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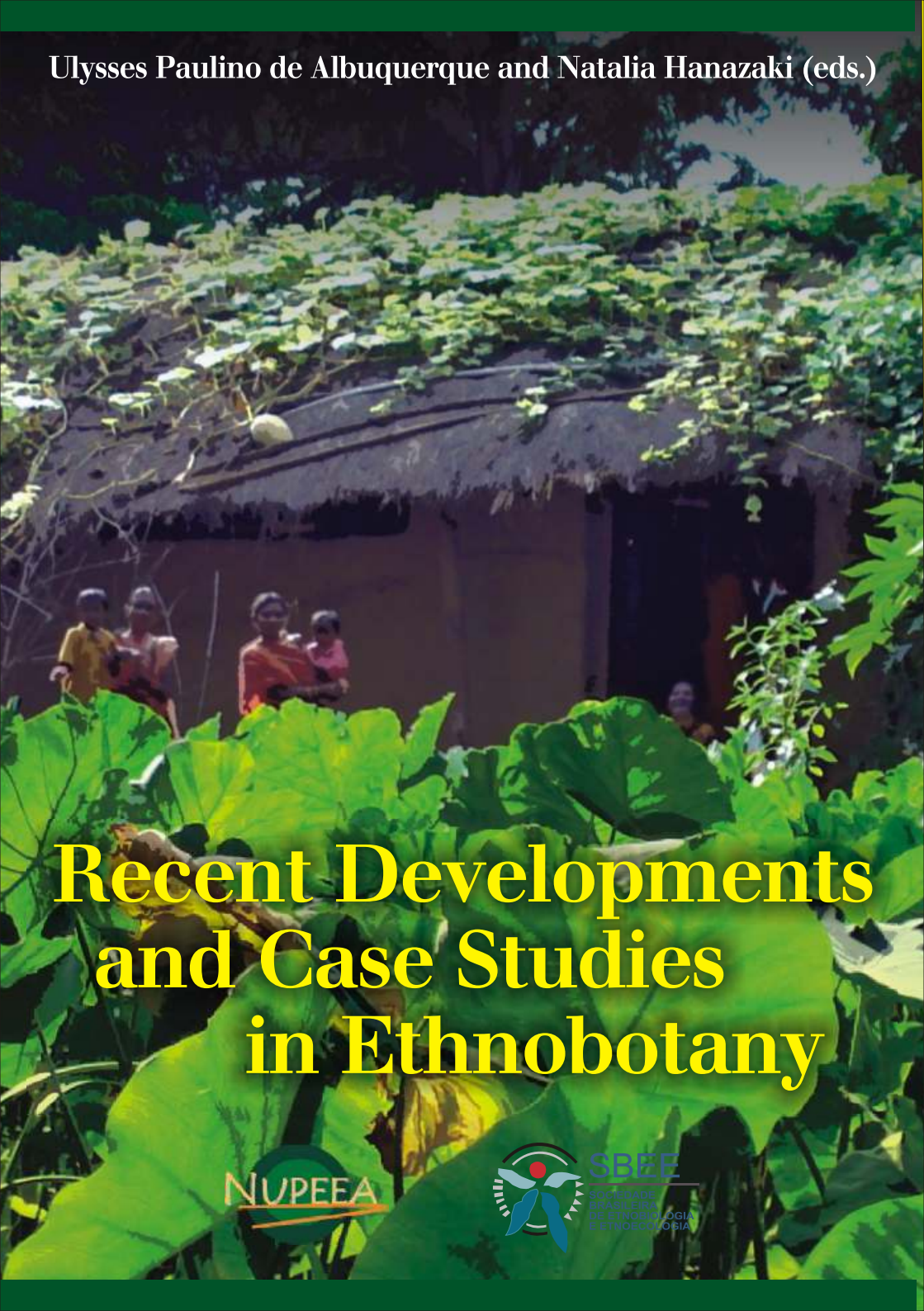

Recent Developments and Case Studies in Ethnobotany

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Chapter 13

From the forest to the consumer: the ecology, local management and trade of amapá amargoso *Parahancornia fasciculata* (Poir) Benoist in the state of Pará.

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Introduction

Plant products are the primary source of income for approximately one million of people in the Legal Amazon, which correspond to 6.25% of the population of the entire region (Pastore Júnior & Borges 1999). Non-timber forest products (NTFP) are also important because of their role in the cultural identity and public health care of rural and urban Amazonians. Numerous forest products used for particular medicinal and nutritional purposes have no plant-based substitutes (Shanley & Luz 2003). While some families choose plant-based remedies out of preference, the domestic use of medicinal plants to treat diseases remains the only health care option for many low-income people in Amazonia (Elisabetsky & Wannamacher 1993).

Currently in Latin America, the value of non-timber forest products has increased in local, regional and national markets, and for export (Alexiades & Shanley 2004). In spite of their critical importance for subsistence use and trade, however,

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there remains a significant gap in research regarding the ecology, harvest and trade of even widely used forest fruits, medicinal roots, barks, leaves, and fibers and exudates (Campbell & Luckert 2002).

National statistics can obscure rather than clarify the role of forest goods to national livelihoods. For example, in 2005, according to the Brazilian Institute of Geography and Statistics (IBGE), timber products represented approximately 85% of the extractivist production in Brazil, while non-timber products represented 15% (IBGE 2005). IBGE' statistics, however, include a minor number of internationally traded forest products such as rubber (*Hevea brasiliensis* (Willd. ex A. Juss.) Müll. Arg.), *castanha* (*Bertholletia excelsa* Bonpl) and *açaí* (*Euterpe oleracea* Martius). In 2005, only 19 species were included. This is in contrast to the Ver-o-Peso market where approximately 211 species of only medicinal plants are offered for sale (Shanley & Luz 2003). Worldwide, national statistics fail to capture the high quantities and diversity of non-timber forest products sold in local and regional markets (Campbell & Luckert 2002).

In addition to considerable gaps in market research, documentation of the ecology and management of widely used plant species handled by Amazon populations remains lacking. The absence of basic ecological information regarding density and distribution of valuable species can compromise the sustainability of the harvested products (Pastore Júnior & Borges 1999). Given their importance worldwide in industry, rural technology and health care, exudates such as resins, oils and latexes are particularly lacking in study.

The objective of this work is to understand aspects of the ecology, management, and trade of *amapá* latex (*Parahancornia fasciculata* (Poir) Benoist). Latex of *amapá* has been used throughout the last century in Brazil by rural and urban populations to combat serious diseases of the respiratory system and to fortify the body after other illnesses such as malaria. To understand the process of latex production, we traced wholesalers of latex in the major sales locales in Belém, back to the principal areas where latex is produced, in the Marajó island. In two communities of the island, we studied the ecology of the species, latex harvesting techniques, and management practices. In the first section of this paper, we present data about the marketing and social organization regarding collection and sale of *amapá* latex, followed by results of the ecological studies. We conclude by offering recommendations to enhance sustainable management of the species.

Amapá (*Parahancornia fasciculata* (Poir) Benoist) is an arboreal species of the Apocynaceae family, which occurs in the Amazon and Guyana (Ribeiro *et al*. 1999). In municipality of Ponta de Pedras, Marajó Island, the species occurs both in pristine and logged forests.

The latex of *amapá* is used by urban and rural populations in the Amazon as a medicine to heal respiratory diseases (Galuppo 2004), including bronchitis, asthma and tuberculosis. The wood of *amapá* is also used by the timber industry, especially in the production of plywood. Therefore, conflict between the use of amapá tree as timber or latex can occur, principally in logging frontiers. *Amapá* tree can reach up to 35 meters in height (Le Cointe 1947). Its white latex, originates from laticifer cells that are present throughout the whole plant (Castro & Galvilanes 2000).

Latex of the *amapá* tree has been used in popular medicine for over a century, and is currently used in the treatment of pulmonary diseases (Rodrigues 1989; Van den Berg 1993) general fatigue, to fortify the body after illness (Le Cointe 1947), as an antisyphilitic (Van den Berg 1982), and to combat anemia (Montserrat *et al*. 2001). Due to its widespread medicinal use, the commercialization of this latex, also known as "*leite*" (milk), is common in open air markets, pharmacies, and supermarkets throughout the Amazon region.

Material and methods

Study area

The municipality of Ponta de Pedras (01º23'25" S and 48º52'16" W) is located 62 kilometers from Belém (01° 27' 21" S and 48° 30' 14" W), in Pará state. It has a population of 24.276 inhabitants and encompasses an area of 3.365 km^2. Its main sources of income are agriculture and services (IBGE 2006). In Ponta de Pedras, small volumes of medicinal plants are sold in the streets or are ordered from extractivists.

The municipality of Belém has a population of 1,408,847 inhabitants and an area of 1,065 Km^2 (IBGE 2006). Official statistics indicate that services and industry are the municipality's main sources of income (IBGE 2006). The marketing for medicinal plants in Belem is well-developed, with markets and specialized stores for phytotherapic products. The *Ver-o-Peso* is the largest open market in the Amazon region, with 80 medicinal plant vendors stands, where over 200 species of medicinal plants are commercialized (Shanley & Luz 2003).

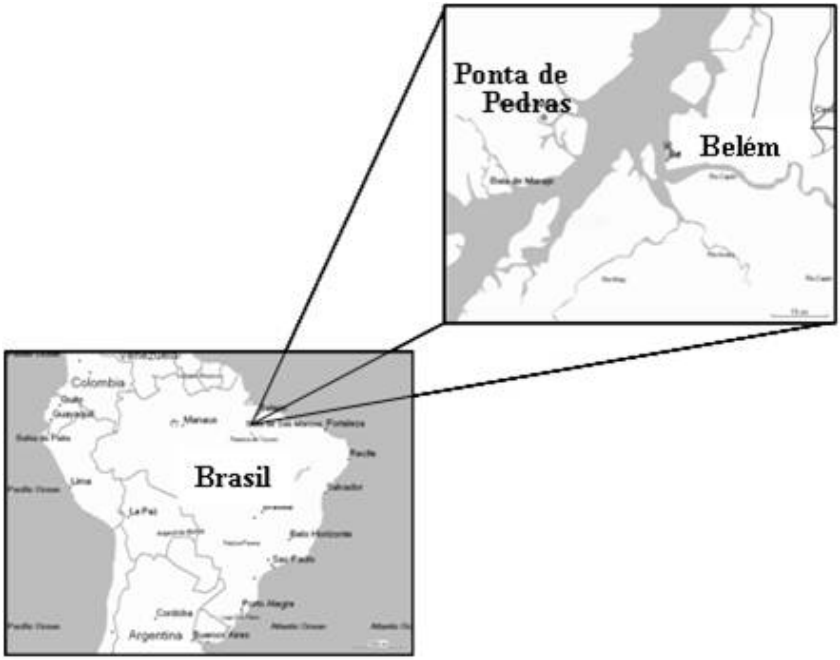

Figure 1. Location of the Study Area

Market Study

Trade data regarding latex of amapá was collected in *Ver-o-Peso* market, an extensive open air market on the estuary of the Amazon River. There, 80 stalls are devoted to sales of medicinal roots, oils, barks and resins. Among them 43 sell *amapá* latex, and 20 were included in our sample for interview with the owners. Questions included information on the origin of the latex, suppliers, the quantity commercialized monthly, sales price and outlets. The same interview was done with owners of eight shops specializing in commercialization of medicinal plants in Belém.

Semi-structured interviews were applied to eight middlemen; these included information on the origin of the latex, suppliers, the quantity commercialized monthly, sales price and outlets. Annual volume of latex commercialized was calculated by adding the monthly data on the quantities of latex commercialized. To obtain data on the collection of latex for domes-

tic use and trade, we interviewed twelve extractivist families.

To understand the origin of the product and production network of suppliers and wholesalers, we visited five communities in the municipality of Ponta de Pedras, indicated by middleman as the source of the product. In Ponta de Pedras, we interviewed all of the retailers and middlemen involved in the marketing of latex of *amapá*.

Management and Ecology

The population structure and management of *amapá* was studied in two communities of Ponta de Pedras, for the purposes of this article termed Marajó I and Marajó II.

Information regarding management of amapá for latex extraction was obtained through interviews and field work with all the twelve latex extractors in Ponta de Pedras, indicated by the middlemen. Semi-structured interviews were done in 2005 with follow-up visits each year to date. These included questions related to social organization, gender issues, percentage of latex income, total family income, and technical obstacles related to forest management.

Population structure of amapá adult tress was studied through inventory of two sites. Marajó I is a privately owned 36-hectare forest, where access is restricted for collectors with latex collection oriented toward only local use and trade. There, all trees with DBH ≥ 10 cm were measured in two 100 m x 100 m plots. Marajó II is a one-hectare forest fragment, characterized by open access; collection from this site supplies the market in Belem. All *amapá* trees in this site were measured. In both study areas, we surveyed the incidence of trees with damaged trunks. During the latex extraction process, the area of the trunk where incisions are made can become deformed, exposing various overlapping cuts, decomposed bark, and/or the presence of nodules.

Latex Extraction

In the study area, latex extraction is performed with a machete or a rubber tapper's knife. We tested each of these to determine if and how the type of tool influences latex production. This phase of the study was undertaken in the privately owned area of Marajó I, where many *amapá* trees had not been previously tapped, and where it was possible to homogenize the treatments.

In each treatment, we selected the twenty- nine existing trees, which were not previously tapped, with a DBH between 22-47 cm and an average of 32 cm, to tap for latex. Incisions in the tapping panel were made in each individual, formed by two opposite sets of six incisions, in a format of "fish bone", commonly used in the region (Fig.2). The height of the last incision in the panel was approximately 2 m, which is the maximum height that latex harvesters reach.

To reproduce the practice used by latex extractors, we made an incision in the center of the panel in the treatment with the rubber tapper's knife while in the treatment with a machete, no central incision was made. The central incision done by extractors who use rubber tapper's knife facilitates the collection of the latex. Its absence, as in the case of tappers who use machete, causes significant loss of latex. In both treatments, the latex was collected in recipients attached to the trunk of the trees. Latex was collected until the flow stopped. The collection was done from May 21st to May 23rd, 2005, from 6:00 am-12:00 pm, the time period used by latex collectors. The relationship between tree size (DBH) and latex production was analyzed through a linear regression (Rao 1998).

To evaluate the impact of the distance among the cuts in latex production, we tested double cuts that were 4, 8, 16 and 32 cm apart from each other. In this experiment, we used the rubber tapper's knife, which causes less damage to the tree than the machete. The treatment was applied to each individual four times, totalizing 16 sample units. The cuts were made at a 1.3 m height, and the volume of latex collected was measured with a graduated cylinder. To test for differences among treatments, we used an analysis of variance (Rao 1998).

Figure 2. Latex extraction with rubber tapper's knife (left) and machete (right).

Results and Discussion

Socioeconomic profile of latex extraction

In 2007, eight medicinal plant specialty stores commercialized latex of *amapá*. Latex of *amapá* is one of the leading medicinal species sold in the market of Ver-o-Peso with 46 of the 80 vendors' stands.

Data collected through interviews with middlemen indicates that more than 10 thousand liters of bitter latex of *amapá* were supplied to markets in Belém in 2005 (Fig. 3). This volume did not include the market of Ponta de Pedras, which at the time of the study had only one small outlet for medicinal plants. The municipality instead has an informal market, where trade is realized through orders placed directly from the consumer to the latex harvester. Annual per capita consumption in the site of origin, Ponta de Pedras (11.9 ml) is higher than Belem (7.5), reflecting availability and access.

The production chain of Amapá latex has five principal agents: harvesters, middlemen, informal retailers (open air markets), owners of medicinal plant stores (retailers and wholesalers), and final consumers. In Ponta de Pedras,

eight middlemen and twelve extractivists are involved in the trade of Amapá latex.

The production chain consists of two main arrangements, similar to that found for other forest products in Amazonia (Medina & Ferreira 2004; Panduro & De Jong 2004). In the most common arrangement, latex extractors sell their product directly in the market of Belém, creating a production chain that includes producer/trader/consumer. Other harvesters prefer to use an intermediary. Roles may overlap in the production chain, with agents playing more than one role. This is the case of producers, who may also be middlemen and buy latex from other producers and retailers in the markets of Belém.

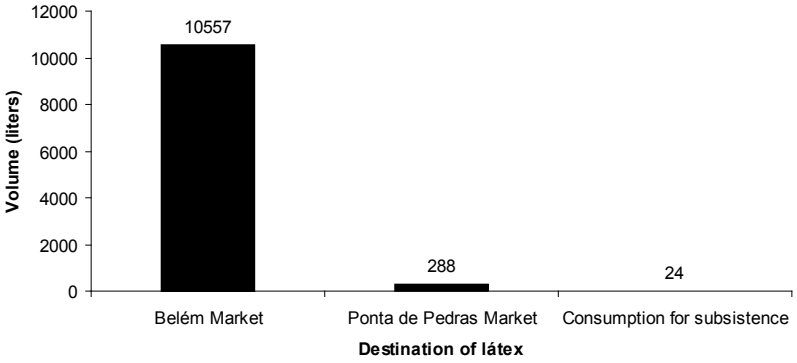

Figure 3. Consumption of latex of *Parahancornia fasciculata* (Poir) Benoist in 2005.

Ninety-seven percent of the latex originating in Ponta de Pedras is traded in the market of Belém (Fig. 3).

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Eight middlemen traded an average of 880 liters latex per month. Middlemen G and H traded the largest volumes, extracting more than 80% of their supply (Table 1). According to one of the middlemen, this practice promotes less dependency and increases the quality and safety of the product for the consumer.

Table 1: Volume and price of latex (*Parahancornia fasciculata*) traded by middlemen in Ponta de Pedras in 2005.

Middleman	Community	MonthlyVolume (l)	PurchasePrice (R$/l)	Total (R$)	Selling Price (R$/l)	Total (R$)
H	1	250	3	750	7	1.750
G	3	180	5	900	8	1.440
F	5	150	2	300	6	900
E	3	90	3	270	6	540
D	2	80	3	240	7	560
C	2	50	5	250	6	300
A	2	40	3	120	6	240
B	4	40	3	120	6	240

For the majority (7/12) of the latex collectors, the income originating from the extraction and sale of *amapá* latex represents more than 50% of the cash income (Table 2). The average volume of latex extracted per month for trade by the twelve extractivists was approximately 834 liters (Table 2). Extractivists A and F obtained the greatest gross income from *amapá* trade, since latex extraction is their main activity and they trade without middlemen. The total gross income of extractivist B originates from latex extraction; their other sources of livelihood are agriculture and livestock for subsistence. Extractivists G, H, I, K and L generally have other sources of income and trade smaller quantities of latex at a higher price. These extractivists obtain higher prices because they take into consideration the amount of time to arrive at the forest and extract the latex, even if it is a small amount. These extractivists trade the product only through purchase order, and with a pre-established price (Table 2). Findings reflect results from other studies in Amazonia demonstrating that the commercialization of medicinal plants in urban markets contributes significantly to extractivists' income (Delang 2005). Some extractivists trade latex in Belém through middlemen at lower prices, but in higher volumes

(Table 2). Some extractivists are said to dilute the latex with water and sell the product at lower prices. However, this claim is still to be confirmed.

Analysis of the percentage of final value distributed among economic agents revealed that traders accumulate about 41% of the product's final value, extractivists obtaining 31%, and middlemen 28% (Table 3).

Table 2: Production, price and monthly income obtained from extraction and trade of latex (*Parahancornia fasciculata* (Poir) Benoist) among extractivists in Ponta de Pedras, in 2005.

Extractivist	Volume (l)	Selling Price (R$/l)	Income from amapá (R$)	Total family income (R$)	Percentage of total income from amapá (%)
A	230	7	1.185	1.500	79
F	150	8	930	1.450	64
D	120	3	360	700	51
E	100	5	500	700	71
B	90	2	180	180	100
C	80	2	160	300	53
J	40	3	120	300	40
I	12	15	180	350	51
G	4	15	60	300	20
L	4	16	64	500	13
K	2	16	32	400	8
H	2	12	24	350	7
Average	70	9	64	586	47

Latex harvesters tend to work individually. Men are involved in tapping and extraction with women participating sporadically in the cleaning, conservation and packing of the product. Although agriculture associations exist in each community, few latex harvesters are part of producer associations. Generally, there is no prior planning or community control of the number of trees tapped or of the time period between subsequent latex extractions. Allowing for the trees to recover seems not to be a concern.

The majority of latex harvesters perceive the resource as abundant, allowing for cyclic exploration and sufficient time for trees to recover. Nonetheless, some harvesters are interested to improve their management practices, particularly after observing a decrease in latex production due to unplanned management and exploitative harvesting.

Table 3: Percentage of the final value distributed among economic agents based on selling prices (SP)

Intermediary	Extractivists		Intermediary		Trader	
	SP (R$)	(%)	SP (R$)	(%)	SP (R$)	(%)
A	3	30	6	30	10	40
B	3	25	6	25	12	50
C	5	50	6	10	10	40
D	3	25	7	33	12	42
E	3	30	6	30	10	40
F	2	20	6	40	10	40
G	5	42	8	25	12	33
H	3	25	7	33	12	42
Average	3	31	7	28	11	41

Ecology and management

Despite the fact that *amapá* (*P. fasciculata*) species is widely used and traded, there are still gaps regarding the species ecology. Even latex collectors who have a significant knowledge about latex extraction do not have a clear understanding of the density of trees and/or volume of latex produced by trees in their vicinity.

Results of the inventory in Marajo I indicate that an average of 75 individuals occur per hectare (DBH ≥ 10 cm), with a variation of 66 to 85 individuals per hectare. In the community of Marajó II, 33 individuals occur per hectare. The population of the community of Marajó I presented a J-shaped curve, indicating stability in the structure of the population (Fig. 4). In the community of Marajó II, the sampled population presented a distribution indicating natural or anthropogenic disturbance (Fig. 4). The average density of individuals in the two communities, 54 individuals per hectare, is high compared to other high value medicinal species in the tropics. For example, *copaíba* (*Copaifera guianensis* Desf.), *mururé-pagé* (*Brosimum utile* (Kunth) Pittier), *jacareúba* (*Calophyllum brasiliense* Cambess.), *jatobá* (*Hymenaea courbaril* L.), and *casca-doce* (*Pradosia huberi* Ducke) occur in average densities of only one to four individuals per hectare (Santos and Ferreira 2005), an indication of the productive potential of *amapá* as compared to these species. The high density and clumped distribution of *amapá* trees in each site may reflect

the ecology of the species, as extractors have not indicated planting or management of regeneration to increase the species density.

In the community of Marajó II, extractivists have open access to trees. Open access has resulted in a relatively high number of trees with damaged trunks, which compromises their production level and health. Open access may be a factor in the lower density of productive individuals in Marajo II than I. Tapping which cuts into the bark too deeply and/or in wide swaths, can result in damage to the structures that transport the tree sap and eventually cause decay of the trunk (Ribeiro *et al*. 1999). Studies regarding communal resource management indicate that, in general, improved management initiatives are related to areas of restricted access (Arnold 1998), whereas in open access areas overexploitation is common, a situation known as the tragedy of the commons, after Hardin (1968).

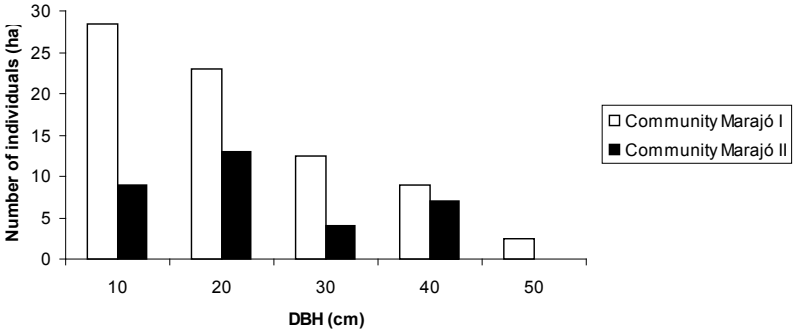

Figure 4. Diametric distribution of *Parahancornia fasciculata* (Poir) Benoist individuals in the communities of Marajó I and Marajó II.

In the community of Marajó I, where rules have been established to allow time for the bark to regenerate , damage to individuals and the population is less common (Fig. 5).

In Ponta de Pedras, latex producers indicate that they tap trees of only 25 cm DBH or more. According to harvesters, smaller diameter trees are not tapped because they produce low levels of latex. Harvesters indicate that the distance and access to mature productive *amapá* trees is the most important factor in the decision to tap or not to tap a tree. In the community of Marajó II, where access to *amapá* trees is not restricted, we observed that the number of trees with damaged trunks is high; such indiscriminate tapping can lead to resource depletion (Peters *et al.* 2007).

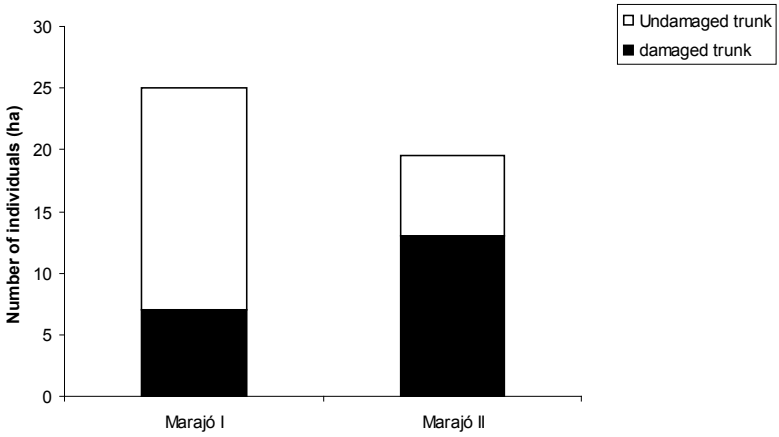

Figure 5. Status of the trunk of *Parahancornia fasciculata* (Poir) Benoist in the communities of Marajó I and Marajó II.

Effect of DBH, extraction tools and practices on latex production

Results demonstrate a significant positive correlation between tree DBH and latex production, independently of the tool used for tapping (Fig. 6). Nonetheless, there is a correlation between the two variables and the linear regression is stronger when a rubber tapper's knife is used (n=28; t=6.26; p<0.001) as compared to a machete (n=29; t=4,00; p<0.001) (Fig. 6). The regression coefficient is also greater when a rubber tapper's knife is used. One explanation for the observed difference is the severe loss of latex when the cut is made with a machete, as seen in Figure 2, which is expected to be also correlated to the tree DBH.

In the past, due to its availability, the majority of latex harvesters used machetes to extract latex. Recently, collectors with prior experience tapping rubber with a rubber tapper's tool started using it to tap *amapá* trees. They employ the rubber tapper's knife as well as a "fish bone" design in cutting incisions in the bark. The tool as well as the design has been shown to be more efficient for the extraction of *amapá* latex (Reis *et al*. 2006). Among the twelve latex harvesters interviewed, ten use a rubber tapper's tool.

In the case of *amapá* latex, each tool has a significantly different impact on

the health and vigor of the tree. Incisions made by the rubber tapper's knife are narrow and less deep and do not reach the xylem. These cuts heal quickly, between six and twelve months. However, tapping a tree with a rubber tapper's tool requires more time and care. Incisions made with machetes are wider and deep, causing nodules in the vascular cambium and deforming the tapping panel. Such damage to the tree leads to decreased latex production and facilitates the presence of pathogenic microorganisms and insects in the tree, which can cause the death of the individual (Abasolo 2003). Studies undertaken in the Philippines with almaciga (*Agathis philippinensis* Warb.) also demonstrate the destruction of the vascular cambium due to deep cuts (Ella 2000).

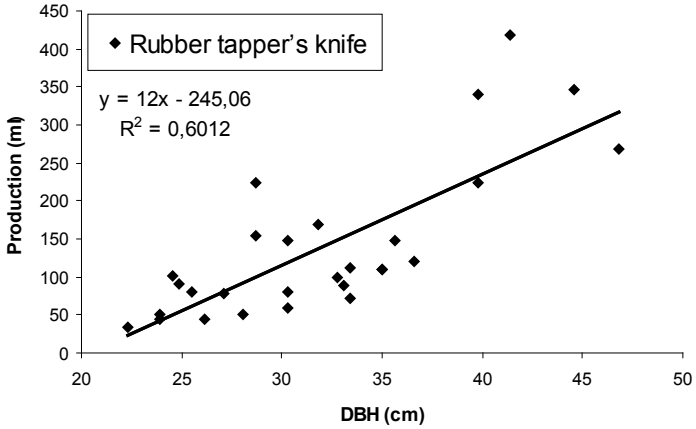

Figure 6. Latex production per individual of *Parahancornia fasciculata* (Poir) Benoist based on tree DBH and the tool used to make the incisions.

The majority of latex harvesters make cuts with a distance of approximately 32 cm from each other, but some make cuts 4cm - 1m apart. When testing the latex production as a function of distances between two subsequent cuts, no significant statistical difference was found (g.l.=3; 15; F=2.60; p=0.100). Nonetheless, the distance of 32 cm between the cuts resulted in almost the double of the latex production compared to the smaller distances (Fig. 7). This result suggests that new experiments should be developed with a greater number of repetitions to compensate for the natural variability in the environment.

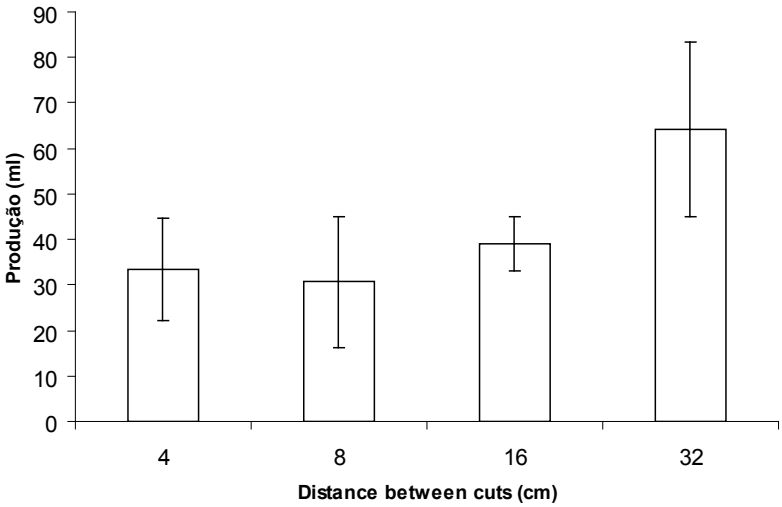

Figure 7. Average latex production of *Parahancornia fasciculata* (Poir) Benoist individuals based on the distance between cuts in the trunk (error bars represent 95% confidence intervals).

Latex production depends on the type of laticifers tubes found in the plant. In the case of bitter *amapá* (*P. fasciculata*), which belongs to the Apocynaceae family, laticifers are not connected (Fahn 1978). Therefore, a large distance between cuts is required in order to access a greater supply of latex in the same plant.

Results demonstrate that the highest volume of latex production observed in this experiment, is produced from incisions that are 32 cm apart, which is what many latex collectors apply. Local understanding of the anatomy of the tree appears to have guided the extraction practice of the majority of latex collectors who generally make incisions far apart. These results indicate that the harvesting practices of collectors are well adapted to the physiology of the plant, reflecting complementarity of traditional knowledge and the sustainable harvest of *amapá* latex.

Conclusion

Amapá latex is an important component of public health care in the regional economy of the Brazilian Amazon. The latex offers affordable treatment for common and serious ailments for rural and urban Brazilians. Given the rise in respiratory diseases internationally and the resistant strains of disease such as tuberculosis, locally derived plant-based remedies for common and chronic ailments may become more important.

Locally, in Ponta de Pedras, the product represents a considerable portion of the income of latex extracting families, and is also widely used for domestic consumption. Within urban centers the species is widely used by all classes of society. Although *P. fasciculata* remains invisible to policy makers, the formal health care sector and economists, the trade between rural and urban areas of this product remains strong as and its role in livelihoods significant.

The results of this study indicate that the average density of *amapá* (33-75 individuals per hectare) is high if compared to other tropical arboreal species used for medicinal purpose. The high population density and clumped nature of *P. fasciculata* (Poir) Benoist facilitate latex collection yet, in this site, appear to be an natural ecological characteristic of the species as collectors have not displayed or indicated management practices to enhance species density.

The results of this study demonstrate that the use of the rubber tapper's knife is more efficient in the management of *P. fasciculata* (Poir) Benoist because it prevents latex waste during extraction, as well as tree damage. The distance between cuts, 32 cm apart, used by latex collectors employing a rubber tapper's tool, promotes a larger production of latex compared to smaller distances, indicating that harvesters' practices reflect a local knowledge of the tree coincident with the plant anatomy. Use of the rubber tapper's tool also reflects the spontaneous adaptation of a used technology by collectors of latex from other species.

The social and political context of latex harvesting is also important to the species maintenance and harvest. Latex collectors, in this case study, reflect a lack of organization, particularly, a lack of criteria for or agreement to managing communal areas. Community derived management plans focusing on the economic species of greatest importance to local livelihoods could allow for longer term harvesting and trade, contributing to the livelihoods of both rural and urban populations.

References

Abasolo, E.P. 2003. Evaluating the sustainability of almaciga resin production practices in Samar, Philippines. **Tropical Forest Update ITTO 13**(3).

Alexiades, M.N & Shanley, P. 2004. Productos Forestales, Medios de Subsistencia y Conservación: estudios de caso sobre sistemas de manejo de productos forestales no maderables. Pp. 01-22. In: M.N. Alexiades & P. Shanley (org.). **Productos Forestales, Medios de Subsistencia y Conservación: estudios de caso sobre sistemas de manejo de productos forestales no maderables**. Bogor: CIFOR.

Arnold, J.E.M. 1998. **Managing forests as common property**. (FAO Forestry Parer 136) Rome: FAO.

Campbell, B.M & Luckert, M.K. 2002. **Uncovering the hidden harvest: valuation methods for woodland & forest resources.** People and Plants International. London: Earthscan. 240pp.

Castro, E.M. & Galvilanes, M.L. 2000. **Morfoanatomia de plantas medicinais. Curso de plantas medicinais: manejo, uso e manipulação**. UFLA. Lavras. 163pp.

Delang. C. O. 2005. The market for medicinal plants in Sapa and Hanoi, Vietnam. **Economic Botany 59**(4): 377–385.

Ella, A. 2000. **Improved tapping of almaciga tree for sustained resin yield. In: Seminar Proceedings Harvesting of Non-wood Forest Products**. Turkey, FAO/ECE/ILO.

Elisabetsky, E. & L. Wannamacher. 1993. The Status of Ethnopharmacology in Brazil. **Journal of Ethnopharmacology 38**: 137-143.

Fahn, A. 1978. **Anatomia Vegetal**. H. Blume Ediciones. Madri. Pp 169-178.

Galuppo, S.C. 2004. **Documentação do uso e valorização do óleo de piquiá (*Caryocar villosum* (Aubl) Pers.) e do leite do amapá-doce (*Brosimum parinarioides* Ducke) para a comunidade de Piquiatuba, Floresta Nacional do Tapajós. Estudos Físicos, Químicos, Fitoquímicos e Farmacológicos**. Master Science Dissertation. Universidade Federal Rural da Amazônia – UFRA. Belém. 92pp.

Hardin, G. 1968. The Tragedy of the Commons. **Science 162**: 1243-1248.

Instituto Brasileiro de Geografia e Estatisitica (IBGE). Available in: www.ibge.org.br. 15 ago 2006.

Instituto Brasileiro de Geografia e Estatisitica (IBGE). 2005. **Produção da extração vegetal e da silvicultura**. Brasil.

Le Cointe, P. 1947. **Amazônia brasileira III. Árvores e plantas úteis (indígenas e aclimatadas)**. Pp. 27-28. Companhia Editora Nacional. São Paulo. 2ª.

Medina, G. & Ferreira, S. 2004. Bacuri (*Platonia insignis* Martius): O Fruto Amazônico que Virou Ouro. Pp. 201-216. In: M. Alexiades & P. Shanley (org.). **Productos Forestales, Médios de Subsistência y Conservación: Estudios de Caso sobre Sistemas de Manejo de Productos no Maderables**. Bogor: CIFOR.

Montserrat, R.; Regina, C.V.; Sabogal, C.; Martins, J.; Silva, R.N.; Brito, R.R.; Brito, I.M.; Brito, M.F.C.; Silva, J.R. & Ribeiro, R.T. 2001. **Benefício das plantas da capoeira para a comunidade de Benjamin Constant**. CIFOR, Belém, 54pp.

Panduro, M.P. & De Jong, W. 2004. Camu-camu [*Myrciaria dubia* McVaugh (H.B.K)] desmarque arbusto amazonico de áreas inundables com Alto contenido de vitamina C pt Loreto, Peru**.** Pp. 275-294. In: M. Alexiades & P. Shanley (orgs.). **Productos forestales, medios de subsistencia y conservacion: estudios de caso sobre sistemas**

de manejo de productos forestales não maderables. Vol. 3 - América Latina. CIFOR, Bogor, Indonésia.

Pastore Junior, F. & Borges, Vag-Lan. 1999. **Extração florestal não-madeireira na Amazônia: armazenamento e comercialização.** Brasília, ITTO – Funatura Ibama – Lateq-UnB, 73p. www.google.com.br in 06/07/05.

Peters,C.M.; Henderson, A.; Maung,U.M.; Saw, U.L.; Ohn, U.T.M.; Lwin, U.K. & Shaung, U.T 2007. The rattan trade of Northern Myanmar: species, supplies, and sustainability. **Economic Botany 61**(1): 3–13.

Rao, P.V. 1998. **Statistical research methods in the life sciences**. University of Florida, USA. 275pp.

Reis, A.R.S; Galuppo, S.C; Almeida, E.F; Serra, M & Freitas, A.D. 2006. Anatomia da Casca e Distribuição dos Laticíferos em *Parahancornia fasciculata* (Poir) Benoist (Apocynaceae). In: **Anais do 57º Congresso Nacional de Botânica**, Gramado.

Ribeiro, J.E.L.S.; Hopkins, M.J.G.; Vicentini, A.; Sothers, C.A.; Costa, M.A.S.; Brito, J.M.; Souza, M.A.D.; Martins, L.H.P.; Lohmann, L.G.; Assunção, P.A.C.L.; Pereira, E.C.; Silva, C.F.; Mesquita, M.R. & Procópio, L.C. 1999. **Flora da Reserva Ducke: Guia de identificação das plantas vasculares de uma floresta de terra-firme na Amazônia Central**. Manaus: INPA. 816 p. il.

Rodrigues, R.M. 1989. **A flora da Amazônia**. Belém: CEJUP. 462 p.

Santos, M.A.C. & Ferreira, M.C. 2005. Inventário de Espécies Medicinais Empregadas pelo Iepa, Macapá-AP. **Amazônia: Ciência. & Desenvolvimento 1**(1): 159-179.

Shanley, P. & Luz, L. 2003. The Impacts of Forest Degradation on Medicinal Plant Use and Implications for Health Care in Eastern Amazonian. **Bioscience 53**(6): 573-583.

Van Den Berg, M.E. 1982. **Plantas Medicinais na Amazônia - Contribuição ao Seu Conhecimento Sistemático**. Belém: CNPq, 223 p.

Van Den Berg, M.E. 1993. **Plantas medicinais na Amazônia**. Coleção Adolpho Ducke. Museu Paraense Emílio Goeldi. Belém. 206pp.

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