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The Role of Ethnobotany and Environmental Perception in the Conservation of Atlantic Forest Fragments in Northeastern Brazil

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ABSTRACT

The present work discusses conceptual and methodological tools in ethnobotany as well as local perception surveys that can generate important information for community-based conservation strategies, and presents results from research undertaken within the project *"Sustainability of remnants of the Atlantic Forest in Pernambuco State, Brazil, and its implications for local conservation and development"*. We discuss the applicability of this data for management planning, focusing on examples derived from studies in the northeastern part of the Atlantic Forest. Most ethnobotanical surveys provide information about the main users of a given resource, the most utilized resources, the plant parts most used for a given purpose, and the most used species. Research on local perception can indicate the main factors that lead people to use a given resource as well as other variables affecting plant use. This type of data is important for establishing strategies focusing on certain groups of species or certain human social groups. The principal objective of this text is to describe the methods used to gather information about local strategies of use and management of plant resources, elucidate the nature of information that can be acquired using these methods, and discuss the possible interpretative contexts.

Keywords: local representations, local resource use, plant biodiversity, tropical forests

INTRODUCTION

Understanding tropical ecosystems has been a growing challenge for biologists and ecologists in the last few decades, especially in light of the need to both use and conserve biological resources. In spite of recent advances in this area and in the accumulation of biological and ecological information, the approaches used have not always been very efficient, objective, rapid, or direct in terms of bottom-line conservation in the ecosystems examined. However, approaches designed to produce direct effects on the use and management of natural resources cannot afford to exclude the social and cultural context into which these resources are embedded or other aspects that will affect the quality of life and the well-being of humans and the environment as a whole.

Studies integrating biological and cultural dimensions of Brazilian ecosystems are rare or at best incipient, and they have advanced very little in the direction of finding alternatives for the use biological resources as well as their management and conservation. The present text introduces the different dimensions of a scientific research program in the Atlantic Forest that is attempting to construct a future model that integrates actions directed towards the sustainable use of specific natural resources (and the environment as a whole) using ethnobotanical-based information. The analysis that we present here is part of the project "Sustainability of remnants of the Atlantic Forest in Pernambuco State, Brazil, and its implications for local conservation and development" – a joint Brazilian-German cooperation that includes various lines of research, including population ecology, landscape ecology, reproductive biology, animal behavior, and ethnobotany. The contribution of ethnobotany to this project is to seek alternatives to the utilization of the natural resources of the Atlantic Forest by means of a diagnosis of the local sociobiodiversity. This term signifies a union of biodiversity (plant diversity in the case of the present work) and cultural diversity, and it means that there can be a cultural construction based on the relationship between people and biological resources. The key dimension to be examined is how the local population uses natural resources, and how these same people can be integrated into viable strategies of sustainable use. We will illustrate here how ethnobotanical actions are being developed within this project and provide some examples from the data already collected.

The local knowledge systems held by communities that use resources from the Atlantic Forest are quite complex and involve a diversity of variables that can indicate forms of utilization of these resources and their sustainability. Most work undertaken in the Atlantic Forest has been directed towards investigating the potential of medicinal plants (Begossi *et al.* 2002; Gazzaneo *et al.* 2005). Only a very limited number of researchers have attempted to quantify the use and knowledge of the resources of a given region (e.g., Hanazaki *et al.* 2000; Cunha and Albuquerque 2006), or determine the perception that these people have about these same resources (Albuquerque and Albuquerque 2005). Given the importance of the Atlantic Forest, these studies are quite necessary to reach our goal of understanding the dynamics and sustainability of people-plant relationships.

The project, in the general terms used here, is based on two basic lines of investigation, the first responsible for studying plant resource use and the second responsible for investigating people's representations about the environment. This information is needed in order to orient future actions that, linked with ecological and biological data from the other research teams, can result in local actions that are compatible with the biological, social, and cultural realities of the local populations.

Received: 23 June, 2008. Accepted: 6 October, 2008.

Original Research Paper

Evaluation of local representations about the local environment

The process of perception of the environment involves both physical and physiological elements (Bell 2001). Understanding the relations between people's patterns of perception in different communities could be a valuable tool for implanting sustainable management plans in local ecosystems. According to Fernandes *et al.* (2006) environmental perception is, in its essence, the "vision" that each person has of the environment that surrounds them, and represents the first step in the direction of knowledge and in the exercise of environmental citizenship. Tuan (1980) defined perception as a response of the senses to an external stimulus, a purposeful activity where certain phenomena are clearly registered while others retreat to the shadows or are blocked. According to this author, a great deal of what is perceived has value to the individual, either in terms of biological survival or for satisfying needs that are rooted in their culture.

Each individual perceives, reacts, and responds differently to the environment, and these responses or manifestation are, therefore, the result of perceptions, of the cognitive processes, judgments and expectations of each individual (Faggionato 2001). Although not all physiological manifestations are evident, they are constant and affect one's conduct, although most often unconsciously. Additionally, each person has his/her own vision of the world that is never objective; as each selectively perceives only what interests them, what is customarily observed, according to their socio-cultural context (Machado 1996). Therein, some authors have shown that some factors such as age, gender, income, instruction, living place and labor activity can interfere in the way people perceive the environment (Bogmaner and Wiseman 1997; Queen *et al.* 2003).

Cotton (1996) affirms that there are two distinct approaches concerning the study of environmental perception. The first seeks to understand the factors that influence the way the environment is locally perceived, also known as the ethic vision (researcher's vision) on the interpretation of the phenomena. The second describes how the environment is in fact perceived by people, that is, under an emic perspective.

Research on perception is still very uncommon in Brazil, being mostly studied in projects examining visitation to ecological stations and state parks there (Silva *et al*. 2003; Jacobi *et al*. 2004). The difficulties in pursuing this line of research are even greater when one considers investigations involving children and adolescents. This young age group, however, experiences the greatest influence from external factors in terms of the manner in which one's relationship with the environment is perceived. It is along this line of investigation that our team intends to examine the different dimensions of perception of the adult and infant-juvenile (school-age) sector of the communities that live near the Atlantic Forest fragments under study in order to: a) identify local representations of the environment; b) analyze their perception of possible landscape changes; c) plan for the zoning of natural areas and forest resource allocation; d) evaluate community preferences for different environments.

Ethnobotanical characterization of local practices of appropriating plant resources

The ethnobotanical studies being developed here are oriented by the desire to document the local practices and knowledge of the resources native to the Atlantic Forest by considering all of the social and cultural dynamics involved in the use of those resources, as well as to investigate how those practices affect the biological dynamics of these fragments. In order to conciliate the necessities of local use of forest resources with the need to conserve the local flora, it will be necessary to establish effective management programs. These programs must not, however, be conducted from the top down, where the government and/or the decision-makers decide on a strategy to be followed and the local populations are expected to obey. There must be a co-construction and co-participation in developing conservation strategies, with the government, decision-makers, and the local communities acting together (Bocco *et al.* 2000; Lykke 2000; Lucena *et al.* 2007). The participation of these communities is extremely important because, among other reasons, these populations usually possess important information about the useful plant species and about the dynamics of the local vegetation (Lykke 2000; Albuquerque 2005). This type of information will greatly contribute to our knowledge about that environment and about human interference in local ecological processes.

Most studies in ecology analyze biological phenomena without considering human presence. However, considering that human populations occupy areas near to the forests and directly interact with these areas, humans must be considered one of the variables in ecological processes - for they have direct influence on both the physiognomy and species composition of those wooded areas. Ethnobotanical studies can thus provide fundamental information about the use of plant resources and the implications of that use on local sustainability. Knowledge concerning patterns of use and collection of local resources, the species most intensively used, the factors the influence plant use, and especially woody plant uses, will be of great value to the task of determining conservation strategies. There have been, however, very few ethnobotanical studies investigating wood uses, for most traditional studies have examined medicinal plants or the general uses of plants but do not analyze wood categories in depth. This lack of dedication to the study of wood products is alarming, given that wood is the product whose extraction causes more damage to plant populations.

Ethnobotanical studies concerning wood products often focus on the use of fuelwoods or charcoal (Abbot and Lowore 1999; Samant *et al*. 2000; Nagothu 2001; Tabuti *et al*. 2003; Almeeruddy-Thomas *et al.* 2004; Bhatt and Sachan 2004a, 2004b; Brouwer and Falcão 2004; Ramos *et al*. 2008a, 2008b) as phyto-combustibles are the principal energy sources in developing countries (Li *et al*. 2005; Shah *et al*. 2007). Other workers have examined the use of wood in construction (Gaugris *et al*. 2006; Kakudidi 2007) or other such ends (Banks 1996; Shah *et al*. 2007). The complexity of the many uses of wood resources is synthesized in **Fig. 1**. Without a doubt, the economic situation of the local popula-

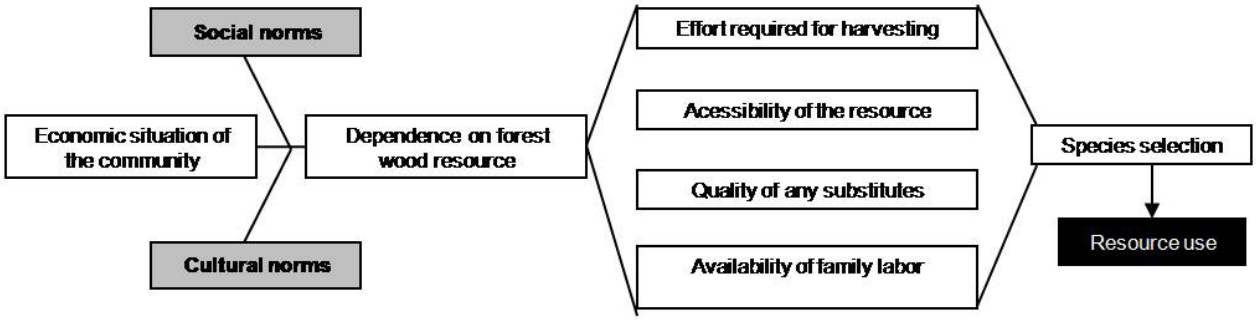

Fig. 1 Schematic representation of the complex system of selection of a species for wood use in rural communities. Based on Campbell and Luckert (2002).

tion is the driving-force that orients the exploitation of these plant resources in spite of any legal controls or the presence of social and cultural norms. In light of these observations, our study will also attempt to outline a general panorama of local wood use in order to: 1) Investigate the various use-categories that demand the greatest quantities of wood; 2) Identify the species that supply the greatest quantities of wood; 3) Verify if there are variables that explain the use of wood products in the community and also indicate their key-users; 4) investigate the dynamics of the use of fuel-woods by examining the natural stocks and local demand.

Besides the analysis focused on environmental representations and wood use, this investigation also aimed to conduct a general analysis of the use of the local natural resources available in different fragments. These analyses are all part of a larger study that is still in the developmental phase. However, we will present here our first reflections of the potential of this data to generate discussions concerning conservation with the preliminary presentation of some results, while at the same time reviewing our methodological options as a reference point for discussion of future studies in Atlantic Forest areas in northeastern Brazil that have ecological and socio-economic similarities to the area considered in this study. Not all of the methodologies that we are utilizing in the present project will be discussed in this article, but they will be presented in more detailed publications (see, e.g., Almeida *et al*. 2008; Silva *et al*. 2008).

THE LOCAL SITUATION

The initial focus of our actions is within the *Três Ladeiras* district, and more specifically, *Vila de Três Ladeiras* and the forest fragments with which the community interact most frequently. The territory of this district comprises about 1/3 of the municipality of Igarassu, Pernambuco State, Brazil (**Fig. 2**). Information from the

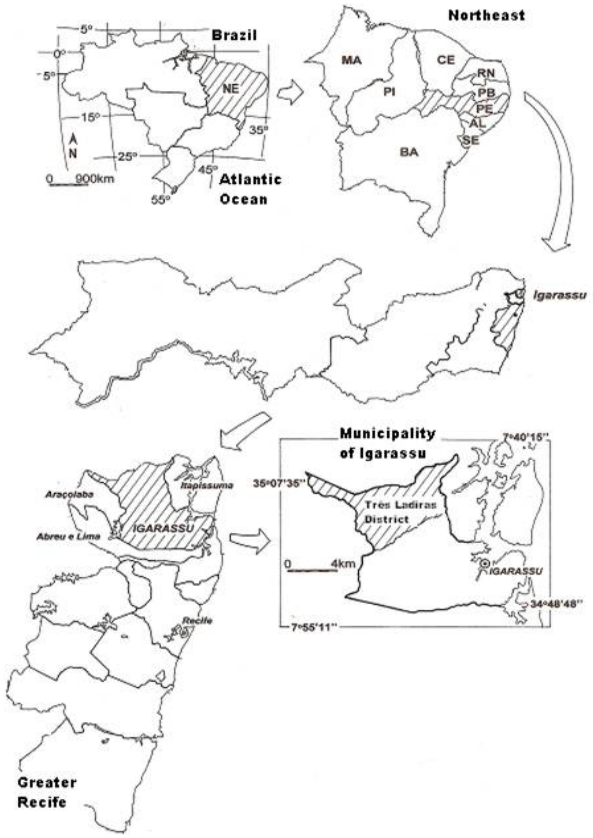

Fig. 2 Localization of the municipality of Igarassu and the Três Ladeiras community (Pernambuco State, northeastern Brazil). Source: Almeida *et al*. (2008).

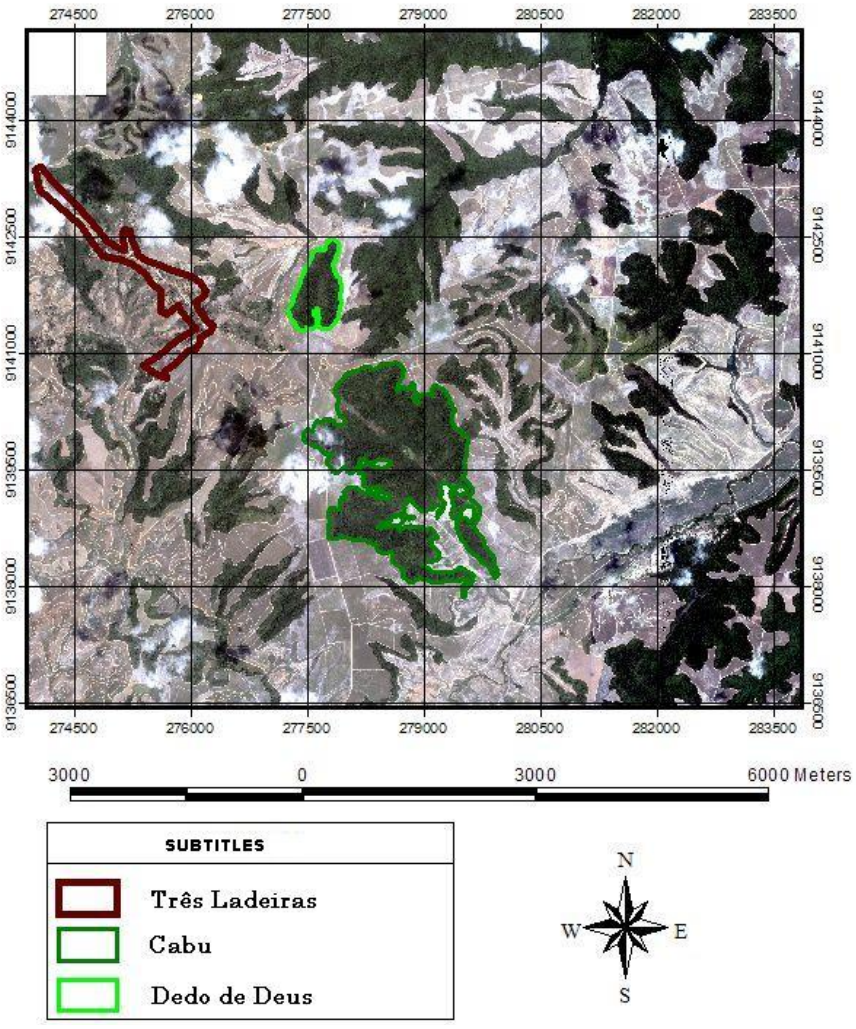

Fig 3 Aerial photograph from the main forest fragments that surround the community of Três Ladeiras, Igarassu (Pernambuco State, northeastern Brazil).

municipal government indicated that this is the poorest and most isolated district in the municipality, with approximately 3,000 inhabitants (FIDEM 2007). The village is located approximately 30 km from the municipal center and is surrounded by a monoculture plantation of sugar cane belonging to the Usina São José as well as by fragments of Atlantic Forest (**Fig. 3**) that were declared ecological reserves by state law (n° 9,989 of January 13, 1987).

According to information supplied by the community health center, the local population is 1472, with 876 adults older than 18 years (436 women and 440 men) (FIDEM 2007). The social services infrastructure in the community comprises two municipal schools, a Catholic church, a few evangelical churches, and a health center staffed by five family health service agents, a doctor, a dentist, and a nurse. The local economy is dependent on the sugar cane industry, which is responsible for employing most of the men in the community. The women are for the most part involved in caring for the family and their property (Gazzaneo *et al*. 2005). There are two schools in the village; one with grammar school students only and the other with grammar and high school pupils. The last (Municipal Mínima de Três Ladeiras school) was chosen for collecting information related to perception studies with young people. This school has 17 professors and 434 registered students (2007) and offers basic instruction as well as night school for young people and adults. The school has the following physical infrastructure: six classrooms, a library space, a teacher's room, a kitchen, four bathrooms, and a small external garden.

Ethical aspects

Before initiating the information collection, local representatives and community health agents working in the locality were contacted and informed about the objectives and intentions of the project. The support of these health agents was very important for establishing contact with the local inhabitants and for getting to know the study area. All of the adults recruited for the research project signed a Free and Clarified Consent Term (FCCT) (in accordance with Resolution 196/96 of the National Health Council) to collect, use, and publish data gathered in the course of this study. In the case of children and adolescents interviewed in the schools, their parents were invited to sign the FCCT. Students from the fifth to the eight-grade classes were selected to be interviewed, with a final total of 92 students participating, divided among 40 boys and 52 girls with ages varying from 10 to 21 years. This number represents 21% of the community population in that age range. Of these students, 29 were in the 5th grade (16 girls and 13 boys) with ages between 10 and 13 years, 22 were in the 6th grade (11 girls and 11 boys) with ages between 11 and 14 years, 25 were in the 7th grade (16 girls and 9 boys) with ages between 14 and 20 years, and 16 were in the 8th grade (9 girls and 7 boys) with ages between 14 and 21 years.

Methodological approximation: triangulation of methods

The relationships between people and plant resources are very complex and dynamic, and they are molded not only by cultural forces, but also by ecological and evolutionary pressures. As such, we opted to use a triangulation method of research (Albuquerque *et al.* 2008a) in an approach that would internally validate the information collected and any interpretations derived from it. We performed a non-probabilistic sampling effort among the people that would be involved in the research (Albuquerque *et al.* 2008b), but we defined the sample size in a way that it could be a representative part of the universe. In order to gain access to the representations of the local adult population concerning the Atlantic Forest fragments and the local landscape, we chose to combine three strategies: semi-structured interviews; photographs ordering of different environments according to the preferences of the interviewees (the preference being related to the places interviewees enjoyed the most); and community mapping (Albuquerque *et al.* 2008a; Medeiros *et al.* 2008; Sieber and Albuquerque 2008). Basically, the questions asked to the interviewees were designed to examine the following dimensions: socioeconomic; local significance and identity; and knowledge, utility and perceptions of the forest and the local natural resources. Additionally, a series of hypothetical questions were developed to investigate the attitudes held by the interviewees in relation to problems linked to the exploration of local natural resources. Investigations with the students involved the use of photographs ordering, associated with encouraging them to produce essays and drawings (Barraza and Ceja-Adame 2005). The essays were analyzed quantitatively and qualitatively using techniques of analysis of the Discourse of the Collective Subject (Lefevre 2005). This type of analysis was chosen as it helps to reveal collective thoughts.

Ethnobotanical data is being collected through a combination of techniques that help us investigate the theoretical and practical dimensions of plant use (Reyes-Garcia *et al.* 2006). From a theoretical point of view, there is a good deal of local information available about the use of plants that makes up the body of local knowledge (although this does not necessarily imply that these species are currently and/or effectively used). Within the practical dimension, the resources that are in fact suffering use-pressure were recorded. Allied to this, we included the component of "preference". This information was obtained by a combination of interviews and free-listing techniques (Albuquerque *et al.* 2008a) conjugated with the technique of "*in situ*" inventories (Gaugris and van Rooyen 2006; Albuquerque *et al.* 2008a) of all of the plant material present in the residences and external areas and garden plots of the property (except those located outside the limits of the Três Ladeiras district, such as sawmills and carpenter shops). The informants were asked to indicate the names of wooden items and the wood from which they were made (in their own vernacular). The measurements of all wooden artifacts were taken in order to be able to calculate their volumes. The analysis of the wood volumes encountered represents the "static" data. However, to obtain conclusions more faithful to questions related to use-pressure, or to categories that demand larger quantities of wood, it is also necessary to associate this static data with the turn-over time of these resources. This analysis was performed together with the "*in situ*" inventory. These same types of analyses were also performed with the stocks of fuelwood, as well as the physical proprieties of the species used to that end. As such, the "*in situ*" inventory, allied to information about the turn-over time of those resources will give us a good idea of the harvesting pressure on the forest fragments, and in which categories that demand is most concentrated.

We have associated our ethnobotanical approach with a plant inventory. To that end, we selected two forest fragments most cited by the community for gathering plant resources. The selection of the fragments obeyed criteria defined by the community itself, such as: (1) proximity to the community, requiring less effort to transport the resources harvested; (2) accessibility, as the forest fragments are located in hilly areas; (3) availability of the desired resource(s), as not all of the fragments contain the species sought by the community. The fragments "Cabu" and "Dedo de Deus" were most cited by the informants, with 47.21 and 16.75% of the indications, respectively (**Fig. 3**).

Partial inventories have been made of the two forest fragments. The area inventoried in the "Dedo de Deus" fragment (the forest area closest to the community) corresponds to a forest that experiences an intense flux of local residents. The area inventoried in the "Cabu" fragment (more distant from the community) demonstrates less signs of use by the human population and it is "apparently" in a better state of conservation. We used the Point-centered quarter Method (Araújo and Ferraz 2008) in both of the fragments as the principal strategy for collecting phytosociological data about the vegetation.

To conduct the point-centered quarter surveys, two 360 meter-long trails were opened into each forest area. In the "Cabu" fragment the trail runs in a general N-S direction, while in the "Dedo de Deus" forest area the trail runs E-W. The distances between points as used in this technique were established in a pilot survey. Subsequently, 25 quadrant points at 15 m distances were marked in each fragment. At each quadrant point the woody species with CBH $\geq$ 15 cm were noted and collected for identification.

To illustrate how an ethnobotanical approach can be integrated with vegetation studies and inventories, we used the preliminary data of whole and cut individuals of each species to calculate an availability index (percentage of whole individuals of a species x among all individuals) and a demand index (percentage of cut individuals of a given species x among all cut individuals). In this

way we calculated the ration between demand (%) and offer (%) for each species. The species could then be classified according to the ratio obtained into: preferred (ratio > 1.25), random (0,80 < ratio < 1.25), and avoided (ratio < 0.80) (Pote *et al*. 2006).

FIRST APPROXIMATIONS OF THE LOCAL USE AND PERCEPTION OF NATURAL RESOURCES

We present here a summary of the work that is being developed as well as an explanation of how the information being gathered about the local vegetation can be incorporated into management and conservation actions.

Use of local natural resources

We recorded a total of 219 local names of woody plants that are know and used by the community under study. Considering these 219 citations as ethnospecies (species based on folk names), 190 (87%) are indicated as effectively being used. All of the species known and used were classified into the following preliminary categories: construction, fuel, technology, medicinal, food source, and "other uses" (miscellaneous of minor uses). The interviewees attributed from 1 to 25 different types of uses to each plant. The most frequently cited species were: *Eschweilera ovatta* (Cambess.) Miers ("imbiriba"/25 different use-citations); *Thyrsodium schomburgkianum* Benth. ("cabatan-de-leite"/24); *Bowdichia virgilioides* Kunth ("sicupira"/22); *Pogonophora schomburgkiana* Miers. ("cocão"/21); *Pithecellobium cochliocarpum* (Gomez) Macbr. ("barbatenon"/20); *Tapirira guianensis* Aubl. ("cupiúba"/19); *Tabebuia avellanedae* Lorenz et Gris. ("pau d'arco"/19); *Schinus terebinthifolius* Raddi ("aroeira"/18); *Byrsonima sericea* DC. ("murici"/17); *Artocarpus heterophyllus* Lam. ("jaqueira"/17); and *Apuleia leiocarpa* (Vog.) Macbr ("jitaí"/17).

The community members were also asked to cite one to three species that they personally preferred. This type of analysis is important for it reveals that although there is a group of well-used species, there exists a subset that may be experiencing even greater harvesting pressure (see Albuquerque and Oliveira 2007). In this way, 62 ethnospecies were considered personally preferred, with special emphasis on the species *Pogonophora schomburgkiana* Miers. (cited by 93 informants) and *Byrsonima sericea* DC. (cited by 66 informants) that are reported to be used as fuelwoods.

The *in situ* inventory reinforces and complements the data presented above, because once again *Pogonophora schomburgkiana* Miers. and *Byrsonima sericea* DC. stand out in the fuelwood category, as does *Eschweilera ovatta* (Cambess.) Miers in the category of technology and construction, and *Pithecellobium cochliocarpum* (Gomez) Macbr. and *Schinus terebinthifolius* Raddi in the medicinal category. *P. cochiliocarpum* was cited by approximately 183 persons, indicating that it is one of the most important local medicinal resources. The bark of this tree is used to make traditional medicines. Depending on the collection and management techniques of the resource, the population structure of this species may be seriously compromised in the future. Without a doubt *P. cochiliocarpum* is a strong candidate for the development of local management strategies as this tree is one of the most important resources for making wound-healing and anti-inflammatory folk medicines, a conservation program could probably count on strong community support.

Of a total of 25 species that were inventoried both as whole individuals as well as cut individuals, 10 were classified into the "preferred" category for collecting, 10 into the "neutral" category (cutting being proportional to their occurrence), while only five into the "avoided" category (**Table 1**). The three species preferred for collecting were: "pupuna-rôxa", "sicupira" (*Bowdichia virgilioides* Kunth.), and "sete-cascos"; while the three most avoided were: "pupuna", "muta", and "coração-de-negro". This type of analysis can indicate the species (or ethnospecies) that are suffering the greatest use-pressure, those that are under intermediate pressure, as well as the species that are apparently not threatened by harvesting. It is important to mention that a plant being classified as "avoided" does not mean that it is not locally used, but rather that it is used in a much lower degree that its relative availability (Pote *et al.* 2006), or that besides being a wood resource, another part of the plant is used (such as the leaves, fruits, bark, etc.).

In the static analysis of the wood volumes encountered in 18 inventoried residences, a total of 16.6 m³. The use-category with the largest wood volume was construction (12.54 m³) (**Fig. 4**), followed by technology (2.08 m³), and fuelwood (1.97 m³) (**Fig. 5**). Data on wood volume and on socioeconomic variables were transformed into their square-root in order to normalize them. According to the paired *t*-

Table 1 Demand/offer ratio for the species inventoried as whole individuals or cut individuals in the forest fragments *Dedo de Deus* and *Cabu* near *Três Ladeiras* community, municipality of Igarassu, Pernambuco State, Brazil.

Species	Ratio: demand (%) / offer (%)
Not identified 1 (Purpuna-roxa)	15.0
Bowdichia virgilioides Kunth. (Sicupira)	9.0
Not identified 2 (Sete-cascos)	9.0
Eschweilera ovatta (Cambess.) Miers (Imbiriba)	8.1
Miconia minutiflora (Bonpl.) DC.	4.3
Pithecellobium cochliocarpum (Gomez) Macbr. (Barbatenon)	3.0
Manilkara sp. (Maçaranduba)	3.0
Pogonophora schomburgkiana Miers. (Cocão)	2.4
Not identified 3 (Pororoca)	1.8
Inga sp. (Ingá-cabeludo)	1.5
Not identified 4 (Sambaqüim)	1.1
Cupania sp. (Cabatan)	1.0
Guatteria australis A.St.-Hil. (Imbira-preta)	1.0
Apuleia leiocarpa (Vog.) Macbr (Jitaí)	1.0
Pithecellobium pedicellare (DC.) Benth. (Jaguarana)	1.0
Himatanthus phagedaenicus (Mart.) Woodson (Banana-de-papagaio)	1.0
Not identified 5 (Cabaçú)	1.0
Luehea ochrophylla Mart. (Pereiro)	1.0
Not identified 6 (Quirí-roxo)	1.0
Thyrsodium schomburgkianum Benth. (Cabatan-de-leite)	0.8
Miconia prasina (Sw.) DC. (Sabiazeiro do brejo)	0.6
Tapirira guianensis Aubl. (Cupiúba)	0.4
Not identified 7 (Coração-de-negro)	0.3
Not identified 8 (Murta)	0.3
Not identified 9 (Pupuna)	0.3

Fig. 4 Constructions with wood and mud in *Três Ladeiras* community (Pernambuco State, northeastern Brazil). (**A, B**) Arrangement of the wood in the construction; (**C**) painted wood and mud house; (**D**) dismantling process of a wood and mud construction.

Fig. 5 Fuelwood use in Três Ladeiras community (Pernambuco State, northeastern Brazil). (**A, B**) stock predominated by *Byrsonima sericea* DC.; (**C**) mixed stock; (**D**) Construction external to the household that shelters the fuelwood stove.

Table 2 Results of the *t*-test for paired samples comparing the volumes of the three wood-use categories encountered in 18 residences in the Três Ladeiras community, municipality of Igarassu, Pernambuco State, Brazil.

Category	Volume
Construction	12.54 a*
Fuel	1.97 b
Technology	2.08 b

* a and b indicate mean significantly different at P<0.01.

test (used to test differences paired by household), the construction category contained significantly greater volumes of wood than the others (**Table 2**). The low volume of fuelwood observed, however, is related to the collecting pattern observed in the community. There are usually no significant stocks of wood set aside for this end, but rather relatively small amounts of firewood are renewed at high frequency. In a dynamic analysis, considering their average turn-over time, the fuelwood category would most certainly stand out in spite of the small volume of wood visible at any given moment, for its turn-over time is very much smaller than that of construction (which can last decades).

In general, the species that were represented by the largest overall volumes of stored wood were *Eschweilera ovata* (Cambess.) Miers and *Pogonophora schomburgkiana* Miers. When classified by use-category, *Eschweilera ovata* (Cambess.) Miers and *Pogonophora schomburgkiana* Miers. were found to stand out in the construction group, while *Byrsonima sericea* DC. and *Tapirira guianensis* Aubl. headed the list for fuelwoods. Interestingly, the species represented by the largest stored volumes of wood in the technology category grow principally in anthropogenically modified areas: *Cocos nucifera* L. ("coqueiro") and *Artocarpus heterophyllus* Lam. ("Jaqueira"). These trees are sought after principally to make furniture as they have very thick trunks.

Even though *Eschweilera ovatta* (Cambess.) Miers and *Pogonophora schomburgkiana* Miers. demonstrated the largest volumes of stored wood in the static analysis, equal or perhaps more attention should be paid to the most important species in the fuelwood category (*Byrsonima sericea* DC. and *Tapirira guianensis* Aubl.). This is because, as was explained earlier, this category has the highest turnover rate and consequently the shortest replenishing time.

Simple linear regression (of the square root-transformed data) performed with the software Statgraphics Plus 5.1 demonstrate that the monthly per capita income negatively influences the general use of wood (R^2=36.16; $p<0.01$) as well as its specific use as a fuel (R^2=35.58; $p<0.01$) and for construction (R^2=38.58; $p<0.01$), in the sense that the lower the per capita income, the more wood use is seen for these purposes. Other studies have shown similar results, predicting the consumption of plant resources based on income (Gavin and Anderson 2007). Families in better financial situations can afford to substitute forest resources with alternative materials, such as natural gas instead of fuelwood in the kitchen, sawn wood (or other non-wood material) in construction in place of rough-worked native trees. In multiple linear regression for the four variables analyzed (average age of the household head, number of people living in each residence, monthly family income, and age of the oldest household member) only monthly family income significantly affected the total volume of wood encountered in the homes ($p<0.05$), the relationship being negative.

Local perception of resources

Children and adolescents who were interviewed in a school environment generally perceived local resources from a relatively similar perspective, and seemed to have been influenced by their formal instruction. **Table 3** synthesizes some of the responses of the students and how these responses are translated into sentiment and actions. By examining the central ideas extracted from the key-words in their essays it was possible to project aspects of their sentiments in relation to the forest and to other living creatures (biophilia and topophilia) (Tuan 1980; Wilson 1989) and to recognize citations with biotic and abiotic components as well as concerns about conservation themes (see Huang and Yore 2003). However, it is important to note that the students cited utilitarian aspects of the forest (removal of wood for fuel) without viewing themselves as agents of the transformations that they describe as occurring in the region. The local vegetation is placed in a very special plane, not only due to its ludical and affective aspects but also by its strong utilitarian appeal. The visions of the children and adolescents appear to vary in terms of their physiological maturity and their capacity to assimilate new ideas and concepts. Students in the 7th grade, for example, had a high presence of birds in their presentations (11 illustrations for the 5th grade, 9 for the 6th, 15 for the 7th and 10 for the 8th grade). This may be explained by the fact that a year earlier many of these students participated in an ethnographic project concerning bird species in which they were stimulated to draw

Table 3 Some central-ideas and key-expressions recognized within the discourse of the collective subject about the local vegetation among students of the *Escola Mínima de Três Ladeiras* school in Igarassu, Pernambuco State, Brazil. Modified from Silva *et al*. (2008).

Key-expressions	Central-ideas	Interpretation
"The forest signifies a very good thing...the forest is good for us and very important to us... a magic and beautiful place. The forest is everything for you and me. Without the forest we cannot live... it is a creation of God. I love the forest.	(A) "I love the forest".	Topophilia
"...there are many animals, leaves, birds... I see snakes, butterflies and mosquitoes... plants, toads, lizards and monkeys. It is full of trees.	(B) "A forest is full of plants and animals".	Biophilia
"... people are cutting and burning... there is garbage in the forest, deforestation, and many creatures are dying. I think we have to preserve.	(C) "There is much deforestation, we have to preserve".	Conservationist vision
"... I go to the forest to get firewood and to play.	(D) "I play and get firewood in the forest".	Utilitarian and ludic vision

and to write essays about the birds they knew (Farias and Alves 2007). This earlier research project apparently influenced their presentations in our current project. Additionally, we noted a strong discontextualization of formal learning with the local reality and a strong influence of the didactic texts used, as the drawing produced by the students contained floral and faunal elements that were completely foreign to the local environment. For more detailed information about the study of local representations that we performed with children and adolescents, see Silva *et al*. (2008).

In relation to the adult component of the community, the data that we have been able to analyze up to the present moment indicates a strong dependence on local resources, including wood and non-wood material. This dependence is expressed in the theme of survival, as a large percentage of the people interviewed (76%, n = 150) expressed the idea that the extraction of these natural resources was necessary in order to maintain their quality of life. It was not surprising to find that among the resources most cited as absolutely necessary for survival were wood products, especially as fuelwood and for house construction (75% of the citations). This dependence on forest resources was justified by the lack of any alternatives to using that vegetation (either for personal or commercial purposes). Although the adult community recognizes the importance of conserving the local vegetation, this view becomes conflicting when confronted with attitudes based on the imperative of fulfilling the most basic necessities of cooking and house construction.

FINAL CONSIDERATIONS

The experience in progress outlined here seeks to define a methodological and theoretical construct that can be applied, in association with other approaches, to identify biologically adequate and socially just alternatives to natural resource use in the Atlantic Forest. In combining the collected data that, we can anticipate that the community understands local resources in a wide spectrum, synthesized in **Table 4**.

Our strategy of triangulating our methods, as briefly presented here, showed itself to be efficient in validating information obtained through different data collecting techniques. Some species, for example, stand out in terms of their local use, either in terms of general uses or specifically in terms of wood uses. At the present moment the species that call for special attention because of their use-versatility include *Eschweilera ovatta* (Cambess.) Miers, *Pogonophora schomburgkiana* Miers., *Bowdichia virgilioides* Kunth., and *Byrsonima sericea* DC., as well as *Pithecellobium cochliocarpum* (Gomez) Macbr. due to its great medicinal importance.

The harvesting of tree resources for construction and fuel (among the use-categories that apparently exert the greatest pressure on the forests closest to the community under study) is directly related to the economic situation of the local population, and their dependence on these resources increases as family income and *per capita* income decrease. As such, for any conservation strategy to be effective it will have to offer alternatives to the use of certain natural products, and these alternatives will have to be accessible to and accepted by that community. Possible alternatives might include easier access to industrialized products such as cooking gas and construction material, or even the designation of certain forest areas as appropriate to supplying local necessities – but supported by community management and silviculture. This possibility, however, still needs new analysis and many adjustments. Various articles, for example, have reported that there are differences between men and women in the use of natural resources, as well as in their perception (Ohmagari and Berkes 1997; Teklehaymanot *et al.* 2007; Voeks 2007; Ramos *et al.* 2008a). Therefore new projects must take into account this dimension when considering resource management and conservation.

The indication that the youngest members of the community are open to receiving conservationist messages may be critical to the effectiveness of future actions. On the other hand, the fact that the adult population manifests its perception of nature from a "utilitarian" point of view creates a significant challenge to elaborating viable local strategies of resource conservation.

This article demonstrates the nature of the information that can be captured using these methods as well as their possible interpretative contexts. Finally, we believe that we have outlined here some of the problems related to the use of these natural resources and the important role that the local populations have in any conservation project.

Table 4 Classification of local resources based on their use and the perception of the Três Ladeiras community, Igarassu, Pernambuco State, Brazil.

Type of use	Examples
Direct use	Medicinal plants (bark, leaves), fruits, wood (construction, fuelwood etc.).
	Recreation.
Indirect use	Perception of the environment as being important in climate control and the maintenance of biodiversity.
	Biophilia.
	Affectivity, topophilia.

ACKNOWLEDGEMENTS

We thank CNPq and Ulm University (Germany) for the financial support given to the project *"Sustainability of remnants of the Atlantic Forest in Pernambuco State, Brazil, and its implications for local conservation and development"*; and for financial support ("Edital Universal" 2007) and the research productivity grants awarded to U.P. Albuquerque. We also thank the community of Três Ladeiras for the patience and attention given, specially the community health agents (Maria, Isaura, Geni, Jacine and Josefa) and the members of the "Mínima de Três Ladeiras" School.

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