedranthus amazonicus*). The Annonaceae family is also important because fruits of some genera are consumed by humans. Bark from *Guatteria decurrens* is employed to extract a perfume used to bath children. An extract from bark of *Guatteriella tomentosa* is used during a special ceremonial day. Sticks used during dance ceremonies are taken from *Oxandra euneura* tree. Bark and root of some genera are employed to make medicinal extracts. Fruits are also used as bait for fishing (*Guatteria kuhlmannii, Oxandra leucodermis, Oxandra polyantha Pseudoxandra pacifica*) and the genera *Guatteria* and the species *Unonopsis veneficiorum* are used to prepare arrow poison (Sánchez Sáenz 1997, Schultes and Raffauf 1990).

It is also possible that the fragment of Annonaceae wood from this sub-sample was a part from a trunk or branch taken for construction. It also could come from a stick used during dancing which could have been thrown away and eventually become burnt.

Trees from the Apocynaceae family (Table 7.37) are used today for domestic artefacts and canoes. They are also used in medicines and the fruits of some genera are eaten. Two genera have been reported ethnographically as being used for their wood. *Aspidosperma* sp. is found in the alluvial plain of the Caquetá river, i.e., no more than 2.5 km away from the site and *Couma macrocarpa* is found also on the low terraces, the plains of clear-water rivers (the closest is 2.5 km from Peña Roja) and on the Tertiary sedimentary plain (the closest is 0.5 km from the site).

Domestic artefacts include axe handles and house furniture made from woods. *Aspidosperma* cf. *excelsum* is used as firewood and the genus *Aspidosperma* is used for building as well as for other purposes (see Table 7.37). The genus *Aspidosperma* sp. is used to make oars and the latex from *Couma macrocarpa* is employed for caulking canoes and also is added to the clay during pottery manufacture. Other uses of the genera include medicines made from the latex and roots. Fruits are used as fish bait and also as food (Cárdenas López and Giraldo-Cañas 1995: 119, Sánchez Sáenz 1997).

Three fragments of charcoal from the ceramic levels were identified as belonging to the Apocynaceae family (see Table 7.1). The pieces could be from a discarded domestic artefact.

Palms are amongst the most commonly used plants by the indigenous inhabitants of the Amazon forest, both at present and during the prehistoric times (see Chapter five for details of the charred seeds identified from Peña Roja archaeological site). Table 7.38 shows the species reported to have been used for wood at present in the region as well as the landscape units in which each of these species can be found. Most of the palms are found in the flood plains of black-water rivers. However these palms are also found in the alluvial flood plains and high terraces of the Caquetá river and on the terraces of Amazonian rivers (see Figure 8.29).

The most common use given to palms in the area are construction and food. Trunks are usually split, their inner part is removed and then they are used for platforms, floors and walls of houses. Palm fruits are eaten raw or after cooking or soaking in water to prepare beverages. Sprouts of some palms are also eaten. Leaves are employed to make thatch. Fibres from the pinnae of young fronds are twisted in order to make strings which later are utilised to make diverse domestic artefacts such as hammocks, storage or carry bags, handles for baskets and so on. Blowpipes and arrows are made from the stems of several species and darts are made from the petiole of *Maximiliana* aff. *maripa.* Salt is extracted from the bark and then added to tobacco paste. Roots from *Geonoma stricta* var. *piscicauda* and from *Socratea exhorriza* are used to make hand mills and graters for manioc respectively. Sometimes palms of *Mauritia flexuosa* and *Oenocarpus bataua* are felled in order to leave them as rearing places for coleopteran larvae (*Rhynchophorus* sp.). These larvae are eaten and constitute an important source of animal protein in the indigenous diet. Some parts of palm trees such as their bark, seeds and sprouts are employed to prepare beverages used as medicines against snake or ant bites and also for other remedies. Muinane collect the fruits from the *Mauritiella aculeata* palm as bait for fishing. Burnt leaves of *Bactris* sp. are used with *Caryocar* sp. leaves to prepare fish poison (Glenboski 1983, La Rotta 1983, Schultes and Raffauf 1990, Galeano 1991, Sánchez Sáenz and Miraña 1991, Sánchez Sáenz 1997, Morcote *et al.* 1998).

Palm trunks are exclusively used as firewood by Nukak people according to the available information at present. This is an interesting aspect that perhaps is related to the high mobility pattern practised by Nukak people. On the other hand palm fruits are a very important food resource for the Nukak and one could assume that the collection of fruits and the common use of palms for many other different purposes made trunks and leaves of palms the easiest source of fuel.

A fragment of a charred palm trunk was found in sub-sample 1 (see Table 7.1). Preservation of the charred fragment is good but identification is difficult due its size and the little published information on palm anatomical micro structure for genera from the Amazon basin. However, the fragment was compared with charred samples from reference collection (see Figure 7.3). The fragment is very similar to *Oenocarpus* cf. *bacaba* which is one of the palms most commonly used at present by indigenous peoples from the Colombian Amazon (see Chapters five and five).

The charred palm wood sample could be derived from a piece of trunk discarded after being used for making floors, walls or platforms during house building.

The charcoal assemblage from the ceramic levels of Peña Roja site contained one fragment that was identified as belonging to the Chrysobalanaceae family. Three genera from this family are reported at present to be used for their wood as well as for other parts of the plant. These trees are found in all landscape units from the area (see Figure 8.29). Today the most common uses are lighting and construction, followed by firewood and pottery manufacture (see Table 7.40).

Wood from several species of the *Licania* sp. genus and one species from the genus *Parinari* sp. (see Table 7.40) is employed for lighting houses at night. They are locally known as "popai" wood. There is no available information at present on the characteristics of these woods which make them suited to providing lighting.

Branches and wood from the species *Hirtella macrophylla* are used in pottery firing hearths (Schultes and Raffauf 1990: 130), as well as wood from *Licania octandra* (Elías Moreno 1994 pers. comm.). Bark from the species *Licania apetala* and *Licania octandra* is burnt, crushed and sieved and then added to clay in order to give it more plasticity (Sánchez Sáenz 1997: 133-136).

The charcoal assemblage sub-sample 1 contained one fragment identified as belonging to the Clusiaceae family and probably to the genus *Tovomita* sp. Three genera were found to be used at present for Clusiaceae woods and can be found in both the frequently and rarely inundated flood plain and low terraces of the Caquetá river (see Table 7.41 and Figure 8.29). All of them are used as firewood, particularly to cook food, except *Calophyllum longifolium*, which is used to manufacture canoes. The trunk from the tree *Tovomita* aff. *spruceana* is used to fire pottery and also as firewood to cook cassava and to smoke fish, tapir and/or pork meat (Elías Moreno 1994 pers. comm.).

At present the most common use given by indigenous people to trees from the Euphorbiaceae family is either firewood or construction. The staple food at present from the Amazonian lowlands is manioc (*Manihot esculenta*), belonging to this family. The *Hevea* sp. trees from which rubber is extracted also belong to this family. Genera used as firewood include *Hyeronima oblonga*, *Micrandra spruceana*, *M. yapurensis*, *Sandwithia heterocalyx*, *S. inclinata*, *Senefeldera karstesiana* and *Vaupesia cataractarum*. Most of these species are found in the lower terraces of Caquetá river. One is found on frequently inundated flood plains of the Caquetá river and other on the tertiary sedimentary plain (see Table 7.42).

The archaeological site is located on a lower terrace, the closest Tertiary unit landscape to the site is 0.5 km from Peña Roja, and the closest frequently inundated plain of the Caquetá river is located 1 km away from the site (see Figure 8.29).

The stilt roots of *Micrandra lopezii* and *Micrandra spruceana* are reported at present to be used to make paddles. Wood from *Mabea nitida* and *Senefeldera karstesiana* are employed to manufacture domestic artefacts including handles of tools (Murillo Aldana and Franco Rosselli 1995: 93). Fruits from *Mabea nitida* and *Senefeldera inclinata* are used as bait for fishing and the seeds, bark and leaves of *Mabea nitida*, *Micrandra spruceana* and *Senefeldera inclinata* are used in medicines (Schultes and Raffauf 1990: 180,186).

Leguminosae is the most abundant family in the studied region. Seven fragments of charcoal from sub-sample 1 were identified as Leguminosae. Today the woods from 12 different genera are used by indigenous communities from the Colombian Amazon region for their woods. Leguminosae trees are found in all the landscape units of the Middle Caquetá region and most of the reported species used at present can be found close to the low terrace where Peña Roja archaeological site is located. The exception is *Monopteryx uaucu* trees which are found on hardrock forms, the closest located 28 km away from the site (see map in Figure 8.29). The most common use that people give to these woods is construction (see Table 7.46) and after that, for firewood. Most of the species reported as firewood are used for cooking food. Muinane people use the species *Swartzia racemosa* to cook cassava and to smoke meat (Elías Moreno 1994, personal communication). *Monopteryx uaucu* is used as firewood for cooking food (Sánchez Sáenz 1997: 236), and oil is extracted from its seeds by the Kuripako people for lighting lamps (Schultes and Raffauf 1990). Seeds from *Clathrotopis macrocarpa* are used to prepare poison for fishing by Muinane people while Huitoto people use leaves and fruits for the same purpose (Sánchez Sáenz 1997: 218, 139). Trunks from *Hymenolobium pulcherrinum* and *Vatairea guianensis* are used to make canoes and the stilt roots from *Monopteryx uaucu* and *Swartzia schomburgkii* are used to make paddles. Fruits from trees of *Inga* sp. are eaten (Sánchez Sáenz 1997: 224-230, 236 ,244).

Taking into account the archaeological context of sample 1 it is possible that Leguminosae woods were used as firewood during the past. However it is important to mention that there is no available information about what type of houses people were building at Peña Roja and where they were built. Although at present buildings are often built with Leguminosae woods, there is no evidence of the collapse of wooden buildings on site due to fire, therefore it seems reasonable to think of those woods as fuel of domestic hearths.

Charred wood fragments from Moraceae were found in sample 1. Table 7.48 shows that construction and food are the main uses of Moraceae woods. The species employed are found in low terraces and the flood plains of the Caquetá river, i.e., 5 km or 1 km away from Peña Roja (see map in Figure 8.29). Mortars to crush coca leaves are manufactured from *Brosimum rubescens* and *Pseudolmedia laevigata*. There is no information on the process of manufacture of these mortars but Nukak people make similar artefacts to macerate fruits and to mill seeds, by burning the inner part of trunks (see Politis 1996b: 307). The only species reported as firewood for cooking food is *Naucleopsis imitans* (Sánchez Sáenz 1997: 291).

Two charred wood fragments from sample 1 were identified as Myristicaceae, which perhaps belong to *Iryannthera* sp. genus according to their anatomical characteristics (see Chapter 7 sub-heading 7.1.2.7 for details and Table 7.17). Table 7.49 shows that at present the most important use of the Myristicaceae wood is construction. It is followed by ornaments/ritual and then by firewood. Two genera are reported from this family: *Iryanthera* sp. and *Virola* sp. These trees can be found in low and high terraces of the Caquetá river as well as on the flood plains of the same river. Both genera are used as firewood to cook food. Trunk woods from *Iryanthera* sp. are used to make axe handles and *Iryanthera tricornis* is used to make blowpipes (Sánchez Sáenz 1997: 297). Both genera are employed to prepare an hallucinogenic snuff from the bark and from the trunk exudate, that is taken during magico-medical ceremonies (Schultes and Raffauf 1990: 323-333, Sánchez Sáenz 1997: 300). Fruits from *Iryanthera* sp. trees are eaten and some are used as bait for fishing. Bark is used for making medicines (Sánchez Sáenz 1997). Bark from *Iryanthera ulei* is burnt to ashes and then added to clay as temper (Schultes and Raffauf 1990: 324).

According to ethnographical information, Myristicaceae family is mainly used for construction and for ritual purposes. However trees from this family are also sources of firewood. Because of the lack of studies on the particular characteristics of human settlements at the time of the ceramic occupation of Peña Roja, it is difficult to relate the presence of charred wood fragments of *Iryanthera* with the custom of preparing hallucinogenic substances.

Woods of the Myrtaceae family are used at present for building houses and for manufacturing domestic artefacts and weapons. All genera reported as used by the present day indigenous inhabitants of the studied region can be found on low terraces and flood plains of the Caquetá river, except *Myrcia revolutifolia* which grows on hardrock areas. The closest of these is 28 km from Peña Roja (see Table 7.50 and Figure 8.29). Trunks of *Calyptranthes pulchella* are used to make axe handles and young trunks from *Myrcia revolutifolia* are employed to make bows for hunting. The archaeological context of this sub-sample at Peña Roja might indicate that Myrtaceae woods were collected to manufacture domestic artefacts or weapons and that later, remnants or damaged artefacts were burnt.

The charcoal assemblage of sub-sample 1 included one fragment identified as Sapotaceae. Table 7.51 indicates uses given at present by indigenous people to woods of the Sapotaceae family. These uses are firewood, construction, manufacture of weapons, food and medicines. The most common use is construction followed by food and then by firewood. Table 7.51 also shows the landscape units where the reported woods can be found today in the middle Caquetá region. With the exception of *Pouteria glomerata* which grows on vegetation formations covering Tertiary sedimentary plains, all the other species can be found on the low and high terraces as well as in flood plains of the Caquetá river (see map in Figure 8.29).

Woods reported in Table 7.51 include species from five genera of Sapotaceae trees. Four of them are used as firewood for cooking food: *Ecclinusa guianensis*, *Micropholis guyanensis*, *Micropholis obscura* and *Pouteria retinervis*. Wood from *Micropholis guyanensis* and *Pouteria cuspidata* is used for lighting. Fruits of some species are eaten. Latex from *Pouteria glomerata* is used to make bird traps (Sánchez Sáenz 1997: 366-373). Leaves and latex are utilised in remedies (Schultes and Raffauf 1990: 411-412).

It is possible that Sapotaceae woods were collected for firewood, lighting and perhaps for their fruits. Sapotaceae trees such as *Pouteria caimito* are cultivated at present by indigenous communities in the Colombian Amazon region.

8.8.3.2. Sub-sample 2: Pre-ceramic occupation

The charcoal fragments identified from pre-ceramic occupation levels at Peña Roja site belong to Annonaceae, Apocynaceae, Burseraceae, Flacourtiaceae, Lauraceae, Lecythidaceae, Leguminosae, Melastomataceae, Moraceae, Myristicaceae, Myrtaceae and Sapotaceae families (see Table 7.3).

The charcoal assemblage from the pre-ceramic levels at Peña Roja site contained four fragments of charred wood that were identified as belonging to the Annonaceae family (see sub-heading 8.4.3.1 for details on Annonaceae wood uses at present in the studied region). The most probable use of these fragments were fuel, taking into account the archaeological context of this charcoal assemblage. At present there is little information about the society who inhabited Peña Roja site during the pre-ceramic period. According to the excavators, the place was occupied by hunter-gatherers but their patterns of mobility and settlements have not yet been investigated. The type of construction used about 9000 years ago is unknown. There are no traces at the site that a fire collapse could have happened during that time. As a result it is believed that the charred wood from the Annonaceae family was used as fuel in hearths made in the area surrounding the location of trenches 9 and 10.

It is interesting to take into account that two stone adzes were found at the pre-ceramic levels of Peña Roja. Wood could have been used to haft these artefacts and at present trunks of trees from the family are used to make axe handles. Wear analysis of one of adzes showed no traces of use on its surface (see Chapter 5, sub-heading 5.3.1.2 for details on the lithic artefacts found at the site).

Two fragments of charcoal from this assemblage were identified as Apocynaceae (see Table 7.1). One of them is probably from the *Aspidosperma* sp. genus. The most common use today of that wood is manufacture of domestic artefacts.

One fragment of charcoal from this assemblage was identified as Burseraceae family. At present woods from this family are mainly used for construction and for medicinal purposes and most of them are found in the lower terraces of the Caquetá river and on the tertiary sedimentary plain (see Table 7.39). Some Burseraceae woods are also used as firewood in domestic hearths for cooking: *Crepidosperma rhoifolium*, *Protium aracouchini*, *P. krukoffii*, *P. Subserratum* and *P. urophyllidium*. Resin from some trees is employed for medical purposes, generally by inhalation of its smoke (Sánchez Sáenz 1997: 113-122). The ethobotanical information does not include the reasons for the preference of these particular woods for cooking food. It could be that some of their properties such as the content of resins from *Protium* sp. contribute to long lasting fires or help to start fires more easily.

One fragment of charcoal in assemblage 2 was identified as belonging to the Flacourtiaceae family. Two genera were reported to be used for their wood in the area. These are found in the low terraces of Caquetá river as well as in the frequently inundated flood plain of the same river, no more than 1 km from Peña Roja site (see Figure 8.29). The most common uses given at present to the wood of this family are construction and medicinal (see Table 7.43). Miraña people use *Lindackeria paludosa* as firewood to cook food (Sánchez Sáenz 1997: 185).

One fragment from this assemblage was identified as charcoal from the Lauraceae family. Table 7.44 shows the woods from Lauraceae family used at present by indigenous people. These include five genera that can be found mostly on the terraces and alluvial flood plains of the Caquetá river. Most of these woods are used at present mainly in house building but trunks from five of them are used to make canoes. The genus *Licaria* sp. is used by Muinane people as firewood (Elías Moreno 1994 personal communication). However it is difficult to relate this charcoal fragment to one of these uses because we only know that it comes from an area of human activity. This information is not enough to allow correlation with any specific activity. There is no information on the type of mobility pattern people were practising 9000 years ago in the Colombian Amazon forest. It is likely that they were fishers (Herrera and Cavelier 1999) and probably could have made canoes and/or rafts.

Information on building types from that time is not available either and therefore it is difficult to know what type of woods people were exploiting for building. Information about present day Nukak people suggests that foragers from the Colombian Amazon region, one could assume that the kind of dwelling places mobile people tend to use are very quickly made from relatively easily found and collected palm leaves (see Politis and Rodríguez 1994, Cabrera *et al.* 1994, Politis 1996a,b, 1998). The genus *Ocotea* sp. is very resistant and that is why it is now widely used as present as house beams and crossbeams (Sánchez Sáenz 1997).

Four fragments of charred wood were identified as Lecythidaceae woods. Table 7.45 shows that three genera are reported as being exploited for their wood in the Colombian Amazon region. These genera are all found very close to Peña Roja site (see Figure 8.29). Today these woods are mainly employed for lighting, construction purposes and for the manufacture of domestic artefacts. The genus *Eschweileira* sp. is the most commonly reported in the ethnographic literature and all the woods at present used for lighting belong to this genus. The strong bark of trees from the Lecythidaceae family is widely used for manufacturing string used to carry products from agricultural fields or games to the house. Muinane people eat the almond from seeds of *Escheweileira chartaceifolia*. Bark from some *Eschweilera* trees is also used to extract a liquid for medicinal purposes (Sánchez Sáenz 1997: 209-213).

It is probable that the charcoal fragments of Lecythidaceae woods from this assemblage were used for lighting.

Leguminosae woods are present in sub-sample 2 charcoal assemblage. Thirteen fragments were identified as Leguminosae woods. As in the case of sub-sample 1 (see sub-heading 8.4.3.1 for detailed information on uses of Leguminosae trees at present) these fragments of charcoal were probably used as firewood. Table 7.46 shows the most common uses given at present for this family and the distribution of the species in the region today.

Sub-sample 2 contained one charcoal fragment identified as being from the Melastomataceae family. Table 7.47 shows the four wood genera reported in the ethnographic literature. All these genera are found in the flood plains or low terraces of the Caquetá river except *Miconia* sp. genus which is found in Tertiary sedimentary plain areas (see map in Figure 8.29). Firewood is the commonest use given to woods from Melastomataceae family. Six species were reported to be used for cooking food: *Bellucia grossularioides*, *Miconia dispar*, *M. phaeophylla*, *M. prasina*, *M. pubipetala* and *Moururi cauliflora*. *Miconia* sp. genus is used by Muinane people to smoke fish and also its seeds are used to extract a dye for painting bark cloth (Elías Moreno 1994, personal communication).

One fragment of charcoal from this assemblage was identified as being from the Moraceae family (see sub-heading 8.4.3.1 for details on the family and its distribution in the middle Caquetá river).

Sub-sample 2 contained three fragments identified as *Iryanthera* sp. and one identified as Myristicaceae. Table 7.49 shows the commonest uses now of woods from the Myristicaceae family as well as the landscape location of these trees (see sub-heading 8.4.3.1 for details on the uses of the family). Three fragments of charcoal identified as Myrtaceae woods were contained in assemblage 2. Table 7.50 shows the uses indigenous people give to these woods and their distribution in the landscape units of the region (see sub-heading 8.4.4.1 for details on uses of the genera reported in Table 7.50). As in the case of sub-sample 1 these woods could have been used for manufacturing domestic artefacts or weapons.

One fragment of charcoal from sample 2 was identified as Sapotaceae wood. Table 7.51 shows main uses of the family at present as well as its distribution in the different landscape units in the middle Caquetá river (see sub-heading 8.4.3.1 for details on uses of the family and its availability in the studied region at present).

8.8.3.3. Sub-sample 3: Pit 5

The charcoal fragments identified from Pit 5 belong to 9 families: Arecaceae, Clusiaceae, Euphorbiaceae, Lecythidaceae, Leguminosae, Moraceae, Myristicaceae, Myrtaceae and Sapotaceae (see Table 7.3).

Two fragments were identified as belonging to the Arecaceae family (see Table 7.1). Taking into account that Pit 5 has been interpreted as the deposit of waste materials after pottery manufacture the possible reason for the presence of palm charcoal into the deposit is examined. At present one palm is used during the process of manufacturing pottery, not for its wood but for its latex. It is *Lepidocarym tenue* whose latex is collected to be added to the clay as temper (Herrera *et al.* 1989). It is possible that a piece of a trunk from this palm were used as one of the fuels during the process of firing pottery.

Two fragments of charcoal from the assemblage contained at Pit 5 were identified as belonging to the Clusiaceae family and probably to the genus *Calophyllum* sp.

(see Chapter seven sub-heading 7.1.1.6 for details on the anatomy of the wood of this genus). Miraña people use trunks of *Calophyllum longifolium* to manufacture canoes (Sánchez Sáenz 1997: 138).

Trunks from *Tovomita* cf. *spruceana*, also a tree from Clusiaceae family, are used to fire pottery by Muinane people (Elías Moreno 1994 pers. comm.). The presence of Clusiaceae fragments of charcoal in Pit 5 could be explained either if wood from the genus *Calophyllum* sp. was used to fire pottery or because Pit 5 contains also residues from different primary contexts, such as domestic hearths or canoe manufacturing hearths. It is also possible, however, that the fragments are not from *Calophyllum* sp. but from another genus, perhaps *Tovomita* sp.

One fragment of charcoal from the Euphorbiaceae family was found as part of the assemblage taken from the contents of Pit 5. As in the case of the other four fragments of charcoal belonging to this family that were found in sub-sample 1, it is possible that it was derived from a piece of wood used as firewood.

The charcoal assemblage of sub-sample 3 contained 7 fragments of charcoal identified as belonging to the Lecythidaceae family. Two of these could be from *Eschweileira* sp. genus. This family is important at present for manufacturing domestic artefacts, house building and lighting (see above sub-heading 8.4.3.2). According to the available information bark from *Lecythis* sp. is used by Kubeo people who burn pieces of the bark to ashes and add this to the clay used for manufacturing pottery (Schultes and Raffauf 1990). It is possible that some of the Lecythidaceae charcoal fragments contained in Pit 5 correspond to wood collected either for its bark which could be used as clay temper or to be used as fuel to fire pottery. On the other hand it is also possible that the fragments identified as Lecythidaceae were used for lighting and their waste discarded into the pit.

Sub-sample 3 contained 5 fragments of charcoal identified as belonging to the Leguminosae family (see Table 7.1 and 7.46 and sub-heading 8.4.3.2 for detailed information on the family). Bark from *Swartzia gigantea* and leaves from

Tachigalia sp. are burnt to ashes and added to the clay as temper when pottery is manufactured (Schultes and Raffauf 1990: 254, 296). These are the only 2 Leguminosae trees reported as used during the process of pottery manufacture. It is possible that other woods from this family have been used during the past as fuel to fire pottery. It has to be kept in mind that the ethnographic data do not include information on specific wood fuels to fire pottery.

One fragment of charcoal from Pit 5 was identified as being from the Moraceae family (see sub-heading 8.4.4.1 for details on the family and its distribution in the middle Caquetá river). Latex from *Brosimum lactescens* is added to clay to make it plastic. It is also used after heating for caulking canoes (Sánchez Sáenz 1997: 284). It is possible that *Brosimum* sp. was were also used as fuel to fire pottery even if the main purpose of selecting the tree was its latex. As has been mentioned already, there is no information on wood fuels employed in these fires. Other probable uses are firewood or manufacture of wooden mortars.

One of the charcoal fragments found in Pit 5 was identified as *Iryanthera* sp. from the Myristicaceae family. Table 7.49 shows the most common uses indigenous inhabitants give at present to woods from this family, as well as their distribution in the landscape of the region (see sub-heading 8.4.3.2 for details on the uses of the family). As in the case of sub-samples 1 and 2, it is possible that these woods were used as firewood, perhaps in hearths where pottery was fired. Bark ashes are from *Iryanthera ulei* trees is also used by Taiwano people as clay temper for pottery (Schultes and Raffauf 1990: 324). It is possible that people used both bark as temper and trunk/branches as fuel to fire pottery. According to Sánchez Sáenz (1997) other uses of *Iryanthera ulei* include firewood and construction. The fruits of the tree are consumed by Andoque and Muinane people. Axe handles are made by Huitotos from pieces of its trunk. An infusion of the bark is used to treat diarrhoea by Andoques and the inner cover of fruits is used as a purgative by Huitotos. Fruits are also used by Muinanes as bait for fishing. Other trees from *Iryanthera* genus are used for firewood as well (*Iryanthera crassifolia*, *Iryanthera polyneura* and *Iryanthera tricornis*). From the inner part of the trunk of

Iryanthera tricornis Huitoto people manufacture blowpipes (Sánchez Sáenz 1997: 294-298).

One fragment of charcoal identified as Myrtaceae woods was found in the assemblage from Pit 5. Table 7.50 shows the uses indigenous people give to these woods and their distribution in the landscape units of the region (see sub-heading 8.4.3.1 for details on uses of the genera reported in Table 7.50). As in the case of sub-samples 1 and 2 these woods could have been used for manufacturing domestic artefacts or weapons.

Six fragments of charcoal from sample 3 were identified as Sapotaceae wood. Table 7.51 shows main uses of the family at present as well as its distribution in the different landscape units in the middle Caquetá river (see sub-heading 8.4.3.1 for details on uses of the family and its availability in the studied region at present). As in the case of sub-sample 1 it is thought that the fragment could have been a remnant of a piece of wood collected for firewood or lighting.

8.8.4. Characterisation of charcoal assemblages and hypotheses on prehistoric wood use at Peña Roja

The archaeological context of both the ceramic and pre-ceramic charcoal assemblages (sub-samples 1 and 2) from Peña Roja site is difficult to interpret from the information available at present. The excavators (Cavelier *et al.* 1995) describe the site as an area of human activity. The excavations covered an area insufficient to allow correlation with ancient indoor or outdoor house floors. Remains of hearths were not recorded but abundant charred macro-remains were collected both during excavation and retrieved from floated or water screened sediments. However in the pre-ceramic levels several patches of white, grey or black soil were reported but these were not interpreted by researchers as hearths. It is not clear yet if the excavated area corresponded to a place were hearth wastes were discarded. Future excavation of this site could help to define the archaeological contexts further. The excavated area is probably part of a general midden where discarded households materials derived from the human occupation of the site were accumulated. These materials include lithics, charred plant macro-remains from the earliest occupation period and sherds, lithics, and charred plant macro-remains from the latest period of occupation.

Firewood is the primary source attributed to the charcoal assemblages from Peña Roja. There are many gaps in the current archaeological information which prevent further interpretation about other probable uses given to woods during the past. It is necessary to investigate more settlements from the same period or the same site in more detail in order to have information on the extent of settlements from each period of occupation, the type of buildings that eventually were built, the kinds of artefacts employed and their functions, as well as other plant and animal remains.

The charcoal assemblage from the ceramic occupation of Peña Roja contained fragments identified as belonging to 11 different families (see Table 7.4) ten of which have been interpreted as being used for firewood. The charcoal assemblage from the pre-ceramic occupation of Peña Roja contained fragments identified as belonging to 12 different families (see Table 7.4). From these nine have been interpreted as being used for firewood.

Charcoal assemblages from sub-samples 1 and 2 constitute scattered assemblages collected in areas where human activities were carried out, possibly close to dwelling places.

Woods chosen for firewood at present are from Annonaceae, Burseraceae, Myristicaceae, Lecythidaceae and Lauraceae families. Woods from the Annonaceae family, in particular from the *Guatteria* sp. genus, are small and easy to collect, woods from the Burseraceae family are good fuels because their resins are highly combustable, Lecythidaceae woods produce flame and burn very slowly (Mauricio Sánchez Sáenz, 1995 pers. comm.). Archaeological specimens from all these families were identified in the charcoal assemblage from the pre-ceramic occupation levels of Peña Roja.

Although the test sample analysed for charcoal identification is too small to allow quantitative analysis and interpretation of data in terms of wood exploitation patterns during the ceramic and pre-ceramic periods in the region, some comments can be derived from the available data. Charred fragments of palm wood were not recovered from the pre-ceramic levels which contrasts with the large number of charred palm seeds found in these excavations. Both assemblages contain woods useful for providing light, in sample 1 mainly Chrysobalanaceae woods and in sample 2 mainly Lecythidaceae woods.

The families found in both assemblages are Annonaceae, Apocynaceae, Leguminosae, Moraceae, Myristicaceae, Myrtaceae and Sapotaceae.

Pit 5 contained a concentrated charcoal assemblage which included fragments identified as belonging to 9 different families (see Table 7.4). The fragments of 8 families have been interpreted as being used for firewood. However, it has to be born in mind that because there is no information available at present on the kind of woods used as fuel when pottery is fired, it is very difficult to hypothesise about the use of the identified taxa from Pit 5. The assumption that the fragments could have derived from fuel is based on the fact that wood of all the identified families are collected at present for fuel as well as for other different purposes. The interpretation made by the excavators concerning the function of Pit 5 as a deposit for waste materials related to pottery manufacture is also assumed (see Herrera *et al.* 1989 and Chapter five for a summary of their information).

Pit 5 could also contain the waste materials from several fires or hearths made to fire pottery, but without information about different types of woods used at present for firing pottery it is difficult to hypothesise about the possible fuels used for the same purpose during prehistoric times.

If Pit 5 is considered as a deposit for other waste materials besides those derived from pottery manufacture, it is possible that the remains of several other human activities involving the use of wood could have been deposited together. These other activities could include fires made for cooking, smoking fish and/or meat, and fires made to manufacture domestic artefacts, weapons and canoes.

In order to test the model for aspects such as high or low variety of taxa contained in different deposits and for particular activities, more data have to be collected. It is necessary to carry out more ethnographic research into fuels used for different types of fires and discard patterns of fire hearth wastes.

Finally it is important to notice that people usually select what they have to hand, and is easily collected. For example, indigenous people living at present in the middle Caquetá river use often woods from the genus *Iryanthera* and the Myristicaceae family for firewood and construction. *Iryanthera* sp. woods are very abundant in the region and they are easily found (Mauricio Sánchez Sáenz 1995, pers. comm.).

9. CONCLUSIONS

This investigation is the first study of an archaeological charcoal assemblage from Colombia. Although woody taxa from the Colombian Amazon include a huge range of different species that present high taxonomic diversity, the identification of the Peña Roja charcoal assemblage was made at the Family level and in some cases at the Genus level. The high diversity and the large number of different species from the area is emphasised by the large number of families and genera (16 and 5 respectively) identified from the small sample of 200 fragments.

In order to explore the nature of the charcoal identification and the diversity of taxa within archaeological charcoal assemblages from the Colombian Amazon, a sample of charcoals was analysed. This was considered appropriate for the purpose of this research because the aim of this thesis was not to undertake a full charcoal analysis of Peña Roja, but to explore ways to interpret wood uses during the past.

Identification of some of the taxa contained in this test sample was carried out and suggestions of the reasons for the presence of the charred wood fragments in the site are made. I am aware that the model has not been applied totally for Peña Roja due to the limitations of the archaeological data available at the present.

In chapters two, three, four and five the geographical, ecological, palaeoecological, archaeological and archaeobotanical information relevant to the middle Caquetá region is assessed. This information is used as a framework for the charcoal identifications and for the proposed model of characterisation of archaeological charcoal assemblages from the region. The archaeological site of Peña Roja is one of the earliest sites found at present in the evergreen forest of the Amazon basin. The cultural materials found in the site indicate that a hunter-gatherer group which collected palm fruits and probably practised small scale horticulture occupied the site at about 9000 years BP. The site was used later by farmers who manufactured pottery. The results of this investigation complement the information from pollen, phytolith, seed remains and soil analyses obtained by other investigators of the area (e.g. Herrera *et al.* 1980-1981, Andrade 1986, Herrera *et al.* 1989, Mora *et al.* 1991, Cavelier *et al.* 1995, Morcote 1996, Morcote *et al.* 1996).

Pollen and phytolith analyses provide general information on environmental interpretation, plants in the environment and the nature of crops and wild plants being utilised. These analyses lack specific information about which plants come into a site, and where and how they have been used on the site. Charcoal identification may contribute to the investigation of this very specific question as well as that concerning the function of the site and particular contexts within the site. Therefore these two types of information, the environmental (from pollen and phytoliths) and the cultural (from charcoal) complement each other well. In order to apply charcoal information it is necessary to have pollen and phytolith data that provide the environmental background information. Environmental information from charcoal identification is difficult to apply to the reconstruction of the broad environmental contexts, at least in the Amazon tropical forest. The results obtained with this thesis allowed me to suggest cultural use of the charcoals for Peña Roja.

9.1. The relevance of charcoal identification to archaeological research in the tropical lowlands

Archaeobotany in tropical areas has proved useful in investigating food production, dietary patterns, the development of agriculture and other human related activities such as fuel use patterns (see for example articles in Pearsall 1983, Hastorf and Popper 1988, Hather 1994, Piperno and Pearsall 1998). Charred plant remains are the most common type of preservation of archaeobotanical remains found on archaeological sites in the tropical lowlands of America. In the Colombian Amazon tropical forest charred seeds have been studied in detail (Morcote 1994a, Cavelier 1995, Morcote *et al.* 1996, 1998).

Charred seed remains of palms and other trees found at archaeological sites from the middle Caquetá river have been used to study ancient diet or food consumption of forest fruits. These studies have led to the revision of some of the assumptions that since the beginning of the Holocene period the area was impossible for human habitation. Small scale horticulture has been suggested for the Peña Roja site based on the identification of phytoliths found in the pre-ceramic levels at Peña Roja. Other economic activities of ancient inhabitants of the area have not been studied by using plant remains so far.

Charcoal identification may complement information from other sources of evidence of plant-human interactions in the past such as pollen, phytolith and seeds analysis. The preservation of plant macro-and micro-remains other than charred wood is relatively low in the tropics. Charred wood found in archaeological sites constitutes the evidence of past wood use as fuel and as material for manufacturing artefacts relevant in daily life and for building houses and other kind of structures.

In this study charred wood remains are used to investigate other uses of plant resources. Identified charred wood fragments from the sub-sample of the pre-ceramic levels at the Peña Roja site included specimens from 12 families and the sub-sample from the ceramic levels included specimens belonging to 11 families. The assemblage from sub-sample 3 contained specimens that belong to nine different families (see Table 7.3). Although the most pragmatic interpretation for these charcoal assemblages is firewood it is probable that some of those woods were collected to carry out specific activities such as smoking of fish, providing of light, manufacturing of domestic artefacts and hunting equipment.

Palaeoenvironmental reconstruction is an important aspect of charcoal analysis (see for example Hastorf and Popper 1988, Johannessen 1988, Smart and Hoffman 1988, Cartwright and Parkington 1997, Vacher *et al.* 1998). In the tropical Colombian Amazon forest palaeoenvironmental reconstruction based only on charcoal identification is difficult. This difficulty is due to the high variety of taxa present in the region; the similarity of wood anatomy between taxa; the methodological problems related to quantitative analysis of charcoals and the lack of information on the processes of deposition and post-deposition of wood remains in archaeological sites.

Additionally, the richness of the ethnographical information on traditional indigenous use of the forest resources in the Amazon region may be helpful in the modelling of past human-plant interactions. However, it must be considered that the accuracy of the archaeological interpretations depends on the availability of data on specific contexts and on the levels of identification of the plant remains.

9.2. Application of the model

The application of the model to the test sample of Peña Roja showed that interpretation of charcoal assemblages carries with it significant problems when a high variety of woody taxa is present. These problems relate to the time required to find diagnostic criteria to distinguish between different taxa or to describe wood anatomy of specific species from an area that has not been previously described. The high diversity of taxa may complicate the correlation between taxa identified and the nature of the contexts since a wide range of woody taxa may be used for different activities involving the use of wood as fuel.

However, both the limitations of the available archaeological information and the small size of the sample of charcoals analysed have to be taken into account. When more archaeological information is available and larger samples of charcoal are studied, the model will be used and it will be especially helpful in the interpretation of particular archaeological contexts of the area.

The model is very much a pioneering piece of work in Colombian archaeology and archaeobotany. It shows how archaeological, ethnographical and ethnohistorical information may be considered in order to understand archaeological material. The model will be used to test ideas and hypotheses about wood use in the past.

The major purpose of the thesis was to create the model. It could be tested in future investigations of charred wood samples from the Colombian Amazon region and perhaps, from other areas of the country.

9.3. Suitability of ethnographic information for characterising charcoal assemblages at archaeological sites in the Colombian Amazon

Ethnographic and ethnobotanical information are vital tools in the interpretation of plant macro-remains found at archaeological sites in the tropical rain forest. However in the case of wood use, the current available information lacks detail that may be helpful when the model is applied to archaeological data. For instance, in many cases, specific woods used as fuel in important activities such as firing pottery are not published, and quantitative analysis of fuels used in permanent domestic fires have not yet been carried out. These analyses would contribute greatly to the understanding of firewood exploitation in the Colombian Amazon tropical forest.

Lists of taxa reported in the literature are not sufficient to establish how much of each one is used. Therefore, the relative importance of each taxon cannot be evaluated at present with the available information. For example, house construction is the most common use of wood reported in the literature, but the taxa useful for construction are used less than the species used for firewood.

In the case of the Colombian Amazon region, remains of some fires would have a low visibility in archaeological terms. Such examples include those made in a non-permanent campsite, fires made for burning fur of game or to manufacture canoes. Their low visibility is because they would be difficult to locate and to be identified as such. On the other hand, the remains of fires and hearths related to daily activities such as processing and cooking food, manufacturing domestic artefacts and manufacturing hunting and fishing equipment probably could be identified in archaeological contexts.

9.4. Suggestions for further research

There is a lack of appropriate botanical keys and basic studies on the anatomy of most woods from the Colombian Amazon. Reference collection of woods used at present by Muinane and other indigenous communities need to be enlarged in order to be used in the identification of charcoal assemblages from the region. The creation of new reference collections of other woody plants such as lianas and palms, which are currently in use by the indigenous peoples will also be essential for furthering the identification of woody plant remains from archaeological sites. In addition, an atlas of woods and palms (fresh and charred) used by indigenous people including micro-photographs would provide a vital framework of reference for the description and identification of archaeological woody plant remains.

Furthermore, some ethnobotanical aspects may be useful for the interpretation of archaeobotanical samples from the area. These include the study of plants such as the woody lianas widely used at present by the indigenous people. They consume fruits from *Salacia gigantea* (Hippocrateaceae family) and from the genus *Passiflora* (Passifloraceae). Other species such as *Doliocarpus* spp. from the Dilleniaceae family has a sap used as a refreshing drink. Fruits from some lianas of the Sapindaceae family are used as bait for fishing. Strings for fastening or to make baskets and fish traps are manufactured from liana fibres. Plants from the Menispermaceae and Loganiaceae families are used to make hunting poison ("curare") and fishing poisons ("barbascos"). The latex of some species from the Apocynaceae Family are used to mix with an hallucinogenic drink called "yage" which is made from the plant *Banisteropsis caapi* (Malpighiaceae), commonly used during ceremonies. In addition, several other lianas are widely used for medicinal purposes (Alvarez and Londoño 1996: 377).

Studies on specific anatomical features of woods which are likely to be highly diagnostic elements in the identification of unknown woods will be necessary. These important elements include, for example, the scalariform and reticulate perforation plates of the woods from the Myristicaceae family and the scalariform perforation plates of some woods from the Chrysobalanaceae family such as *Licania* sp. Some families are relatively easily distinguished (eg. Annonaceae) and the study of their micro-anatomy would help in the identification of particular genera.

In addition, studies on physical and chemical properties of woods used as firewood, to provide light (Chrysobalanaceae, Myristicaceae and Lecythidaceae families), smoke fish or meat (Clusiaceae) and to fire pottery (Chrysobalanaceae) would help to explain the reasons why people chose specific woods for different purposes. An understanding of the mechanical properties of woods used to build houses and other structures might also be used to explain human selection of woods in the past. Cultural reasons such as specific restriction to the use of certain plants may be taken into account when studing past human wood selection.

According to the current information at present indigenous peoples from the Colombian Amazon use at least 275 woody species of woods for different purposes. Although the ethnobotanical information from the area is wide, some aspects are not mentioned. Investigations on the patterns of firewood exploitation in the Colombian Amazon including quantitative information on different species collected would greatly augment research into past human forest management and past human selection of firewood in the area.

The taphonomy of plant macro- and micro-remains in archaeological sites of the Colombian Amazon region has not been studied. Deposition and re-deposition of charcoals derived from hearths and other types of fires may be affected by the activity of natural and human factors. Natural factors include the activity of soil fauna, rain and runoff water on archaeological sites. Human factors include removal of hearth wastes and their re-deposition on places such as domestic gardens. Specific investigation of site formation processes and the taphonomy of charcoal assemblages in present day indigenous settlements would create wider scope for the interpretation of the archaeological charcoal assemblages.

The design of a standard sampling strategy which could allow the comparison between archaeobotanical data from different contexts, periods and sites will be an important task for the future research in the Colombian Amazon and also in other areas of the country.

There is no doubt that the Colombian Amazon is potentially an important area for intensive study in the future. Evidence of early human occupation and management of plants have been found in several places of the region including the middle Caquetá river in the southeastern part of Colombia.

However future archaeological research needs to be undertaken in order to provide the recognition of variation in contexts and samples of archaeobotanical remains, necessary to investigate many unknown aspects of past human inhabitants of the area. These aspects include size of settlements and their spatial distribution, specific and diverse contexts within the archaeological sites and the spectrum of associated plant remains. In order to apply the model to reconstruct how people use different woods in the past, larger areas have to be excavated and an effort has to be made to define particular contexts within the sites.

Future archaeological research will allow the application of the model to other cases and it is anticipated that it will allow distinction among different kinds of activities practised by people in prehistoric times. However it has to be taken into account that the plant remains preserved, found and eventually collected on an archaeological site can only represent a part of the whole spectrum of plants used and/or consumed during the past. The accuracy with which past human activities would be reflected in the archaeological plant remains varies according to several factors such as areas excavated, plant preservation, post-depositional processes, methods of recovery and levels of identification.

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