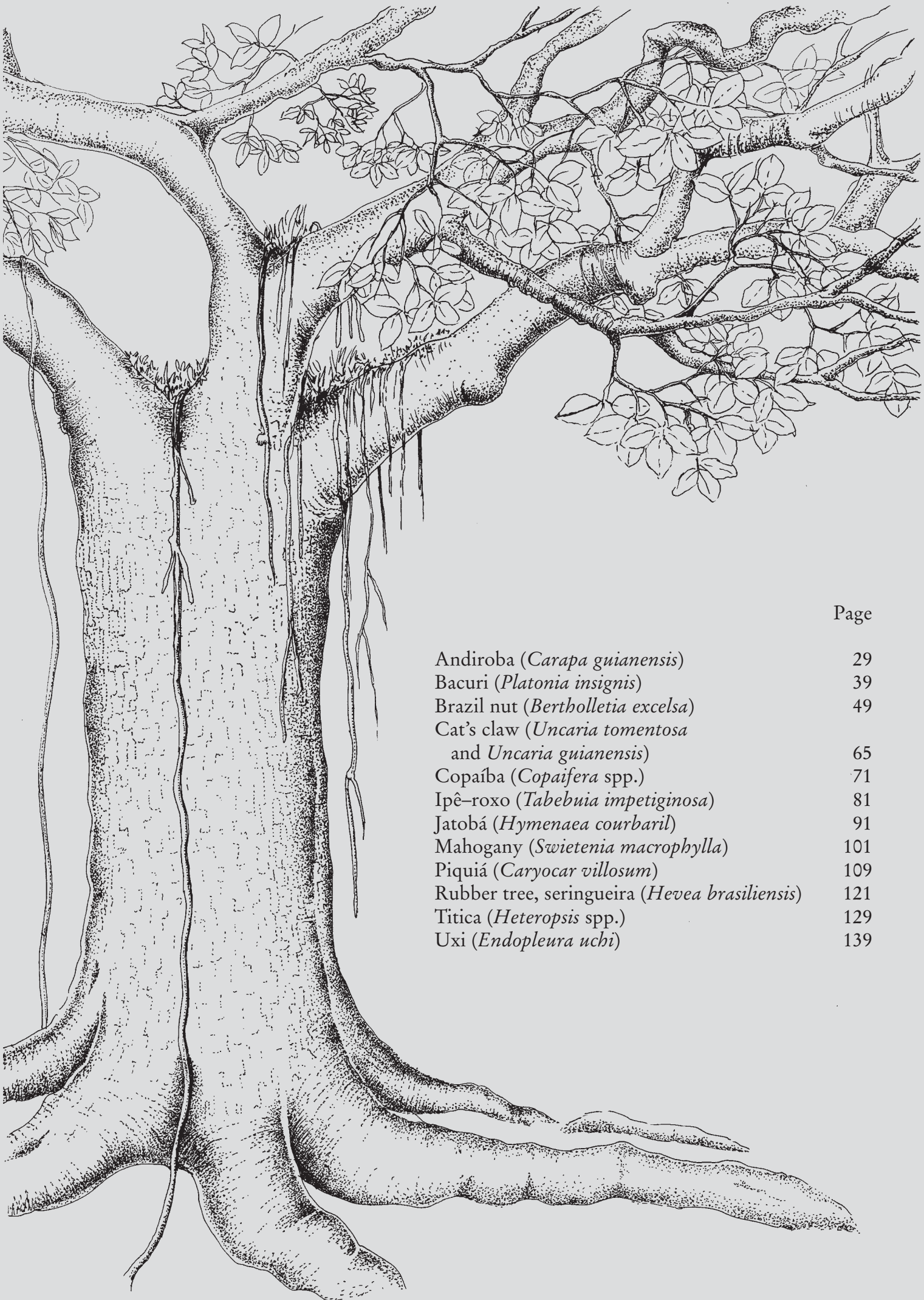
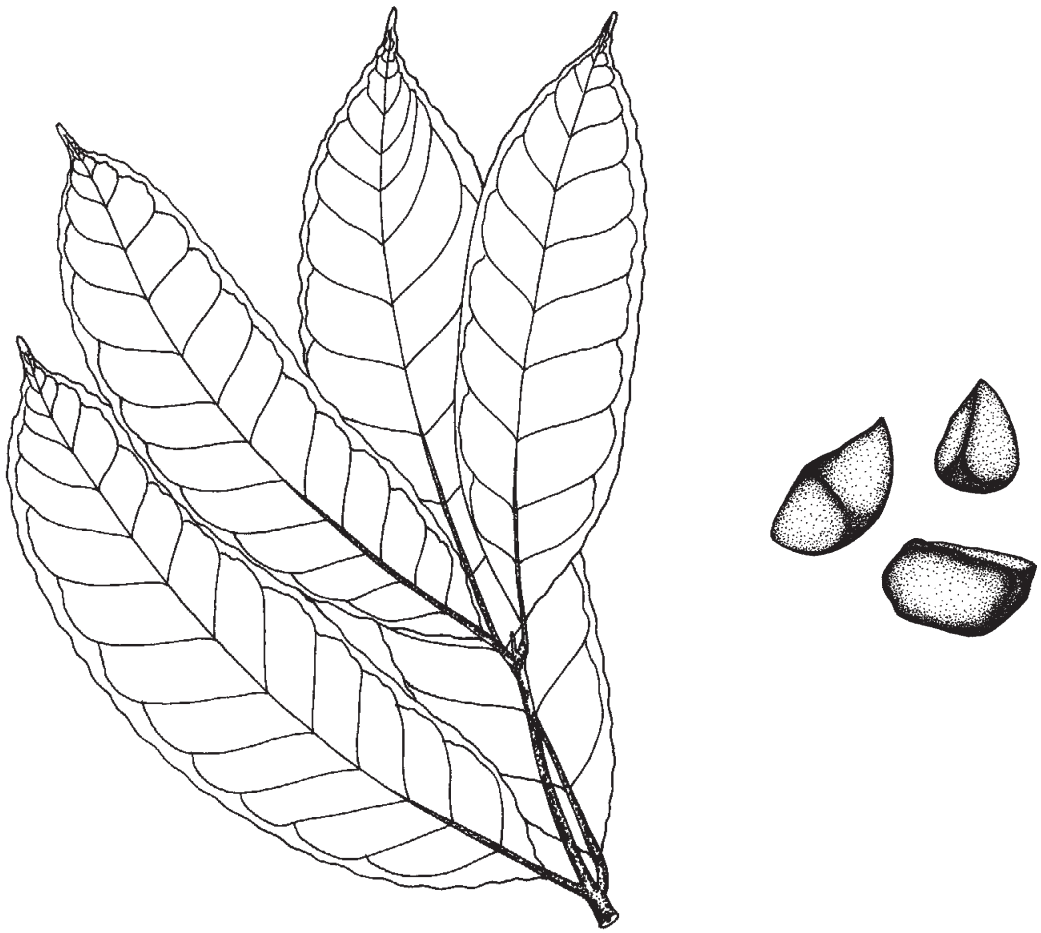
Trees and vines



Andiroba

Carapa guianensis Aubl.



Patricia Shanley
Marina Londres

A powerful anti-inflammatory medicinal oil extracted from the seeds of andiroba is one of the most widely used natural remedies in the Amazon. Andiroba oil can mend badly sprained ankles, repel mosquitoes and is used in veterinary medicine to cure the infected cuts of animals. Indigenous groups in Brazil have traditionally painted their skin with a mixture of andiroba oil and the bright red pigment from the seeds of urucu (*Bixa orellana*). Andiroba is also valued for its bark and wood. The bark can be made into a tea to fight fevers, worms, bacteria and tumours. In addition to its lightness and durability, andiroba wood is bitter and oily, deterring attacks by termites and caterpillars. Because the deep, golden-hued wood is of superior quality, andiroba is considered on a par with mahogany. For this reason, andiroba is increasingly difficult to find in logged areas.

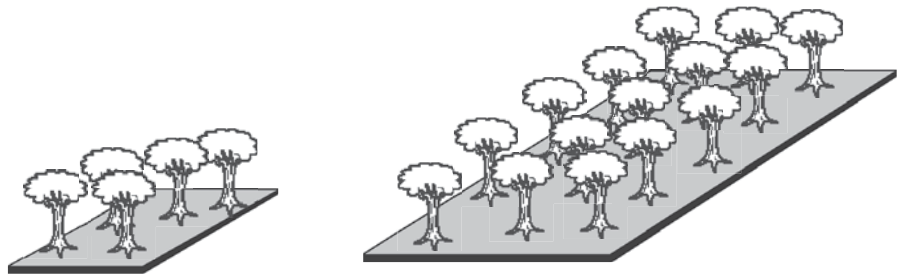
Andiroba trees have straight trunks that can reach 30 m in height, often with buttress roots. Growing throughout the Amazon basin, Central America and Africa, andiroba prefers seasonally flooded forests and the margins of rivers, but it is also found in terra firme forests.

ECOLOGY

Flower and fruit seasons

Andiroba's flowering and fruiting seasons vary by region. In eastern Pará, andiroba flowers from August through October, and its fruits mature from January through April. In Manaus, andiroba trees produce fruit between March and April.

Density

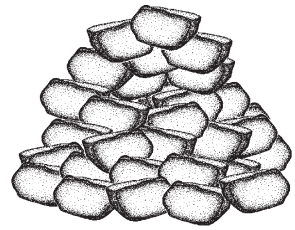


1 to 8 trees/ha

5 to 38 trees/alqueire

Andiroba trees grow in terra firme forests, but they are most commonly found in várzea.

Production



an average of
4–10 kg in várzea
0.3–3.4 kg in terra firme
of seed/tree/year

The mysteries of andiroba fruit production are still unfolding. Some years a tree may bear hundreds of fruits, and others none at all, but the factors that drive this phenomenon remain unknown.[1] Likewise, we lack the long-term studies necessary to recognize patterns of fluctuation in production for an andiroba population, but one study observed three years of low fruit production followed by two years of plentiful production.[2] Moreover, every year there is a percentage of trees within a population that produces zero fruit, and these percentages also vary drastically between years. A study conducted in the Amazon estuary region[3] found that, for a given year, 23% of the adult andiroba trees did not produce any fruit, and a study in Acre[2] found that 82% of the trees did not produce in one year compared to 35% of the trees the following year. For those trees that do produce seeds in a given year, scientists have also measured very divergent levels of annual seed production: from as low as 0.02 kg of seed/tree to as high as over 100 kg of seed/tree. Although production among individual trees seems to be extremely variable, recent studies have reported that averages of fruit production (including adult non-producing trees) within a given population vary between 4.4 and 10 kg of seed/tree[3] in várzea and between 0.3 and 3.4 kg of seed/tree[2] in terra firme. Each kilogram contains about 55 seeds, and each fruit contains from 12 to 16 seeds. The seeds are composed of approximately 26% shell and 74% nut.

The table below shows some of the ranges in production numbers documented by researchers. Variation in production can be due to numerous biophysical factors such as whether the population occurs in várzea or terra firme. The methods used to determine production estimates in the following studies may differ, particularly the sample size and the number of years the study was conducted. It is important to emphasise that the ranges represent the amplitude (maximums and minimums) of production among individuals within a population. However, averages are the appropriate estimate to be used if managers are to extrapolate production from inventory data.

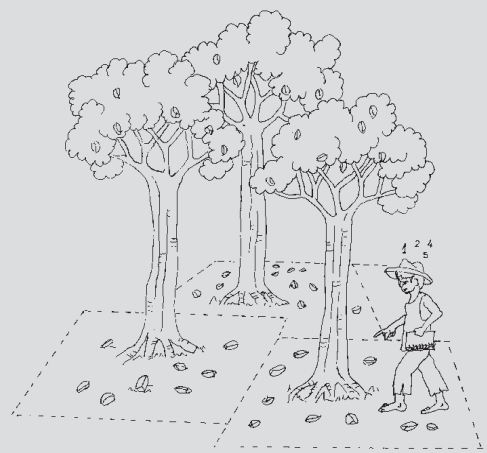
Location	**Habitat (may include different forest types within the "general" habitat)**	**Annual production/tree (note if average or range)**
La Selva, Costa Rica[1]	terra firme	Range of 750–3 900 seeds approx. 15–79 kg
Alto Rio Guama, Pará, Brazil[4]	terra firme	Average of 1.2 kg
Santarem, Pará, Brazil[5]	terra firme	Range of 0–50 kg
Gurupá, Pará, Brazil[3]	várzea	Average of 4.4–10 kg, Range of 0–155 kg
Acre, Brazil[2]	terra firme	Average of 0.3–3.4 kg, Range of 0–16 kg

How many fruit? A method to estimate production

André Dias

Scientists do not yet know the productivity of many species of tropical trees, even those, like andiroba, that have extensive markets and valuable uses. However, to make good use of forest resources it is important to know which trees are in a particular forest, where they are located and how much they can produce. In the community of Pedreira, Pará, a study was undertaken to estimate the average number of fruit an andiroba tree produces per year. Researchers counted all the andiroba trees in a given area and all the fruit that fell beneath a sample of 100 trees.

To estimate production rapidly, they grouped fruit productivity into categories from low to high. The results showed that 37 trees produced little or nothing; 43 trees produced up to 15 kg, 13 trees produced between 15 and 50 kg and 7 trees produced greater than 50 kg.[5] Extrapolating to the larger forest, the community calculated that their forest could produce a little over 1 200 kg of seeds/year. Thus they were able to estimate the labour required to produce the oil, as well as their potential annual earnings.



ECONOMIC VALUE

Andiroba oil is one of the most widely sold natural remedies in Amazonia. The oil industry has its origins in the city of Cametá, in the state of Pará, and its commercialization generates significant employment and income throughout Amazonia. In Cametá, children eagerly collect and sell andiroba seeds. Street kids relate that 4 kg fetch them US$0.10 – enough to buy a pack of crackers. In Salvaterra, on Marajó Island, which lies in the mouth of the Amazon River, unemployed men, women and children comb the beach for seeds washed down from inland rivers. In 2004, they could sell 1 kg, about 55 seeds, for US$0.07 to companies in São Paulo. In 2009 in the Belém market, 1 litre of andiroba oil cost, on average, US$6. Stores often buy the oil during the harvest when prices are low, hold on to the oil and sell it out of season at a higher price.

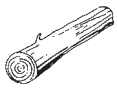
The oil is also in demand internationally and is exported to Europe and the United States of America. From 1974 to 1985, between 200 and 350 tonnes of oil were exported annually, mainly from the states of Maranhão, Pará and Amapá. In 2009, in the United States of America, an 8-oz bottle of andiroba oil can be purchased over the Internet for between US$23 and US$40.[6] One proof of andiroba's popularity is the number of soaps, creams, oils and candles made from andiroba on the market in the Amazon region and throughout the world. In the supermarkets of Belém, the soaps can cost from US$1.50 to US$5, while body oil (50 ml) costs US$3. A 150-g bag of andiroba bark costs US$1.

Whereas supermarkets, pharmacies and corner vendors sell andiroba in Belém, in the western Amazonian state of Acre andiroba oil is hard to find in the market: few communities in Acre produce andiroba oil, and those that do generally produce it for local consumption.

The wood from andiroba, called 'false' or 'bastard' mahogany, is also in high demand for export. In 2004, it could be found in Pará sawmills for US$68/$m^3$ sawn. For export, 1 m^3 did not sell for less than US$170. While in the United States of America, 20 board feet (0.05 m^3) of andiroba is sold for US$157.[7]

USES

Oil: Andiroba oil is widely used as a medicine for bruises, sore throats, inflammation, arthritis and worms, as well as to help heal umbilical cords. In the countryside, andiroba is commonly applied on the skin to promote the growth of scar tissue and to repair skin damage. But one must use caution – it can create scar tissue on the surface before the internal wound has properly healed. The oil also works as an insect repellent and is an ingredient in soap production. Rubber tappers take advantage of andiroba oil for lamp fuel. Indians mix smelly andiroba oil with the bright red pigment from the seeds of urucu to paint their skin.



Wood: The wood is of excellent quality, a brilliant honey-brown in colour, and resistant to attacks from insects and caterpillars. Shingles are often made out of andiroba, and builders rely on it for civil construction.

Bark: Thick and bitter, the bark can be removed easily in large pieces. It is used to make tea to prevent fevers and worms, to fight bacteria and to treat tumours. Ground into powder, it can be used to treat wounds, skin ailments and to promote the growth of scar tissue.

"Remedy of the saints"

In Brazil, plants that are extremely effective at curing ills, such as garlic, copaiba and andiroba, may be called "santo remedio" or " remedy of the saints". Rubbing andiroba on serious injuries can speed recovery. Apart from helping a sprain or wound to heal, andiroba keeps mosquitoes and other insects from landing on the wound. The oil is also useful for animal injuries. Horses often develop serious saddle sores. Andiroba oil soothes and heals their skin and helps to promote hair growth.

Lost knowledge

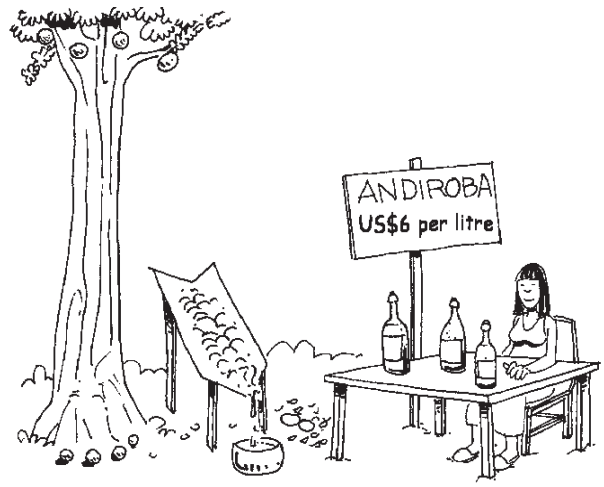
In the community of Pedreira, Pará, one farmer noted, "In the 1940s there weren't more than eight houses here. We lived by hunting, selling andiroba oil, animal skins and breu resin (*Protium* spp.). In the 1950s we began to tap rubber, selling the latex of maçaranduba (*Manilkara* spp.). Now we produce farinha and work less in the forest. Today, the young don't even know how to extract andiroba oil. The trees are there, but they are going to waste."[5] In other regions, knowledge regarding the uses and ecology of plants and animals is not being passed on simply because the trees and wildlife no longer exist. When flora and fauna vanish from the local landscape, ecological knowledge of those species also fades.

Backwoods processing: the key to andiroba's curative power?

With a group of ecologists, Gloria Gaia, a forest farmer from the countryside, visited the Department of Chemical Engineering of the Federal University of Pará (UFPA). She and an esteemed phytochemist exchanged ideas about how to produce andiroba oil. She explained, "My mother left the seeds covered with green leaves for 30 days to ferment, then worked an additional week or two to extract the oil." Gesturing to the machines around him, the phytochemist swiftly replied, "Guess how much time it takes me using solvents and presses? Only one hour!" Sceptical, Gloria asked him if the chemical substances that cure people also occur in the rapidly produced oil. He responded that scientists do not yet know; but they have discovered that some of the components of the traditionally-produced, fermented oil do not appear in the swiftly-produced industrial oil. Might these components be responsible for the medicinal properties of the oil?

Traditional techniques for extracting oil

Gloria Gaia



There are many ways to extract andiroba oil. One process is referred to as making "board oil". The oil made from this process is called virgin because it's absolutely pure and of the best quality. Making "sun oil" is faster and less work-intensive. Both processes begin in the following way. Boil the seeds until they are soft. Break a few open and use your fingernails to test if the flesh is thick and oily, seeing if your nail can pass easily through it. Take the seeds out of the water, spread them on the ground, cover them with green leaves and let them sit for 40 days. After 40 days, open all the seeds with a knife and remove the flesh. Knead the pulp and make small balls. In Cametá, women first soften the pulp with their feet, and then later with their hands.

Board oil

Place the balls in a trough made of wood or metal, an old canoe, or two pieces of wood joined long-ways in a V shape, with one end of the trough leaning towards the ground. Place a fine strip of cotton from the edge of the pulp to the end of the inclined trough; this way, the oil will run directly from the trough into the container. Knead the pulp every day. After four to six days, the pulp will become hard and dry. To obtain more oil, place it in the sun. You can also use a *tipiti* (fibre sieve) to extract the remaining oil.

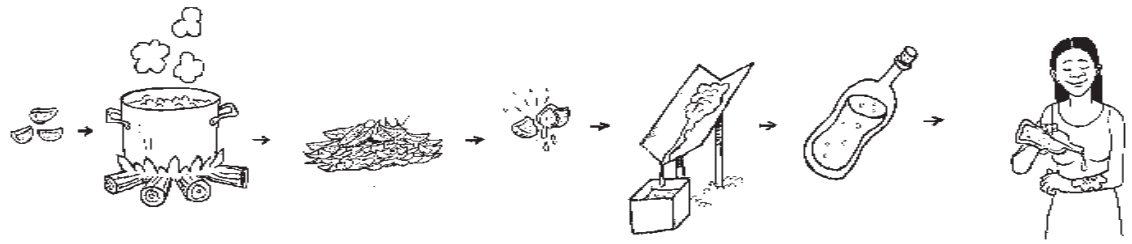
Sun oil

Leave the pulp in the sun for two days, turning it over every two hours throughout the day. At the end of the second afternoon, take the pulp inside and shape it into softball-sized balls. Place them on inclined boards to allow the oil to drip out. On the third day, heat the pulp in the sun again for three hours, and then place the pulp in a *tipiti* for two days to extract the rest of the oil. The sun process produces more oil, but many believe that some of the oil's potency is lost. The dry pulp of the andiroba seeds can be used to make soap or tossed into the fire to repel mosquitoes.

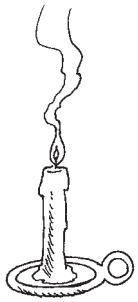
Variation in oil yields

André Dias

In Amazonia, production varies greatly depending on the mode of extraction. Production with the use of a press has been estimated at between 8 and 12 litres/40 kg of seeds.[8] Sometimes collectors do not have time to boil the seeds the day they are harvested, or they cannot retrieve the pulp before it starts to rain. Communities often extract the oil without a press, or with only a homemade sieve, and therefore produce less than by the industrial method. The table below compares production and summarizes how Dona Maria and Dona Rita from Santarém and Dona Glória from Cametá make the oil.



Dona Rita	Dona Marita	Dona Glória
40 kg of seeds were boiled 4 days after they were collected.	40 kg of seeds were boiled the same day they were collected.	40 kg of seeds were collected and stored in a container with water so as not to lose moisture, and then they were boiled.
The boiled seeds were stored in a sack for 26 days.	The boiled seeds were stored in a sack for 15 days.	The boiled seeds were covered and stored for between 30 and 40 days in a dark corner of the house.
The pulp that was removed from the seeds was placed in the sun the same day.	The pulp spent 5 days in the shade.	The pulp spent 3 days covered in a pan.
For 19 days the pulp stayed in the sun, was kneaded once in a while and kept out of the rain.	The pulp stayed in the sun for 14 days, was kneaded every day and was always kept out of the rain.	The pulp was kneaded and left in the sun for the oil to run out.
40 kg of seeds produced 1 litre of oil.	40 kg of seeds produced 3 litres of oil.	40 kg of seeds produced 4–5 litres of oil.



Mosquito repellent and dengue fever

Andiroba oil can be used as a repellent against gnats and mosquitoes. It also reduces inflammation caused by insect, snake and bat bites. Studies by the Amapá State Research Institute (IEPA) discovered that candles made from the dry remnants of andiroba seeds repelled the mosquito that carries dengue, *Aedes aegypti*.[9]

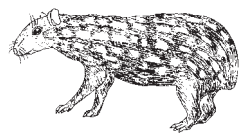
Women earn respect and income

The Tapajós National Forest has an abundance of andiroba and other NWFPs that sell briskly at good prices in local markets. Due to the richness of forest resources in their villages, a group of resourceful women from the communities of São Domingo, Nazaré and Pedreira decided to start an andiroba oil business together. To sell the oil legally, they had to surmount numerous legal and logistical obstacles. These included developing a management plan and securing permission from the Brazilian Environmental Protection Agency (IBAMA) to transport the oil. Through perseverance and hard work, the women's endeavour has met with success and enables them to contribute to their families' incomes while earning them respect among their peers. One of the secrets of the business's success is the participation of older women; it is only the elders that still know the best techniques for extracting andiroba oil.

Recipe for soap

Place 1 litre of andiroba oil in a pan to boil with 4 kg of melted cow tallow. Boil for 30 minutes and add 250 g of silicate or caustic soda if you have it. If you would like scented soap, try adding various fragrant herbs. Boil until thickened. Allow the mixture to cool and place in a mould. Finally, cut the soap into pieces and store. In the countryside, it is customary to add ashes from cacao shells mixed with water to the tallow and andiroba oil. This kind of soap is used to wash clothes, to clean itchy skin, or to treat skin infected with ringworm or fungal infections. To make the cacao ashes, simply burn the dry skins of the fruit. The best ash is white (very strong and acidic) and should be stored in a jar in a dry place.

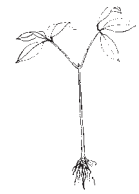
WILDLIFE



The bitter andiroba seeds are appreciated by paca and agouti. Just as squirrels collect and hoard acorns, agoutis sometimes eat the seeds beneath the trees; other times, they bury the seeds to eat later. Fortunately, they do not always remember where they hid them, and new trees spring up.

Management

germination
10 days



growth
1.6 m/year

production
10 years

Neuza Boufleuer and Cristina Lacerda

Andiroba has great potential for agroforestry because it produces both excellent wood and medicinal oil. Germination begins in the first six days and ends after two or three months with 85–90% of the seeds sprouted. Andiroba grows rapidly, even in degraded areas, both in sun and shade. For this reason, planting andiroba is a good way to enrich secondary forests and other degraded areas. But be careful with the seeds because rodents like to eat them. Although andiroba grows best in flooded forests, it can also be planted in terra firme. Scientists do not yet know if it is better to plant seedlings close together or spread apart, in full sun, in partial shade or in mostly shade. It seems that in the initial phase the trees grow well in the shade, but light is important for rapid development over time. When andiroba trees are in full sun, the trunks increase in diameter rather than gain height[8], and when they are close together, they are more susceptible to insect attacks.

Women for sustainability: rethinking timber vs. seed extraction

Carlos Augusto Ramos and Marina Londres

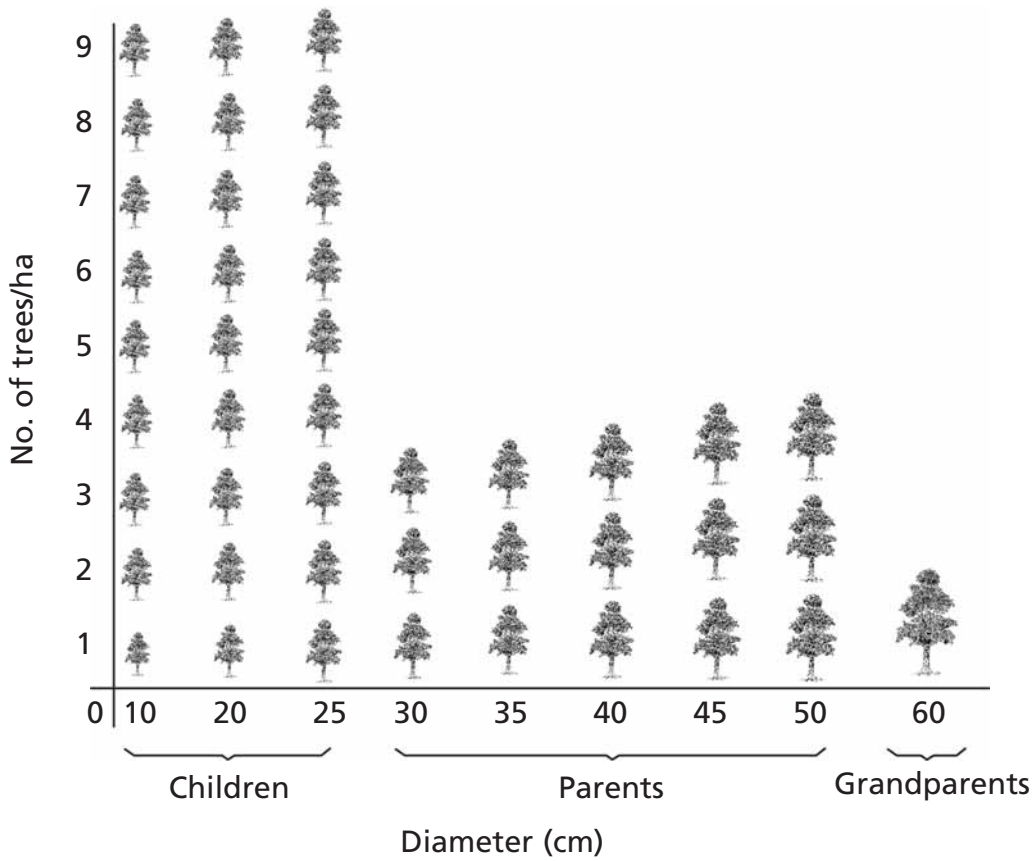
An extended family of healthy trees demonstrates a wide variety of ages, including many children, a number of parents and a few grandparents. This means that the family will continue to reproduce well into the future. When there is not a sufficient distribution of generations, the species could have difficulty maintaining the population.

One study in the São João do Jaburu community in Gurupá, Pará, illustrated that the andiroba population had many grandchildren, few parents and almost no grandparents. No trees over 60 cm diameter were found. Why? The locals had been accustomed to selling big trees for timber. Thus, many of reproductive trees were lost to the timber trade.

Through the initiative of village women, the communities are now rethinking their use of andiroba to focus on oil production. To ensure that seed collection did not further decimate the andiroba population, community members have been working together with ecologists[3] to count and monitor andiroba seed production. They fenced off the ground below the crowns of andiroba trees using nylon fishing nets and monitored the fruit fall weekly. From the 2006 monitoring results, it was possible to estimate the total seed production of andiroba populations within the community forest lands, and compare production with the total amount of seeds harvested by the community. The contrast was stark: the community was collecting less than 1% of the total seeds produced in the

forest. This illustrated that the community can increase seed extraction and oil production without significantly affecting andiroba regeneration; increased oil production in turn promises to increase family incomes and improve the prospects of preserving both the community and its forests.

Where are our parents and grandparents?
Andiroba diameter classes



[1] McHargue, L.A. & Hartshorn, G.S. 1983
[2] Klimas, C. 2010
[3] Londres, M. 2009
[4] Plowden 2004
[5] Dias A.S. 2001
[6] www.grasshuttreasures.com/amazonoils.html and www.rain-tree.com/andirobaprod.htm
[7] http://www.woodworkerssource.com/Andiroba.html, July 15, 2008
[8] Clay, J.W., Sampaio, P.d.T.B. & Clement, C.R. 1999
[9] O Liberal 1998

Bacuri

Platonia insignis Mart.

Patricia Shanley
José Edmar Urano Carvalho
Gabriel Medina
Socorro Ferreira

In the quiet, early morning hours before dawn, village children walk barefoot for kilometres to arrive at the base of bacuri trees. They brave the dark woods to beat their friends to the chase. Under the branches of these magnificent trees, they crack open the thick green rinds of the bacuri fruit to taste the soft white, aromatic flesh within, then carry home as many as they can. The popularity of the fruit has increased in cities as well, giving rise to a variety of products in the market, such as yoghurt, jam, liquor, cake and sweets. The name bacuri comes from the indigenous language Tupi-guarani, where "ba" means fall and "curi" means soon. Bacuri is the fruit which falls as soon as it ripens.

This beautiful tree can reach 15 to 25 m in height and 1.5 m in diameter, or almost 5 m around. It has a straight trunk, which exudes a yellow latex, and opposing branches that form a "V" that can be recognized from a distance. Its shiny leaves are opposed, and it has large, lovely flowers with pink petals. The bacuri tree is native to the state of Pará, and the area of greatest concentration is the estuary of the Amazon River, particularly in the Salgado region, and the island of Marajó.[1] It grows in the states of Maranhão, Piauí and other areas,[1] but rarely in western Amazonia.[2] Bacuri is also seen in parts of Colombia, Venezuela, Guyana, Suriname and French Guiana. Bacuri is found in primary forest but also occurs in secondary forest. Because it re-sprouts from the stump when felled and responds well to fire, it can regenerate in degraded areas of various soil types, except dry soils.

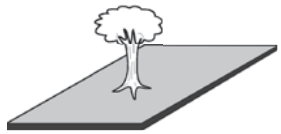
ECOLOGY

Flower and fruit seasons

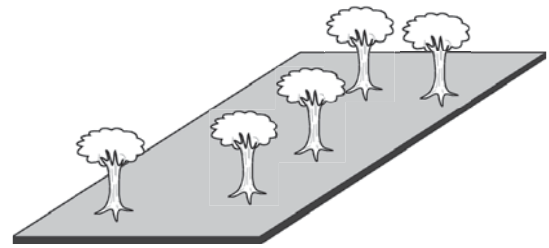
J F M A M J J A S O N D

The bacuri flowers from June to August and appears in the markets of Belém during the rainy season, from January to April. Luckily, the timing of the harvest of this delicious fruit varies by region, prolonging its availability in the market. Early in the season, the island regions like Marajó supply Belém; later, the fruit is supplied by the Bragantina area. In recent years, collectors in the state of Maranhão are also supplying bacuri fruit to vendors in Belém.

Density



0.05–1.5 trees/ha



2–7 trees/alqueire

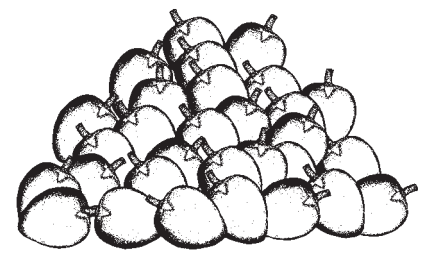
Density varies from region to region. Bacuri occurs in low densities in primary forest, about one tree per hectare. In tall secondary forest of ten years or more, it is possible to find 1 800 bacuri saplings/ha.[3] The bacuri tree is fire resistant. Some say the more it is burned, the more it buds. If a bacuri tree is cut and burned in the process of preparing an agricultural field, various shoots emerge from the trunk and the roots. If these are protected, they will grow into trees, forming large bacuri stands.

Production

A bacuri tree can produce up to 2 000 fruits in a year, but the average is about 400. Many bacuri trees do not produce fruit every year; they rest from one year to the next. In a five-year study with a sample of 16 trees, an average of nine trees were productive per year.[4] Potentially, 50 trees in 1 hectare can produce:

9.5 tonnes of fruit
= 1 tonne of pulp
= 6 tonnes of peel
= 2.5 tonnes of seed, which can be used as animal feed[5]

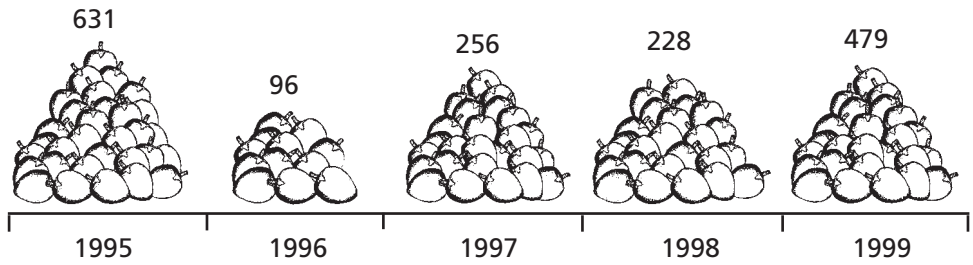
The fruit normally has a thick rind and two seeds and is 10% pulp by weight. New research has discovered fruit without seeds, which have 18% pulp.[6] Some bacuri fruit with thin skins can have 28% pulp.[6]



an average of
400 fruit/tree/year

How many fruits per year?

Because bacuri is so delicious, it is worth the effort to know exactly how many fruits the trees produce. Look at the average production of 16 trees over a five-year period:



Some people hit the tree with a machete, believing the impact will make the tree produce more. But be careful, this practice may only encourage the fruits to fall prematurely.

Economic value

According to one vendor, "Bacuri is turning to gold in the market"[4]. Recent prices reflect this popularity: in February 2003, in the Ver-o-Peso market, one bacuri fruit cost between US$0.10 and US$0.25 each, depending on its size. In 2008, the fruit ranged from US$0.30 to US$0.60. In January 2009, in the same market, bacuri cost from US$0.40 to US$0.65 each. One kilogram of pulp, which sold for US$2.60 in 2003, fetched US$5.90 in 2008. A sack with 100 fruit sold for from US$18 to US$41. In 2009, a chocolate filled with bacuri cost US$0.40. In 2003, a litre of Bacuri liquor cost US$4 in the supermarkets.

In February 2001, approximately 4 000 fruits/day were sold at the Bragança outdoor market alone.[3] That market increased threefold in five years. In the ten main open air markets in Belém, more than 491 000 bacuri fruits were sold in 2004, with 178 000 sold in the Ver-o-Peso market alone. The commercialization of bacuri generated more than US$74 800 in 2004. In one morning, more than 10 600 bacuris arrived at the Açaí Fair, coming from Soure and Ponta de Pedras on Marajó Island.

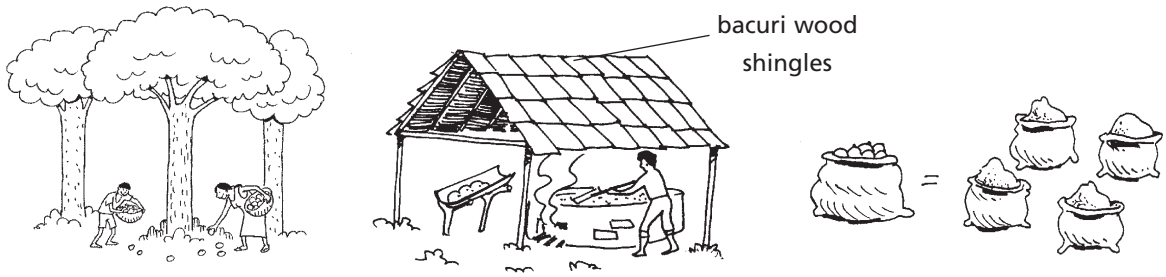
Bacuri is one of the most popular fruits in the wholesale markets of São Luís, Teresina and Belém.[7] Its sweet pulp is used in puddings, ice creams and juices. In areas close to markets, women, children and the elderly collect bacuri. Near Bragança, during the harvest, each collector earns approximately US$4 for three hours of work.[3]

Fruit or farinha?

During the 1995 harvest, when Curumim and Antonino from the Rio Capim region sold bacuri, one sack of fruit (150 to 200 pieces) was approximately equal to the value of four sacks of farinha. They estimated it took one day to collect US$40 worth of fruit (200 fruits at US$0.20 each).

To produce the same US$40 worth of farinha, it would have taken approximately one week. An advantage of marketing bacuri rather than other forest fruits is that its thick skin protects the pulp on the journey to the market, and the fruit stays good for up to seven days under the tree.

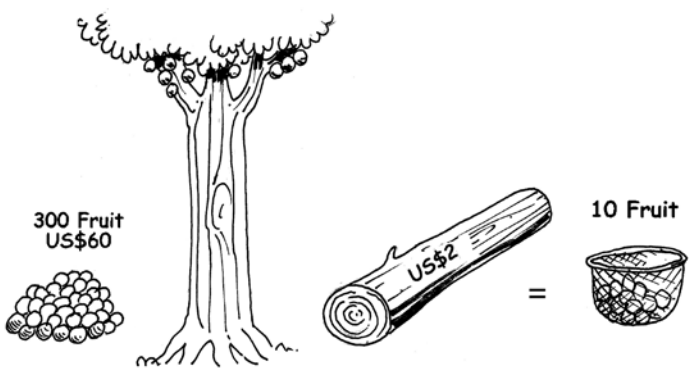
Labour for US$40 worth of bacuri and farinha



Fruit or wood?

Similarly, Curumi and Antonino compared the value of the fruits of the bacuri tree to the value of its wood. One tree trunk in the forests of some communities in this region of Pará was sold for US$2. In the same period, ten bacuri fruit were worth the same amount (ten fruit at US$0.20/fruit). Being hunters from Rio Capim, they thought about this. Their experience indicated that one bacuri tree produces an average of 400 fruits/year. They estimated that their families, the neighbours and the animals in the forest ate 100 of those, leaving approximately 300 fruit on the ground.

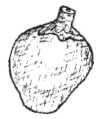
Curumi and Antonino decided to collect those fruit and send them to market. With about two days of labour, they were able to collect and sell the fruit. Even with the fluctuation of prices during the harvest, they earned US$40 for the 300 fruits from this one tree in one year. The sale of a tree for its wood can only be done once, but its fruit can be sold every year that the tree is productive. To earn the same money from lumber sales, they would



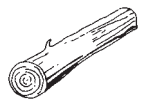
have to sell 20 trees. Curumi and Antonino understand that a standing tree is much more valuable to them than if it were sold to loggers or cut down to make way for agriculture.

Of course not everyone is able to sell his or her fruits. Many lack transport, are unable to secure a stand in the market, need to work in the fields or have an illness in the family. But even without selling a single fruit, it is important to remember the invisible profits from the bacuri tree. The fruit is an excellent source of nutrition for the whole family and can also be used to make liquor, juice and sweets.

USES



Fruit: The fruit pulp is used in juice, frozen crèmes, ice cream, jam, sweets, flan, cakes, yoghurt, frozen ice treats and liquor. In Belém, chefs are creating dishes incorporating bacuri, and businesses are canning pulp to sell to other states.



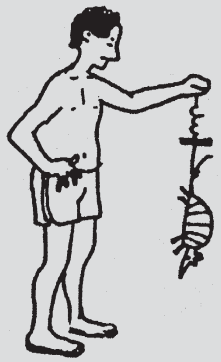
Wood: Bacuri wood is of excellent quality and is used in construction, in boatbuilding and for making furniture. In the interior of Pará, the wood is used to make shingles.

Oil: Bacuri oil appears in soaps and is recommended by some to treat skin diseases and to heal cuts on animals.[8]

Latex: The yellow latex produced by the tree is used in a few regions to treat eczema, herpes and other skin problems.[8]

Invisible income

Leda Luz, Margaret Cymerys and Patricia Shanley



To measure the importance of the forest in the household economy, 30 families in three communities along the Capim River weighed all of the forest products they extracted during 1994. The results showed that over the course of one year the vines, game and fruit that an average family extracted were equivalent to 25% of their average annual income. Expert hunters catch game for their families with a value equivalent to half the average annual income. Buying fruit, fibres and meat would be exorbitantly expensive for many rural families whose main source of income is the sale of farinha and timber. The primary forest provided 85% of the vines, 87% of the fruits and 82% of the game extracted. It is advantageous that communities consider this invisible income before selling wood or forested land. Communities can negotiate with loggers to conserve areas of forest that have many useful tree species as well as conserving patches of forest which may serve as corridors for wildlife, linking them with other wooded areas. Villagers can also plan to preserve areas adjacent to the forests of neighbouring communities or ranchers allowing for a higher biodiversity throughout. With planning, it is possible to manage the forest to extract wood as well as fruit, vines, oil and game.

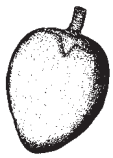
NUTRITION

Bacuri pulp is an important source of minerals that can be eaten by growing children to strengthen their bones and teeth. It is high in fibre and provides some protein. Every 100 g of pulp offers 105 calories, more than cupuaçu and less than uxi and açaí, as well as 7.4 g of fibre, 33 mg of vitamin C, 20 mg of calcium, 1.9 g of protein, 36 mg of phosphorous and 2.2 mg of iron.[9]

A large percentage of a fruit's weight is its rind. Each fruit differs, but by weight: approximately 10–12% of the fruit is pulp, 18–26% is seed and the rest, rind (exocarp).[10,11] The rind also has a delicious flavour and with the proper preparation can be eaten. To make the bacuri rind palatable, it must be cooked to eliminate the heavy resin content. It also becomes more delicious when you mix in 20% to 30% pulp. There are a number of other recipes that are made with milk and sugar. Experiment!

Recipes

Bacuri rind marmalade



Peel six bacuris, remove the seeds and set the pulp aside. Wash and boil the peels until soft. Pour out the boiled peels into a colander and remove the outer skin. Mix in 250 g of sugar and 1 litre of water. Boil until it becomes syrupy. When the syrup begins to thicken, add the pulp. Continue boiling and stirring for 30 minutes, taking out any residue of resin. Turn off the flame when the mixture begins to pull away from the bottom of the pan.

Frozen crème of bacuri rind

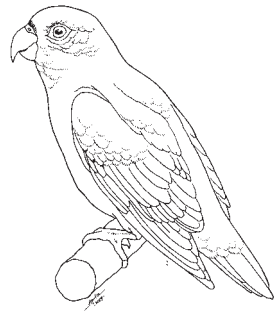
The bacuri rinds should be cut, washed and boiled until they are soft. Next, scrape the inner rind away from the outer skin with a spoon. For five or six rinds, mix in one can of condensed milk, one can of cream, ¼ cup of sugar and ¼ cup of pulp. Put the mixture in a glass cake pan and place it in the freezer. It will be ready to serve in about one hour.

Juice of bacuri peel

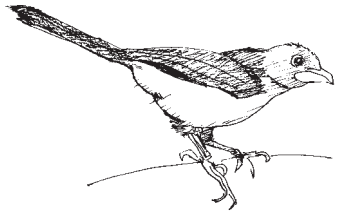
Grate the peel of three medium-sized bacuris. Let it soak in 1 litre of water for 24 hours. Strain the mixture. Add sugar and drink.

NOTE: Cooking oil can be used to remove the bacuri latex from pans and utensils.

WILDLIFE



It is likely that fruit-eating animals enjoy the large bacuri fruit, but little research is available on its consumption by wildlife. Animals such as rodents and monkeys that are able to gnaw through the thick rind should be able to attain the sweet pulp inside. Bacuri is unique as it is one of the few trees in the neotropics known to be pollinated by large perched birds. Many trees in Amazonia are pollinated by hovering birds, like hummingbirds, but few have flowers designed to attract parrots. Bees enter bacuri flowers to collect pollen, but only birds such as the white-bellied parrots, and golden-winged parakeets successfully pollinate the flower.[12] Other birds observed pollinating bacuri fruits in central Amazonia include the white-eyed parakeet, yellow-rumped cacique, purple honeycreeper, silver-beaked tanager, blue-grey tanager and palm tanager.



MANAGEMENT

germination
1–2 years

growth
fast in the sun,
50 cm to 1 m/year

production
8–10 years

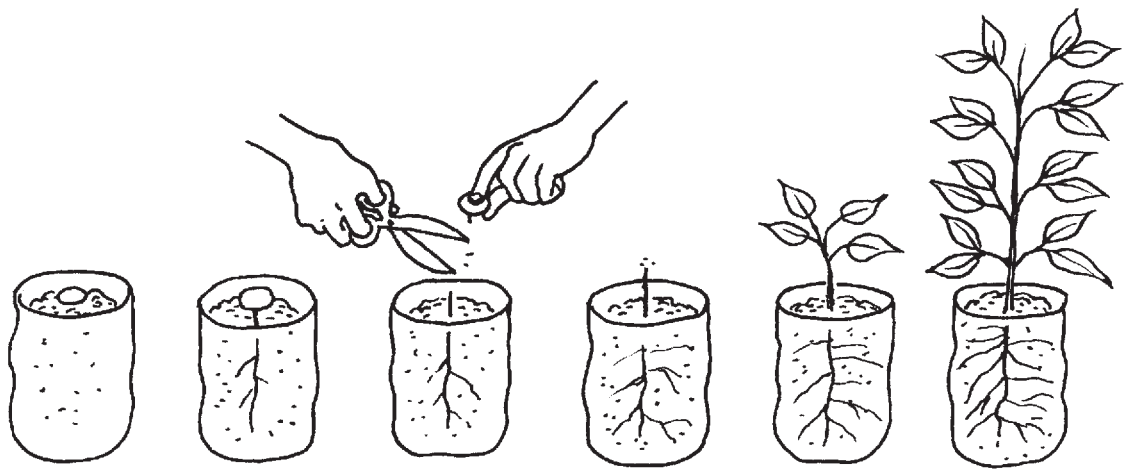
The bacuri is a tree with multiple uses (fruit, wood and resin) and a high economic value. As we have seen, it is more valuable standing than sold as timber. For this reason, bacuri trees should be preserved in their environment, as well as planted and managed in degraded areas. The bacuri tree grows well in poor soil, with best production in open areas with a lot of sun. Because of the high value of the fruit at the beginning and the end of the harvest, those who have trees that produce between seasons should maintain them carefully.[13]

In areas of secondary forest where bacuri sprouts easily from the roots of old trees, as is the case in the Bragantina region in Pará, farmers are implementing management plans. Taking advantage of the proximity of markets and the high price of the fruits, some farmers are reserving a few areas to grow bacuri trees. For example, in the community of Taquandeua, after harvesting manioc from their shifting cultivation plot, families let the forest grow back. After one year, bacuri trees dominate the area. The best trees are selected and maintained at a distance of 4–8 m between them, while the rest of the area is cut and farmed. After ten years of selective cutting, many families are already eating and selling bacuri from their managed plots.[3] In these areas, people only cut a bacuri tree in cases of extreme necessity.

Speed your seeds

If bacuri does not grow in your area on its own, you can plant it. You can do this in one of two ways: by planting the seeds, which take two years to germinate, or by planting grafts and sprouts that produce earlier. A good way to get sprouts quickly and cheaply is to plant a seed and wait 70 days for the roots to grow. Then cut the seed and leave the root in the ground. From the severed root, after two months, a small yellow sprout will grow, which requires a few more months to develop. You must wait about four or five months until the sprout reaches about 40 cm and is ready to be transplanted. A seed with a small piece of root can be used to form new sprouts. Just repeat the process. From one seed it is possible to obtain three or four sprouts. The recommended space for this planting is 10 x 10 m, reaching up to 115 plants/ha. Using this method you can have sprouts ready in less than one year.[14]

Be careful not to use seeds from the same tree. To produce, a bacuri tree needs a few birds, like the golden-winged parakeets, to bring the pollen of other bacuri trees that are a good match for it.[15] Scientists recommend that it is better to use fruits from up to ten different trees to avoid genetic incompatibility among the saplings, which can cause mature trees to be unproductive.



Other bacuris

Douglas C. Daly

Bacuri has many relatives. Normally they are small- or medium-sized trees that grow beneath the canopy in terra firme forest and have yellow bark and fruit. The pulp that surrounds the seeds is white, sweet, acidic and refreshing. Become familiar with the relatives of this favourite tree:

Species	Fruits	Occurrence	Adult tree size
Bacuripari liso *Garcinia (Rheedia) brasiliensis* Mart.	Yellow, round, approx. 3 or 4 cm in diameter, smooth, containing 1 to 3 seeds.	Primarily in flooded forest, most commonly in Central Amazonia, but also reaching as far as Bolivia, Paraguay, southwest Peru, Guyana, French Guiana and the Atlantic forest.	Small, between 5 and 8 m.
Bacuri, bacuripari *Garcinia (Rheedia) macrophylla* Mart.	Yellow, oval, from 6 to 8 cm in diameter, with a short stem on the end, smooth, with 4 seeds. Sold in many markets.	An ecologically flexible species, growing in terra firme forest, seasonally flooded forest, permanently flooded forest (*igapo*), and secondary forest. Probably native to Amazonia but with ample distribution in the northern region of South America. Widely cultivated.	Size varies, generally between 12 and 15 m.
Bacuri mirim *Garcinia (Rheedia) gardneriana* (Planch. & Triana) Zappi	Hanging, yellow, more or less oval with a long stem at the end, only 3 or 4 cm long in total, with 2 seeds.	In forests, distributed primarily in eastern Brazil, extending to the south of Pará, Minas Gerais, Matto Grosso, and Bolivia (Santa Cruz). The flavour is well liked, but it is considered only a snack because of its small size.	Small, from 5 to 8 m.
Bacuri de espinho *Garcinia madruno* (Kunth) B. Hammel	Sold on the streets of Santa Cruz de la Sierra in Bolivia, yellow, round or ovular, 5 to 6 cm in diameter, rough because it is covered in wrinkles, containing 1 to 3 seeds.	In terra firme forest, widely distributed in Amazonia. It can also be found in Central America, western parts of Venezuela (Barinas and Táchira), the Pacific coast of Colombia and Ecuador.	From 8 to 15 m.

[1] Calzavara, B.B.G. 1970 / Cavalcante, P. 1991
[2] Clay, J.W.C.; Sampaio, P.B. & Clement, C.R. 2000
[3] Medina, G. & Ferreira, S. 2004
[4] Shanley, P. 2000
[5] Villachica, H. 1996
[6] Carvalho, J.E.U., *et al.* 2002
[7] Souza, V.A.B., *et al.* 2000
[8] Braga, R. 1976
[9] http://www.hort.purdue.edu/newcrop/morton/bakuri.html
[10] Barbosa, W.C., Nazaré, R. F. R. & I. Nagata. 1979
[11] Cruz, P.E.N. *et al*. 1984
[12] Maués, M.M. & Venturieri, G.C. 1997
[13] Lima, M.d.C. (ed.). 2007
[14] Carvalho, J.E.U.; Nascimento, W.M.O. & Muller, C.H. 1999
[15] Maués, M.M. & Venturieri, G.C. 1996

Brazil nut

Bertholletia excelsa Bonpl.

The noblest trees in the forests of Tauaú were the Bertholletia, and one specimen was perhaps as large a tree as I have anywhere seen on the Amazon valley.

R. Spruce 1853

Karen Kainer, Margaret Cymerys,
Lúcia Wadt, Valdirene Argolo

The Brazil nut tree – valued for its nutritious nuts and for the herbal medicines made from other parts of the tree – is so essential to the livelihoods of Brazilians that it is a felony in Brazil to cut one down. Brazil nuts are one of the few internationally marketed rain forest products that are harvested primarily from wild trees. The large fruit fall more than 40 m from the top of these giants rising out of the Amazon forest. The fruit contain 10–25 nuts (which are botanically classified as seeds) that have long been noted for their vegetable protein content. More recently, Brazil nuts have been identified as an excellent source of selenium, which helps to fight cancer, boost the immune system and enhance general well-being by reducing anxiety and lifting energy levels, confidence and mood.

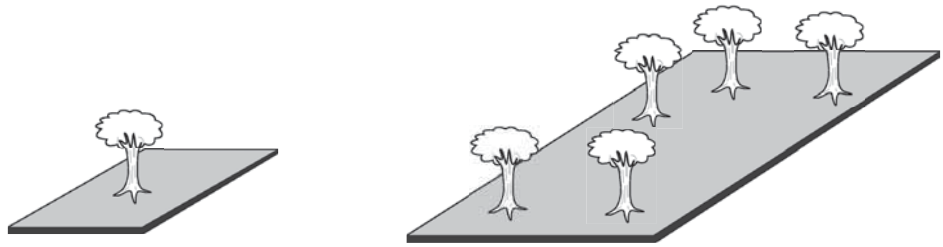
The Brazil nut and the piquiá are akin in that they possess the most massive trunks of all the trees in Amazonia. In Pará, there is one Brazil nut tree with a trunk over 15 m in circumference.[1] Brazil nut trees occur in terra firme Amazonian forests in Colombia, Venezuela, Peru, Brazil and Bolivia, as well as in parts of Guyana.[2] In Acre, they are found only in the eastern portion of the state but remain a species of utmost importance for local people in that region.

ECOLOGY

Flower and fruit seasons

In Acre, flowers of the Brazil nut tree begin to open at the end of the dry season, when the fruits from the previous season are almost ready to fall. The flowers appear from October to December, and the fruits mature in 14–15 months, falling from December to February. In Pará, the flowers appear from September through February, and the fruits fall from January to April.

Density

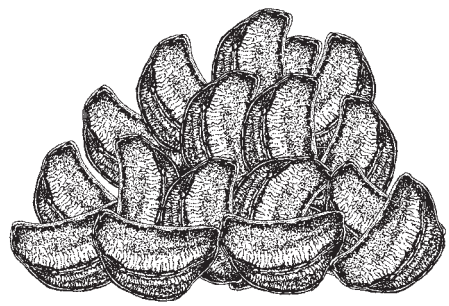


0.1–12 trees/ha **0.5–58 trees/alqueire**

Brazil nut trees may occur in stands called *castanhais* or *bolas,* sometimes separated by kilometres of forest with no Brazil nut trees. A study of over 20 sites across the Amazon basin revealed widely varying densities, from 0.1 trees/ha in sites at the edge of the Brazil nut range in Madre de Dios, Peru, to 12 trees/ha in Amapá, Brazil.[3] Densities between 1.3 and 4.0 trees/ha were found in the Chico Mendes Extractive Reserve in Acre.[4] A study in southeastern Amazonia found 1.7 reproductive trees/ha.[5] In the National Forest of Caxuanã there are from 10 to 12 Brazil nut trees/ha and in Trombetas, from 0 to 15 trees/ha. A study in the Bolivian Amazon found densities of 1 to 5 adult trees/ha.[6]

Production

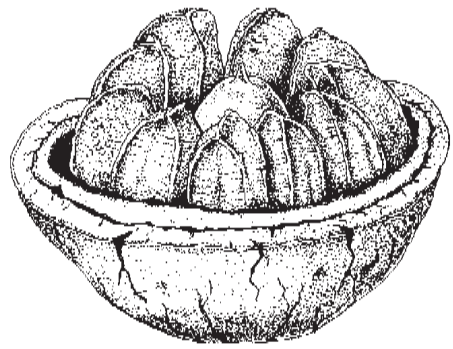
Brazil nut trees have extremely hard-shelled woody fruits the size of a grapefruit that encase 10–25 nuts. It is difficult to estimate the average production of a Brazil nut tree because the number of fruits produced varies greatly from year to year. Production is related to the size of the tree. But this is not a firm rule, as some large trees do not produce any fruit at all.



average of 1 000 nuts/tree

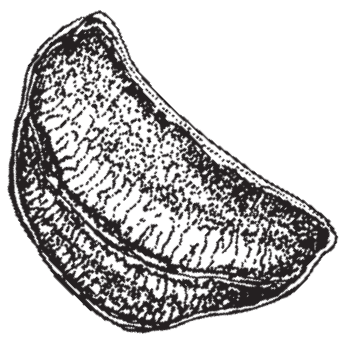
Fruit production varies between trees, with some producing zero and some up to 2 000/tree.[7] A study in southeastern Amazonia found 103 to 270 fruit/tree and a mean of 17 nuts/fruit.[5] Another study at three sites in eastern Amazonia determined a fruit production of 63–216/tree.[8] In addition, one study of 140 large trees (larger than 50 cm dbh) found that in any given year approximately 25% of the trees produced 75% of the nuts from these stands.[9] Until the end of the 20th century, Brazil was almost the exclusive producer of Brazil nuts in the world. Bolivia has since edged ahead of Brazil to become the world's largest Brazil nut producer.[10]

Economic value



In 2008, harvesters in Acre were paid US$5.90 for a can of Brazil nuts (11 kg). This value has fluctuated considerably over the past decade, from a low of US$1.20 in 2001 to a high of US$7.40 in 2005. In 2007, Brazil produced more than 30 000 tonnes of Brazil nuts for sale, generating over US$23 million.[11] Brazil nuts can be purchased in the markets of Rio Branco, the capital of Acre, for US$2.70 for a 250-g package. In Belém, in 2009, a litre of shelled Brazil nuts sold for US$4.20 and unshelled for US$1.30. Brazil nut oil is being used in the production of shampoos, facial masks and other health and beauty products in Brazil, as well as by international companies. A 100 ml bottle of Brazil nut oil can be purchased on the Internet for about US$9.[12]

The rich and fragrant Brazil nut is immensely popular in England and the United States of America, and almost all of the Brazil nut production is exported to satisfy those markets. However, data from the Brazilian Minister of Development, Industry and Commerce show that exports have been falling since the 1970s, though not necessarily because the nuts have diminished in popularity. In 1998, European regulation reduced the acceptable level of toxic substances (aflatoxins) produced by fungi that contaminate Brazil nuts. This change disrupted global commerce of the nut.[13] In July 2003, the European Union shut its doors to the trade of the Brazil nut in its shell. Removing the shells is a meticulous process that adds significant time and expense to Brazil nut production, making it a less viable source of income for many harvesters in Brazil. Since the 1960s, it is estimated that the international export of Brazil nuts from the Amazon is between US$18 million and US$126 million/year.[14] However, more importantly, the collection, processing and sale of Brazil nuts generate money and jobs for thousands of Amazonian families.



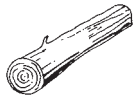
USES

Nut: Brazil nuts are usually shelled and eaten fresh, but they also appear in sweets and ice cream. They can be made into a sweet spread, ground into flour, or used as "milk" to season food.

Oil: Brazil nut oil appears in soap, creams and shampoo.

Fruit: The hard shell of the fruit is used to make crafts and toys. It also serves as a medicine and for making coal. Because of its shape, it can act as a mortar and pestle or be used as a bowl to collect latex.

Bark: The bark can be made into tea, which is used as a medicine for diarrhoea.



Wood: Although historically used for fence posts and construction, the wood is now rarely used because it is illegal to fell Brazil nut trees.

Healthy farinha and purified water

Lênio José Guerreiro de Faria

In Asia, people look forward to the steaming bowls of rice that accompany every meal. In Amazonia, a meal is not a meal without farinha, a coarse and fragrant flour made from manioc root. Rural and urban Amazonians alike eat several cups of farinha daily. When choosing from the dozens of sacks of farinha produced both industrially and by local farmers, customers consider texture and colour to be the most important signs of quality. Most urban consumers prefer yellow farinha to the traditional white, and some businesses add artificial dyes to make the flour more appealing. However, these chemical additives have caused serious allergies, especially in children. The problem became urgent enough that the Laboratory of Chemical Engineering of the Federal University of Pará (UFPA) began studies on potential natural colourings. University researchers discovered that curcuma of the ginger family, is an excellent colouring, but it has an odour and a flavour that do not combine well with farinha. They persevered and discovered that charcoal made from the Brazil nut fruit shell is extremely effective in removing the flavour and odour of curcuma. Picking up on this idea, a researcher from the University of French Guiana visited UFPA to see if and how charcoal from Brazil nut shells could be used to purify water in rural areas. They discovered that 1 g of charcoal made from the large Brazil nut fruit can cover a surface area of 250 m^2, and like a giant sponge, absorb most impurities, leaving the water remarkably clean.[15]

A luxury product

Virgin Brazil nut oil, produced in Amapá, is being exported to Europe, where it is available in Parisian supermarkets. The oil has the advantage of being rich in selenium. Brazil nut oil from Laranjal do Jari in Acre is being sold with a "green seal", as it is made by a traditional population in a protected area.

Selenium: a miracle mineral

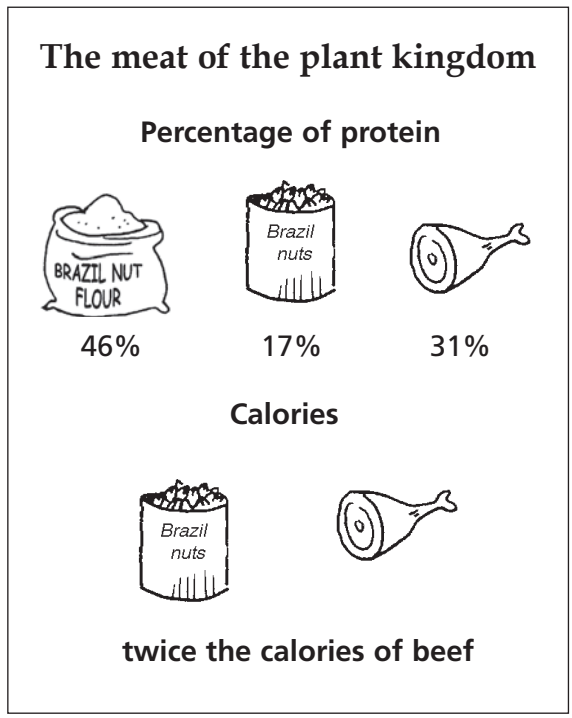
An increasing number of people in Western society suffer from cancer as well as from stress-related disorders such as anxiety, fatigue, depression and memory loss. Eat Brazil nuts! Studies recently conducted in the United States of America and Europe showed that Brazil nuts contain selenium, a trace mineral that has the power to prevent cancer and combat certain viruses.[16] In addition, this mineral provides energy, lifts the spirit and reduces the chances of catching common, chronic illnesses.

Studies show that bad moods are sometimes linked to a low level of selenium in the body and that consumption can contribute to boosting confidence. Selenium proteins have also been discovered to be an important source of antioxidants. Oxidization has a role in premature aging, Parkinson's disease and Alzheimer's disease.[17] The quantity of selenium in the Brazil nut is linked to the presence of this mineral in the soil. Due to lower concentrations of selenium in the soils of Acre, the Brazil nuts from that state reflect slightly lower levels of selenium. Brazil nut trees do not grow in North America and Europe, and research indicates that American diets contain only 20% of the recommended daily dose of selenium.

To ensure that you are getting enough selenium in your diet, doctors recommend a 200 mcg selenium supplement per day, the equivalent of about two shelled Brazil nuts. Because the nuts lose up to 75% of their selenium content after they are shelled, it is best to eat them immediately after removing their shells. But do not get carried away, because eating more than 25 nuts/day is considered to be unhealthy. If Brazil nuts are hard for you to find, another delicious food that strengthens the body, prevents many diseases, combats cancer and is a good source of selenium is garlic. Eating two or three cloves/ day has tremendous health benefits.

NUTRITION

Rich in protein, vitamins, minerals and calories, the Brazil nut is considered the meat of the plant kingdom. The nuts are from 12% to 17% complete protein with all the essential amino acids. The flour made by grinding the nuts is approximately 46% protein, with no fat.[18] In comparison, beef is 26% to 31% protein. The Brazil nut has about half of the protein content of beef and twice as many calories. It has almost as much protein as cow's milk, and provides complete amino acid content. Brazil nut "milk" is delicious, and you can use it as a substitute for cow's milk in cooking. To make the milk, simply grate the nuts and add water, squeezing the mixture through a cheesecloth or strainer. Brazil nuts contain minerals, such as phosphorous and potassium, and vitamin B. In addition, 100 g of Brazil nuts comprises 61 g of fat, 2.8 mg of iron, 180 mg of calcium and 4.2 mg of zinc. The Brazil nut also has great quantities of the amino acid methionine, which is considered by some nutritionists to be one of the elements most lacking in Amazonian diets.[19]



Recipes

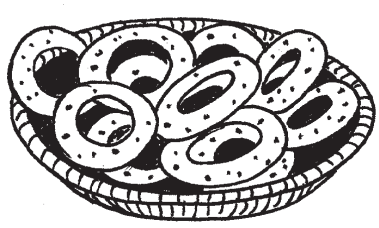
Brazil nut sweet biscuits by the famous Brazilian cook Maria Cosson

Ingredients:

- 2 cups of grated Brazil nuts
- 4 cups of flour
- 1½ cups cornstarch
- 2¼ cups butter
- 1 cup of sugar

Preparation:

Mix all of the ingredients until the dough is firm. Roll out the dough with a rolling pin and cut the biscuits into the desired shapes. Dust the biscuits with flour before baking at 350 °F for 12–15 minutes.



Chicken in Brazil nut milk

Ingredients:

- 4 teaspoons of butter or oil
- 1 whole chicken
- juice of 1 lemon
- 1 tomato, peeled, chopped
- 1 onion, chopped
- 1 bunch of cilantro
- chili pepper, garlic and salt to taste
- Brazil nut milk using 1 cup of grated Brazil nuts

Preparation:
Cut the chicken in pieces and season with salt and garlic. In a pan, sauté the onions, tomatoes, cilantro, lemon juice and chili pepper in the butter or oil. Add the chicken and let it simmer. Next, remove the chicken from the pan and allow it to cool. Remove the bones from the chicken and cut the meat into large pieces. Add the nut milk to the broth remaining in the pan and mix in the chicken pieces.

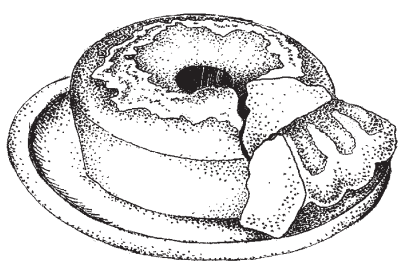
To make Brazil nut milk: grate the nuts or pound them with a mortar and pestle. Next, place the grated nuts in a pan with a little hot water and mix well. Squeeze the mixture through a cheese cloth or a strainer to extract the milk. The remaining Brazil nut pulp can be used as animal feed.

Marajó cake

Ingredients:

- 2 cups of sugar
- 1 cup of butter
- 4 eggs
- 1 cup of grated Brazil nuts
- 1 cup of condensed milk (with a little water)
- 1 cup of flour

Preparation:
Cream the butter and sugar, add the eggs and continue to mix until smooth. Stir in the grated Brazil nuts and the condensed milk and mix. Then add in the flour and stir well. Pour the mixture into a cake mould and bake in the oven.



Cupuaçu and Brazil nut bonbons

Ingredients:

- 1 large cupuaçu
- 1 kg of sugar
- 1 plate full of grated Brazil nuts
- 1 plate of chopped Brazil nuts toasted in a pan with butter to taste

Preparation:
Remove the cupuaçu pulp from the shell and cut the pulp away from the seeds with scissors. Place the pulp in a pan with water and bake it to reduce the acidity. Rinse the pulp in a colander. Mix the cupuaçu, sugar and grated Brazil nuts in a pan and place over a flame. Allow it to simmer until the mixture pulls away from the bottom of the pan. Spread the mixture on a greased baking sheet or carving board. Sprinkle the toasted Brazil nut pieces over the mixture and roll it into short sticks. Wrap in coloured cellophane or aluminium foil.

Beautiful hair

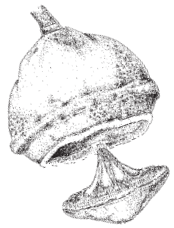
For silky smooth hair, mix one cup of Brazil nut oil with one cup of honey and one egg yolk. Apply to clean hair and rinse after a few minutes.[s]

Treatments for hepatitis and morning sickness

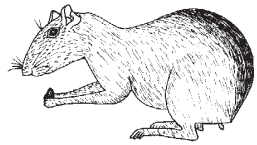
In various regions of Amazonia, the Brazil nut fruit shell is considered to be an effective remedy for hepatitis, anaemia and intestinal problems. A large fruit is thoroughly cleaned and filtered water placed in its centre to soak for two or three hours, or until the water becomes blood-coloured. The water is drunk daily, like a tea, until symptoms subside. Some pregnant women beleaguered with morning sickness state that eating one or two Brazil nuts/day alleviates their symptoms.

WILDLIFE

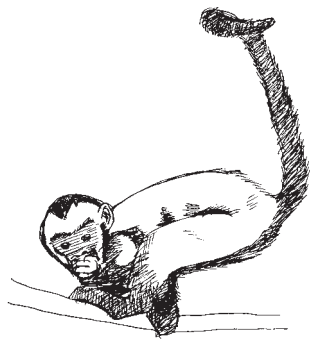
Agouti, monkey and frog



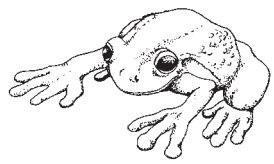
The Brazil nut tree demonstrates the important links between plants and animals in an intact rain forest. For example, there are two species of poisonous frogs (*Dendrobates castaneoticus*, *Dendrobates quinquevittatus*) that almost exclusively use the rain-filled hollow of Brazil nut fruits for their tadpoles.[21] The Brazil nut flower has a closed hood and is pollinated efficiently only by large-bodied bees capable of pushing open the hood and entering the flower.[2] These bees of the genera *Bombus*, *Centris*, *Epicharis*, *Eulaema*, and *Xylocopa* live in the closed forest. A recent decline in Brazil nut production has been linked to pollination deficiency, possibly owing to the smoke from forest fires reducing bee abundance or to the reluctance of some bees to visit fragmented landscapes.[7] The creamy, pale yellow flowers are also a favoured food of paca, peccary, armadillo and deer. Hunters often build platforms near Brazil nut trees, where they wait for game to come and devour the thousands of meaty flowers scattered on the forest floor.



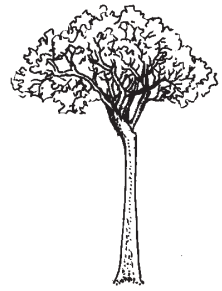
The agouti is a true friend of the Brazil nut as it is one of the only animals able to gnaw through the thick, hard husk of the Brazil nut fruit to reach the nuts inside. Primarily the agouti, but occasionally squirrels disperse Brazil nuts throughout the forest. The agouti scatter-hoards the seeds up to 1 km away from the mother tree, burying and reburying them at depths of 1–2 cm to dig up and eat during the leaner times between fruit seasons.[7] Like squirrels, the agoutis may forget some of their buried seeds, allowing the seeds to germinate. Given their key role in dispersing seeds, it is important not to overhunt agoutis, so that there is no shortage of Brazil nut trees in the future. Scientists think that both the work of agoutis and the work of people following indigenous management practices have been responsible for creating high concentrations of Brazil nut trees in certain areas.[22]



Rubber tappers in Acre say that capuchin monkeys have also figured out how to open Brazil nut fruits when time has softened their hard husks. The monkeys blow into the small opening of the pod and then beat it on a branch until it breaks. But the monkey often loses out to clever friends waiting below, who are quick to grab any nuts that may fall. A monkey may also try to retrieve the fruit with his hand, but the opening is so small that its hand can be injured. Older monkeys have learned to delicately remove the seeds with a finger tip, one at a time. They say that observations of this practice led to the proverb: "An old monkey never places his hand inside a gourd."



MANAGEMENT



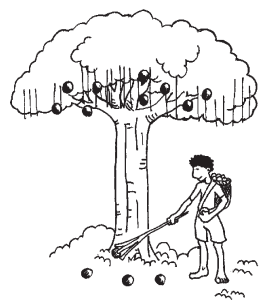
germination
12–18 months
5½–6½ months with treatment

growth
0.9 cm in
diameter/year

production
50 cm dbh

Brazil nut trees live many years; three large trees were carbon dated to be more than 650 years old.[23] The late Murça Pires, distinguished botanist from the Goeldi Museum in Belém, thought that the Brazil nut tree could possibly live for 1 000 years or more. But lately some researchers have expressed concern that there are not enough young trees. One study of the Amazon basin reported that young Brazil nut trees were limited or non-existent in some sites where the Brazil nuts had experienced decades of heavy harvest.[3] Another study at three sites in Acre found that all sites had sufficient seedlings and young trees to maintain the population given current nut harvest levels.[24] Similarly, a study at two sites in Bolivia found reasonable seedling densities despite the areas experiencing heavy Brazil nut harvest for several decades.[6] Monitoring to make sure there are enough young trees coming up in the forest to maintain future generations is always a good idea.

How might Brazil nut harvesters increase their production? One option is to plant seedlings. A study of Brazil nut trees in Acre compared their survival and growth in forest clearings (where they grow naturally), in shifting cultivation plots and in pastures.[25] These three potential sites for planting Brazil nut trees were all surrounded by a larger landscape of relatively undisturbed forest. Results illustrate that Brazil nut trees do well in forest clearings, although their growth is slow. Pastures offer all the conditions needed for the Brazil nut tree to grow well, including full sun; however, it takes a lot of work to construct protective fences and clear away weeds. This study showed that the best place to grow Brazil nuts in the rubber tapper communities is in their shifting cultivation plots, planted together with rice and corn, before the plots become secondary forest. This way they grow rapidly and it is not necessary to do a lot of work to keep the area weed-free. Brazil nut trees can grow at least 1 m/year in height. In general, several years after abandonment of shifting cultivation plots, higher densities of seedlings and saplings are present,[26] making these types of secondary forests efficient sites to tend naturally regenerating Brazil nut seedlings to increase productive densities in the long term.



Colonists, mostly migrant farmer families from Southern Brazil, in the Reca Project on the frontiers of Acre and Rondônia states, have also had success planting Brazil nuts in agroforest systems. But it is critical to have some forest nearby so that the trees can be pollinated and produce fruits. Brazil nut trees planted in fields far from forests probably will not produce. Old Brazil nut plantations do not give fruits, possibly because the large bees that pollinate the trees need areas of forest to survive, or perhaps because the trees in these plantations are of similar genetic material, precluding necessary cross-pollination.

Breaking seed dormancy

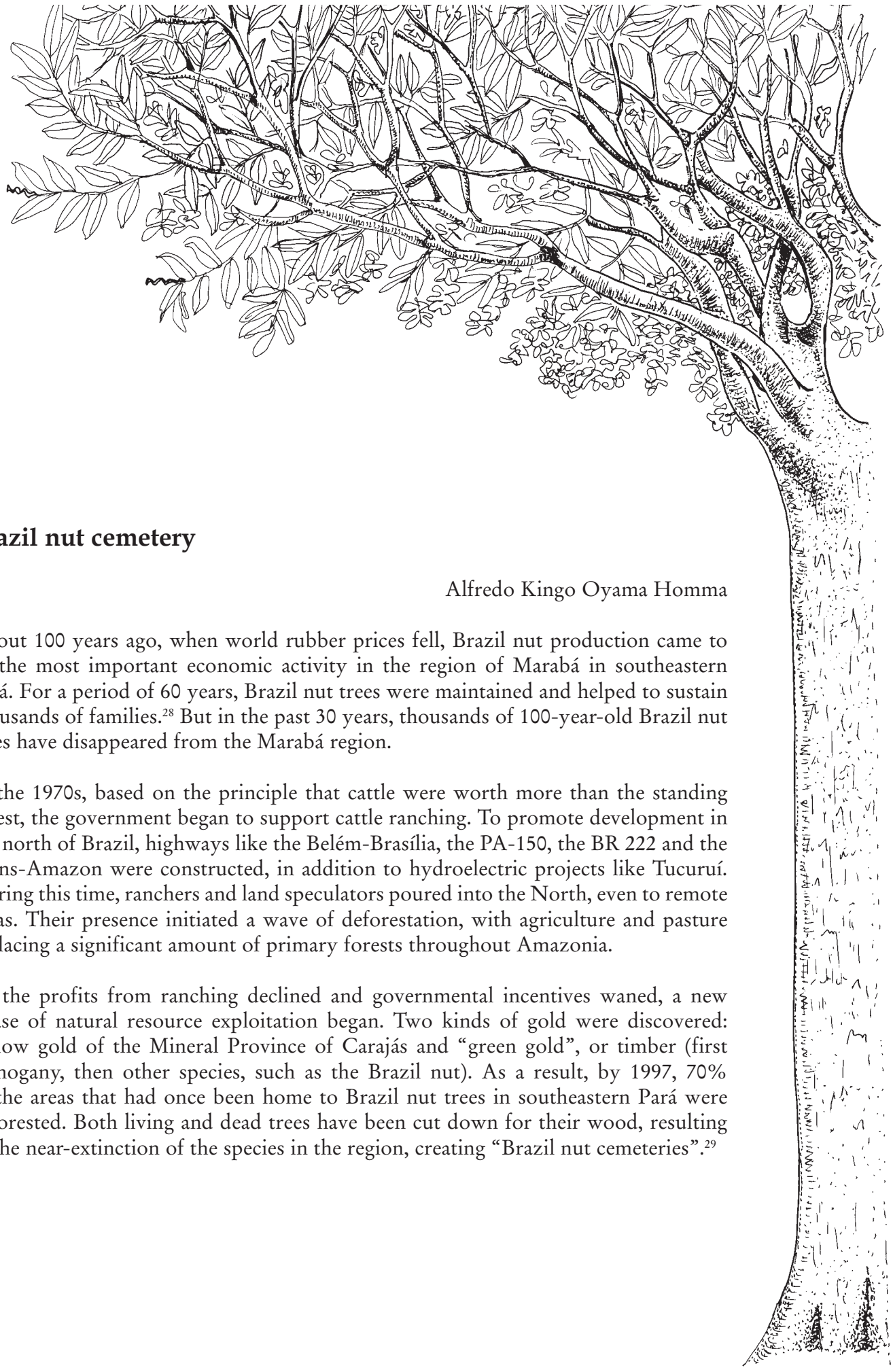
Brazil nuts have a few germination secrets. The seeds, which we commonly refer to as nuts, have a dormancy period such that they will not germinate just after the fruit falls from the tree. One way to shorten the dormant period is to collect newly fallen nuts and store them in a container with moist sand.[25] Always keep the container in a dry, shady spot, with good air circulation. After five months, extract the seeds from their seed coats (which are now soft and loose), throwing out any seeds that have been damaged. Sow the seeds in a spot where they will not be attacked by ants or rats. In two weeks some will begin to germinate; the majority will germinate within six weeks. Transplant the newly germinated seedlings into plastic planting bags or in a home nursery. After they have reached 25 cm, or grown 16 leaves, plant them permanently in a sunny spot.[27] Brazil nut trees can grow quickly with sufficient sun and are able to reach reproductive size, generally 40–50 cm dbh, in 10–12 years. Trees growing in the forest under lower light conditions generally will take 60-70 years to reproduce. In Bolivia, the age of first reproduction was estimated at 120 years and emergent trees that receive greater sunlight had the highest reproductive percentage.[6]

Why plant Brazil nut trees?

Johannes van Leeuwen

In addition to nuts, Brazil nut trees also supply high-quality wood. The law allows only specially planted Brazil nut trees to be cut for timber. Many species like piquiá and ipê do not grow straight when they are planted out in the open, and when they are planted in groups they are susceptible to illness. However, Brazil nut trees grow straight and rapidly in plantations. Until they are ready to be planted, care must be taken that the saplings are not dug up by agoutis or rats.

It is best to plant the Brazil nut tree seedlings on a rainy day. If they do not get enough rain, the saplings will drop all their leaves. And when it is not possible to make a deep hole, cut the last bit of the root. The Brazil nut root will quickly grow deep into the soil, which is why it is called a pivotal root. The root should never be allowed to double over in the plantation as the deep root prevents the tree from being blown over by the wind when it grows tall.



Brazil nut cemetery

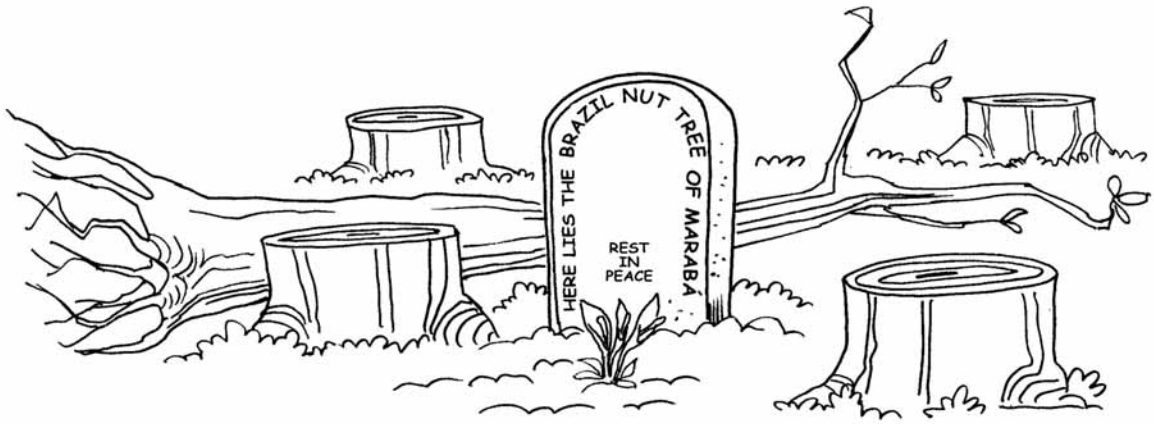
Alfredo Kingo Oyama Homma

About 100 years ago, when world rubber prices fell, Brazil nut production came to be the most important economic activity in the region of Marabá in southeastern Pará. For a period of 60 years, Brazil nut trees were maintained and helped to sustain thousands of families.[28] But in the past 30 years, thousands of 100-year-old Brazil nut trees have disappeared from the Marabá region.

In the 1970s, based on the principle that cattle were worth more than the standing forest, the government began to support cattle ranching. To promote development in the north of Brazil, highways like the Belém-Brasília, the PA-150, the BR 222 and the Trans-Amazon were constructed, in addition to hydroelectric projects like Tucuruí. During this time, ranchers and land speculators poured into the North, even to remote areas. Their presence initiated a wave of deforestation, with agriculture and pasture replacing a significant amount of primary forests throughout Amazonia.

As the profits from ranching declined and governmental incentives waned, a new phase of natural resource exploitation began. Two kinds of gold were discovered: yellow gold of the Mineral Province of Carajás and "green gold", or timber (first mahogany, then other species, such as the Brazil nut). As a result, by 1997, 70% of the areas that had once been home to Brazil nut trees in southeastern Pará were deforested. Both living and dead trees have been cut down for their wood, resulting in the near-extinction of the species in the region, creating "Brazil nut cemeteries".[29]

The destruction of the Brazil nut trees in southeastern Pará illustrates the conflict between public policies and smallholder needs. Allotted only 50 hectares or less of land, farmers discovered that the income from extracting Brazil nuts and cupuaçu fruits is less in the short term than the income produced by farming and ranching. Colonists who had previously been able to plant one portion of their lands and leave the other forested, determined that, given only 50 hectares, clear-cutting made the most short-term economic sense.[30]



Brazil nuts: managed by Indians?

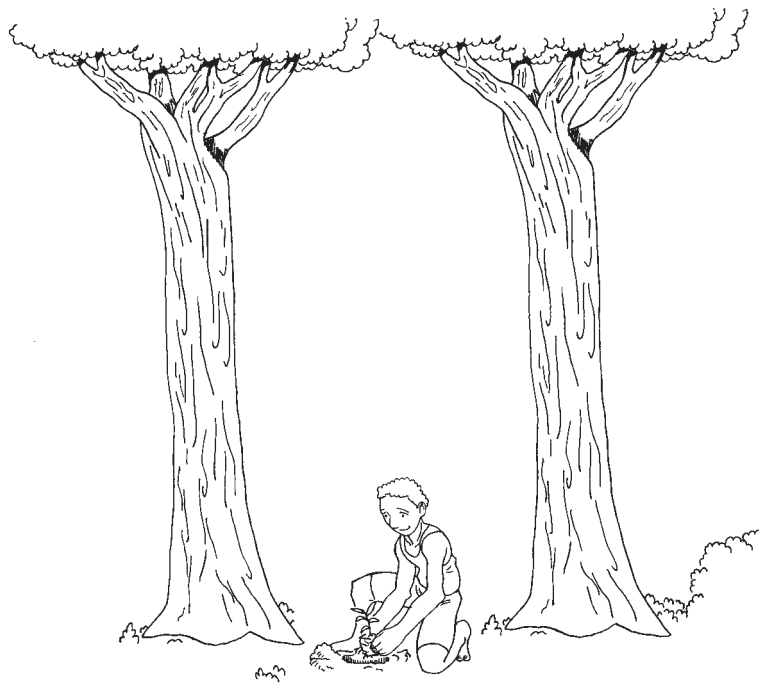
Rafael P. Salomão

If you take a walk through the forest of the Trombetas region, you will find Brazil nut trees in great densities and varieties. In an area of 789 ha, there are approximately 1.5 Brazil nut trees/ha, with some hectares having as many as 13 trees. These concentrations are known as *bolas* or *castanhais*. In contrast, in a nearby forest of 1 500 ha there were only seven Brazil nut trees. The two areas are only 30 km apart and have the same rainfall, light and soil type.

Archaeologists are working together with ecologists to explain these *bolas*. Many people believe these areas were managed by Indians hundreds of years ago. These *bolas* are well known by the locals, who even give them names like "Big Deer", "Small Deer" and "Chico's Bola".

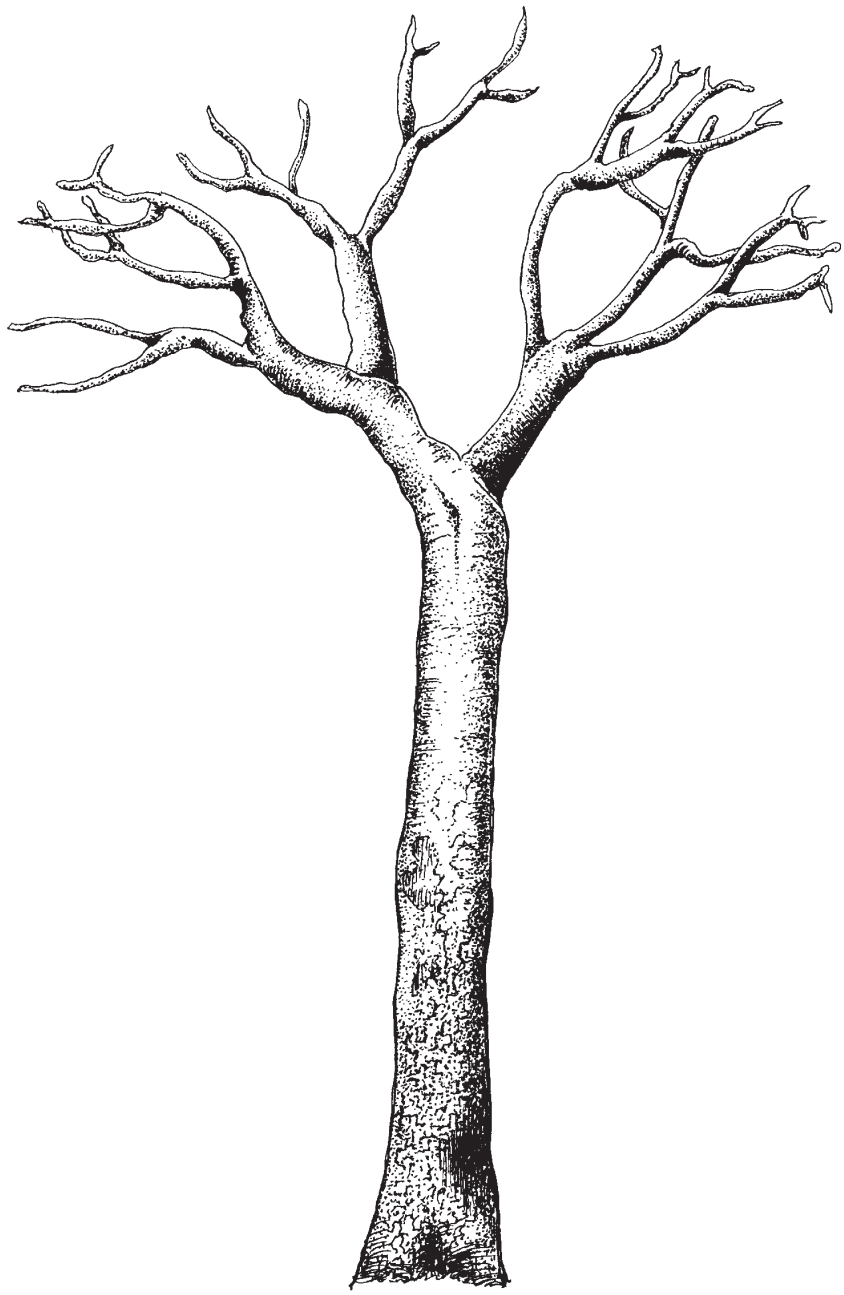
"Social species"

In addition to having an abundance of Brazil nut trees, Trombetas is also rich in minerals that are mined by large industries. In severely degraded areas, Brazil nut trees are being replanted and are growing well. The Brazil nut tree is an excellent species for recuperating degraded areas. After two decades, trees planted in 1984 had already attained diameters of 60 cm. The scientists responsible for reforestation have not forgotten the local population. Instead of only planting species that are valued for their timber, they are also planting what are known as "social species," trees like the Brazil nut that offer nutrition and health benefits for local people.



Protected trees: the living dead

Along lengthy highways throughout Amazonia large expanses of pasture exist where one can see only a few enormous, white, skeletal trees standing dead on their feet. These are Brazil nut trees. Brazil, Peru and Bolivia appreciate the Brazil nut tree so much that they created laws incurring fines or jail time for anyone who cuts one down. However, the law is clearly not effective in preserving the Brazil nut trees. Studies in Acre show that, 20 years after the creation of pasture, 80% of the Brazil nut trees die without ever having reproduced.[31] Persistent burning of the pastures takes a toll on the trees, probably leading to premature death. Even if they survive, fruit production is diminished because these isolated trees are far away from other Brazil nut trees, which hinders cross-pollination since the large bee pollinators generally do not venture into open areas.[32]



[1] Salomão, R.P. 1991
[2] Mori, S.A. 1992
[3] Peres, C.A. *et al.* 2003
[4] Wadt, L.H.O.; Kainer, K.A. & Gomes-Silva, D.A.P. 2005
[5] Baider, C. 2000
[6] Zuidema, P.A. and Boot, R.G.A. 2002
[7] Ortiz, E.G. 2002
[8] Miller, C. 1990
[9] Kainer, K.A, Wadt, L.H.O. & Staudhammer, C.L.. 2007
[10] Assies, W. 1997
[11] IBGE, 2007
[12] http://store.florestas.us/bo001.html
[13] Newing, H. & Harrop, S. 2000
[14] FAO. 2009.
[15] For other experiments with Brazil nuts see Faria, L.J.G. & Costa, C.M.L. 1998
[16] Gross, D. 1990
[17] Chang, J.C. *et al.* 1995
[18] Ramos, C.M.P. and Bora, P.S. 2003
[19] Benton, D. 2002
[20] Balée, W. 1989 / Cotta, J.N. *et al.* 2008
[21] Caldwell, J.P. and Myers, C.W. 1990
[22] Balée, W. 1989
[23] Vieira, S. *et al.* 2005.
[24] Wadt, L.H.O. *et al.* 2008
[25] Kainer, K.A. *et al.* 1998
[26] Cotta, J.N. *et al.* 2008
[27] Muller, C.H. 1995
[28] Emmi, M.F. 1987
[29] Bentes, R.S. *et al*. 1988
[30] Homma, A.K.O. 2000
[31] Mello, R.A. *et al*. 1998
[32] Powell, A.H. and Powell, G.V.N. 1987

Cat's claw

Uncaria tomentosa (Willd. ex Roem. & Schult.) D.C. and
Uncaria guianensis (Aubl.) J.F. Gmel.

Elias Melo de Miranda

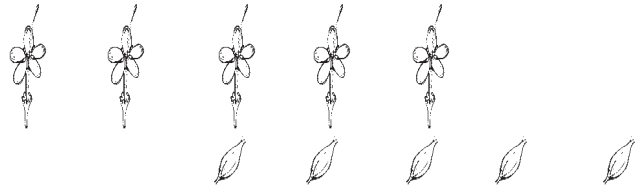
Thousands of years ago, indigenous Peruvians discovered the medicinal power of a spiny Amazonian forest vine: cat's claw (unha-de-gato). However, this locally well-known vine only gained widespread popularity in Peru after it first became famous in Europe.[1] Studies of the bark, roots and leaves have established the presence of alkaloids that stimulate the body's immune system against tumours, inflammations, viruses and ulcers. Today, cat's claw is used throughout Amazonia and has growing domestic and international markets.

There are a great variety of species known as cat's claw. The two most famous belong to the genus *Uncaria*. The main characteristics of these vines are the claw-like spines from which the name is derived. The cat's claw climber, *U. tomentosa,* is large and has semi-curved spines, which enable it to wind its way up tree trunks. The creeper, *U. guianensis,* is smaller and has difficulty climbing because it has sharply curved spines, like goat's horns, which do not easily grip onto other plants. Both are found in the tropical regions of Brazil, Peru, Venezuela, Colombia, Bolivia, Guyana and Paraguay.

ECOLOGY

Flower and fruit seasons

creeper (*U. guianensis*):



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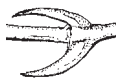
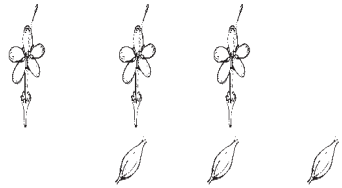
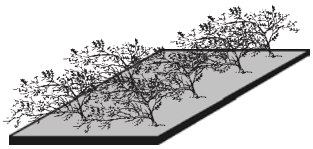


climber (*U. tomentosa*):

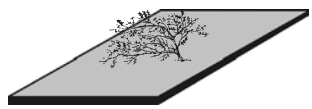


The two species have different fruiting seasons. The creeper, *U. guianensis,* flowers first, from February to June, and produces fruit from April to August. The climber, *U. tomentosa*, flowers from September to November, and produces fruit from October to December.[2]

Density



33 plants/ha in
várzea for *U. guianensis*



1.7 plants/ha in
terra firme for *U. tormentosa*

A study of the two species in the state of Acre, Brazil determined that cat's claw occurs more frequently in várzea (33 vines/ha) and in secondary forest (11 vines/ha) than in terra firme (1.7 vines/ha).[3] But the two species exhibit differences in the habitats they prefer. The climber, *U. tomentosa*, prefers closed forest or forests with small openings and generally occurs in low densities. The creeper, *U. guianensis*, develops best in secondary forest, along riverbanks or roadsides where it can form large concentrations.

Production

Creeper
4 kg of
bark/vine

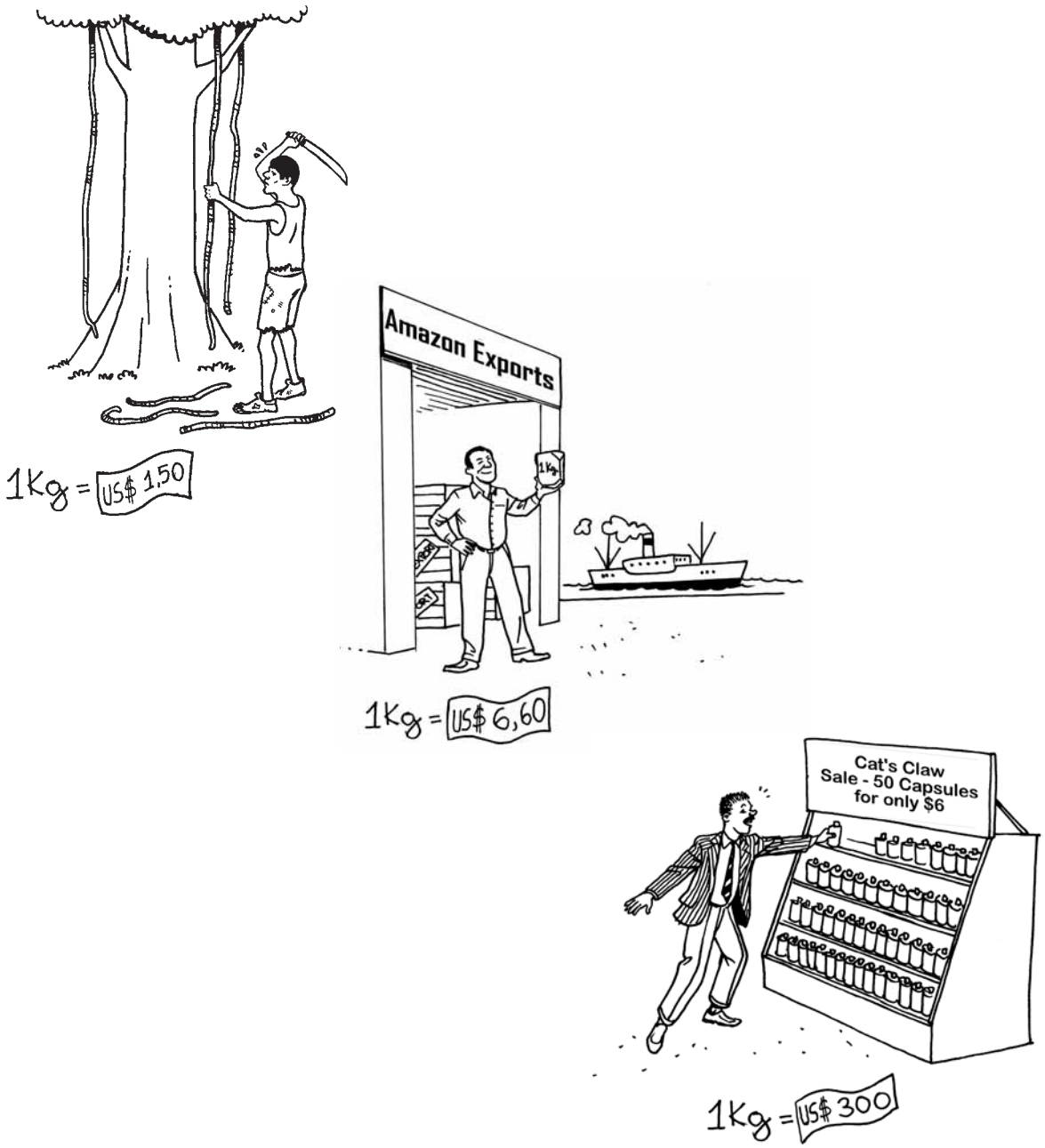
Climber
10 kg of
bark/vine

On average, it is possible to extract about 0.5 kg of bark/m of vine. Creeping cat's claw reaches between 5 and 10 m in length, and in 1 ha it is possible to find 15 individuals over 5 cm in diameter that can furnish approximately 60 kg of bark. In contrast, climbing cat's claw grows from 10 to 30 m in length but occurs in low densities, approximately 1 vine/ha, yielding approximately 10 kg of bark. Since the climbing *U. tomentosa* individuals provide more bark, collectors in Peru tend to concentrate their collection efforts in the upland forest. In order to satisfy demand in 1995, Peruvians collected vines from a 20 000 ha area.[2]

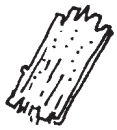
Economic value

In Peru, the world's largest producer of cat's claw, exports peaked in 1995 at 726 tonnes. From 1996 to 1998, between 275 and 350 tonnes were exported.[4] Peruvian export businesses can purchase 1 kg for US$0.90 and sell it for US$3.90. In the United States of America, 1 kg transformed into capsule form is worth between US$200 and US$500. Brazil exports less, but it is easy to find cat's claw in Amazonian markets. In 2008, at the Ver-o-Peso market in Belém, 150 g of bark sold for between US$1.20 and US$2.40. For US$1.20, a packet of 50 g of powdered cat's claw, 20–30 g of leaves, or 50 g of the vine could also be purchased.

1 kg of bark: the value for the collector, the exporter, and the price in the United States of America (in 2003)



USES

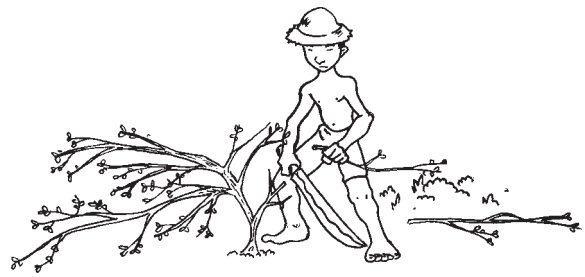


Bark: The bark of cat's claw is used to make teas as it possesses properties which stimulate the immune system and, in a few tests, demonstrated antiviral and anti-inflammatory effects.[3]

Roots and leaves: The roots and leaves can be used in medicinal teas.

Vine: Fresh, drinkable water is released when the vine is cut. Rattan-type furniture is also produced from the vine.

Preparing the vine for market



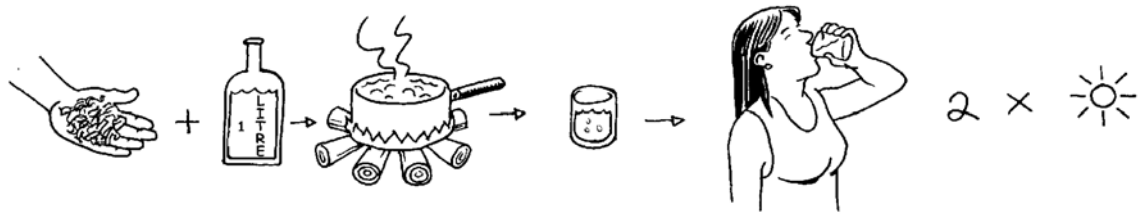
After harvesting the vine, scrape off the moss and dirt using a large knife. The moss on the climbing cat's claw is often black, while the moss on the creeping cat's claw frequently has an off-white colour. To remove the bark, simply tap one piece of vine against another until it comes loose. Set the bark in a shady spot to dry for three to five days during the dry season. Next, cut the bark into sizes preferred by the consumers. To protect the bark from humidity and to make the product more attractive to customers, place the bark in labelled bags.

Know the differences between the two principal types of cat's claw

	Climbing (*U. tomentosa*)	Creeping (*U. guianensis*)
Length	10–30 m	5–10 m
Diameter	5–40 cm	4–15 cm
Spine	semi-curved	curved
Habitat	openings in the primary forest	secondary forest, riverbanks and roadsides
Occurrence	high altitudes, 400–800 m	low altitudes, 200 m
Density	few/ha	can be found in great numbers

The different types of cat's claw also vary in their chemical composition. The level of alkaloids, for example, appears to be different from species to species. Within the same species, the levels can also vary significantly, depending on the age and the habitat of the plant.[2] The effects of the tea may also vary from person to person and plant to plant.

Recipe for medicinal tea



To brew tea, using the bark or root, local users offer the following recipe: Boil 20–30 g of bark or root of cat's claw cut in small pieces in 1 litre of water for 20–30 minutes. This tea can be taken every eight hours, between meals. If using the leaves, boil 15–20 g in 1 litre of water for 15–20 minutes; strain and drink every six hours.

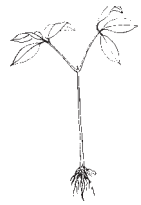
Is cat's claw truly medicinal?

Because of its strong history of traditional use, the sale of cat's claw took off prior to scientific confirmation of its effectiveness. Some researchers maintained that the medicinal properties of cat's claw had not been adequately proven, but recent phytochemical studies have identified beneficial properties in the bark.[5] In Peru, together with copaíba (*Copaifera* spp.) and sangre-de-grado (*Croton lechleri*), cat's claw continues to be among the most widely sold medicinal plants. In the remote rural areas of Pará, Brazil, it is known as jupindá, and many families use it to make a tea to strengthen the body against malaria. In 2001, of 30 families with cases of malaria, only two used medicine from the national health service, SUCAM. All the other villagers utilized cat's claw tea mixed with species such as veronica (*Dalbergia* spp.), cedro (*Cedrela odorata*), pau d'arco (*Tabebuia impetiginosa*) and escada-de-jabuti (*Bauhinia guianensis*).

The efficacy of other plants of the genus *Uncaria* has been confirmed in other regions of the world, including China, Taiwan Province of China and Africa. The flavonoids (antioxidants) found in a number of *Uncaria* species have also been used by the pharmaceutical industry to treat vascular diseases.[2]

MANAGEMENT

germination
5–20 days



growth
1 cm/year

production
5–10 years

Seeds germinate in 5–20 days, and the seedlings can be planted from six months to two years later.[2] When the vine is cut, the finer shoots can also be stuck in the ground and grown (the same way manioc is planted). Cat's claw has the advantage of being fire-resistant, and it grows well in open areas. The vine can reach 5 cm in diameter in five years, and it is ready to be harvested in 5–10 years.[2] Both the vine and the root are used frequently by local populations in the Amazon. However, it is better to collect only the vine, cutting it after it bears fruit, while leaving about 50 cm to 1 m of vine so that the plant can regenerate. Covering the cut with clay will help to keep the vine from losing water. Since the vines of the forest-dwelling *U. tomentosa* are large and provide substantial quantities of bark, it is worthwhile to take special care when harvesting them because these vines are less abundant. Plantations in open areas produce many thin vines along the ground, but scant bark.

[1] Jones, K. 1995 & Alexiades, M.N. 2002a
[2] Alexiades, M.N. 2002a
[3] Miranda, E.M., Souza, J.A. & Persira, R.C.A. 2001
[4] Hughes, K. & Worth, T. 1999
[5] Heitzman, M.E. *et al.* 2005

Copaíba

Copaifera spp.

Arthur Leite
Andrea Alechandre
Onofra Cleuza Rigamonte-Azevedo

Copaíba, known as the antibiotic of the forest, is one of the medicinal trees most widely used in the Amazon to treat inflammations and wounds. The Indians discovered the curative power of copaíba oil, and since then it has healed the minor as well as the life-threatening injuries of thousands of people. Rural people contend that far from the hospital or the pharmacy, copaíba oil is your best remedy.

The copaíba tree is also known as the "oil wood", "miracle tree" and "diesel oil tree" because it produces a thick, yellow, sticky medicinal oil that is extracted by making incisions in the trunk. The filtered oil can also be used as a biodiesel fuel. Copaíba trees reach about 36 m in height, 140 cm in diameter and up to 3 m in circumference. The trees are found throughout the tropics, but with the greatest incidence in Brazil, where 16 different species are well distributed throughout the country.[1]

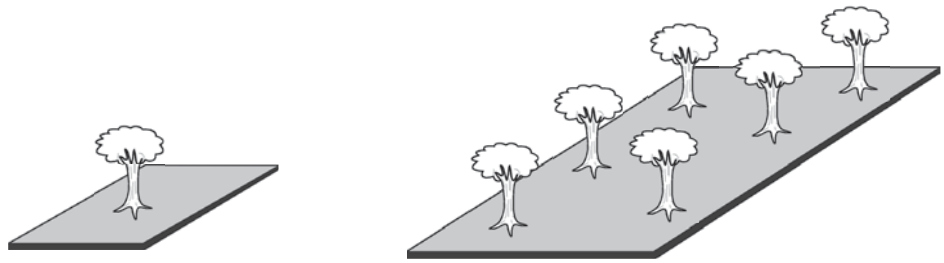
ECOLOGY

Flower and fruit seasons

J F M A M J J A S O N D

In Acre, as in Pará, the copaíba tree flowers in the raining season, from January through April, and fruits from May to September. Bees are the tree's principal pollinators.[2]

Density



0.1 to 2 trees/ha

0.5–10 trees/alqueire

In the Amazon, the copaíba tree occurs in terra firme forests, and on the margins of lakes and streams. It also grows in the forests of the Cerrado of Central Brazil. The municipality of Tarauacá, in the state of Acre, is known to have large areas in which one or more copaíbas can be found per hectare. In some regions, such as the southern part of Pará, their numbers are diminishing because of the timber trade.

Production

The annual production of oil from copaíba trees varies from 100 ml to 60 litres/tree, though not all trees produce oil. Oil production also appears to vary depending upon soil type and the age of the tree. In the area of Pedreira, Pará, out of a sample of 114 trees, 22% did not produce oil, 50% had low production (fewer than 3 litres), 23% had regular production (from 3 to 9 litres) and only 1.7% produced more than 10 litres.[3] Another study in the state of Amazonas illustrates that in sandy soils 75% of trees are productive, while in clay soils only 45% are productive.[4] Data from 62 trees in Acre indicate that 41% produce in the first extraction, while the second extraction reached 72%, with better production in terra firme forest.[5] Scientist Dr. Alencar conducted a long-term study in Manaus and discovered that after repeated tapping, production diminished.[5] To ensure a consistent supply, scientists in Acre suggest extracting only 1 litre/tree, every three years.[6]

average of 1 litre of oil/tree

ECONOMIC VALUE

In 2009, in the medicinal plant shops in Belém, a litre of copaíba oil cost between US$11 and US$15. Oil sold in glass bottles fetched a higher price, as a 50-ml vial cost US$4.20 and in the United States of America copaiba oil can be purchased over the Internet at US$40 for 8 oz.[7] Copaíba bark is also used as a medicine; in 2008, 1 kg of copaíba bark cost US$8 and each 150 ml sack sold for US$1.20. Soaps were also in demand, costing between US$2.00 and US$2.40 apiece.

Copaíba oil was widely exported during the rubber era and after the Second World War. In 1947, for example, Brazil exported 94 tonnes. Today, the oil is sold to France, Germany and the United States of America. In 2006, Brazil sold 523 tonnes of copaíba oil, earning revenues in excess of US$1.9 million.[8] Because of deforestation in Pará, copaíba oil is increasingly scarce in Belém. It is now coming from distant regions like Manaus, in the state of Amazonas. Considering that in the national market 1 litre of copaiba oil is worth more than 15 kg of rubber, rubber tappers in Acre are investigating harvesting copaíba oil as a potential option for diversifying production.[2] In 2004, in the sawmills of Tomé-Açu, Pará, 1 m^3 of copaíba wood cost US$68. In 2008, 1 m^3 of sawn copaíba timber had a market price of US$206.[9]

Prices vary

Those who extract copaíba oil should pay attention to the variation in price according to who is selling the oil, where it is being sold, how it is processed and what kind of packaging is used. Notice the difference in price of the litres of oil sold in different situations:

Price of 1 litre of copaíba oil – 2004

Vendor	Price in US$
Caboclo from Capim River, Pará	0.70
Medicinal plant shop, Belém	9
Logger, Paragominas	10
Sawmill owner (from Paragominas to São Paulo)	17
Ver-o-Peso, Belém (20 ml bottles, US$0.52 each)	26
Belém airport (20 ml bottles, US$1.54 each)	77

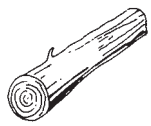
Oil: various colours, scents and textures

Rubber tappers are familiar with various types of copaíba trees: red, white and yellow.[2] However, researchers were surprised by the variety in colour, scent, flavour and density of the oils; together with the local people they discovered more than ten types. The clear oils tend to be favoured by medical industries and the darker oils tend to be used to make soap and to treat injured animals.[5]

USES

Oil: A metabolic product of the tree, created by canals which secrete the oil from the medulla or centre of the trunk, the oil has antibacterial and anti-inflammatory properties. It is used to promote the growth of scar tissue for wounds and ulcers, as well as to treat serious and chronic skin diseases, such as dermatosis and psoriasis.[10] In Rio Branco, the capital of Acre, it is most commonly taken for throat infections. Acre's largest consumers are the elderly.[6] In contrast, in Pará, all ages and social classes consider copaíba one of the most important natural remedies in Amazonia.

Industrial use for the oil: The oil is utilized as a fixer in the manufacture of varnish, perfume and paint. It can also be used in photographic development. More recently, copaíba oil can be found in natural beauty and personal care products, including soaps, creams and shampoos. Rural folk continue to use it as lamp oil, and it is being planted in some areas as a source of biodiesel.[11]



Wood: The copaíba tree produces a superior timber that is highly sought after because it is resistant to insects, particularly termites. It is used in civil construction and the manufacture of boards.

Bark: In some regions, the tea of the bark is used as an anti-inflammatory. In Belém, because of the high price of the oil, tinctures made from the bark are often used as a substitute.

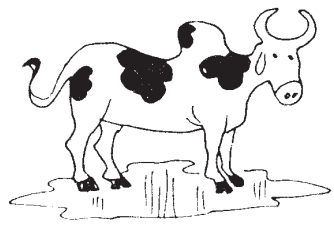
Remedy for a sore throat

Mix one or two drops of copaiba oil with a tablespoon of honey. Take twice a day.[12]

Forest lantern

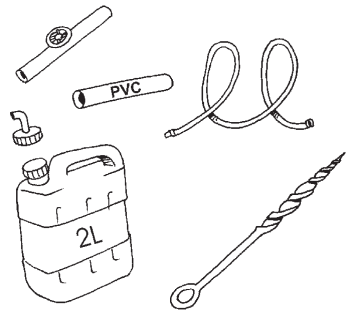
Without costly flashlights, how do villagers make their way across pitch black forests? Copaíba oil is used as fuel to light up the night. Place a wick in an oil container and set it alight. During years of low income and/or economic downturns, home-crafted technologies, such as rustic lamps, often return in use.

Hoof protection



In southern Pará, copaíba is commonly used by ranchers. They pour oil on the ground near salt licks. When the cattle approach to eat the salt, their hooves become covered in oil, which prevents foot-and-mouth disease.

Tools of the trade



- 1 drill, 1.20 m in length and 1.9 cm in diameter;
- 1.27 cm plastic tubing to place in the hole in the tree, and a plug for the tube or hole;
- 1.9 cm rubber hose, 1.5 m in length;
- 2-litre soda bottles or other jug to collect the flowing oil. To store for long periods, glass bottles are recommended.

The tools needed to remove the oil cost about US$51, approximately one month's earnings from rubber collection in 2004. In Acre, the Secretariat of Forests and Extractivism (Sefe) paid for the kit and thus enabled the collectors to become self-sufficient.

Extracting the oil

Copaíba occurs in low densities in the forest, and for this reason great care must be taken in its extraction. In some places, people fell the trees or cut them deeply with a machete so that they may obtain higher volumes of oil than they can in a careful extraction. However, a deep cut wounds the tree and may lead to a fungal or insect infection from which it may not recover. When it suffers from a severe infection, a tree can die in as little as three years. A tree's bark is similar to a person's skin, protecting it from illness.

With the correct method, it is possible to extract oil year after year with no ill effects. Use a small drill to puncture the centre of the trunk, from 20 to 50 cm deep, depending upon the width of the trunk. Next, insert plastic tubing or a piece of metal pipe beneath the hole to let the oil drip out into a container either suspended from the tree or on the ground. The oil can be left to drain for a few days. After removal, close the container to prevent insects from entering and plug the hole in the tree. It is advantageous to carefully extract the oil, as it has a high economic value, can be preserved for long periods and is easy to transport.[6]

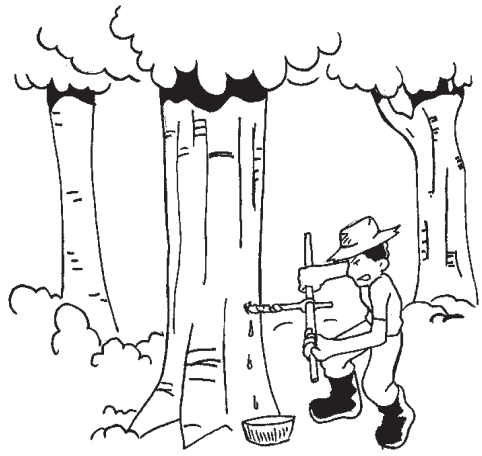
The process of extracting oil varies greatly from region to region. In Acre, they say that the best time to harvest the oil is during the rainy season, while in Pará many prefer to harvest during the dry season. Some also say it is best to tap the trees during the new moon, perhaps because the moon affects the circulation of the oil.

Diary of a rubber tapper: 1906–1916

One hundred years ago, rubber tappers avidly seeking the sticky exudate of rubber trees, "white gold", also sought out the healing, golden oil of copaiba trees. A rediscovered diary from that era reveals that tapping copaiba trees was a dangerous occupation: "We had to tap around 100 trees, walking in the woods and worrying about snakes and wild animals the whole time. We had to find our way around large areas of forest and keep careful track of which trees we had tapped. Out of 100 trees, only half would produce some oil. For food, there were only a few Brazil nuts and small game to eat. At night, we had to be sure we had found a high place to tie our hammocks so the jaguars could not reach us."[13]

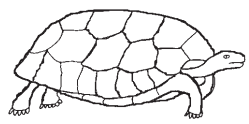
Tips for oil extraction

- It is important to choose trees with a circumference greater than 150 cm. Hollow trees generally do not produce oil.[6] If the first hole does not provide oil, try the other side of the tree, or drill at a different height.
- If the oil does not come out, some people light a fire at the base of the tree to heat the resin; however, fires can damage the tree and potentially get out of control.
- Many trees do not produce oil immediately after being tapped. In this case, leave the hose in place, or plug the hole, and come back in a couple of days.
- In addition to tapping near the base of the tree, people sometimes tap farther up (10–20 m) to potentially extract more oil.



WILDLIFE

Copaíba fruits are appreciated by deer, tortoises, agouti, birds, pacas, monkeys, peccaries, squirrels and tapirs. Over a one year period, hunters in a community along the Capim River captured 63 kg of game beneath copaíba trees. Wounded animals lick and rub themselves with the oil that runs down the trees.[6]



Management

germination
35 days

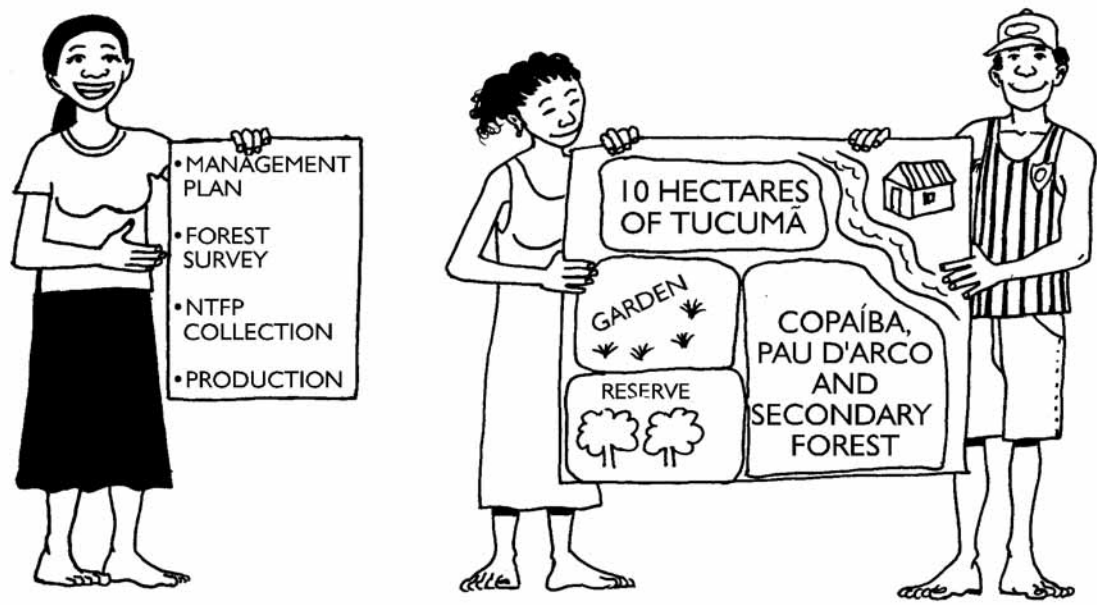
growth
50 cm/year

production
larger than 40 cm
in diameter

The seeds take 35 days to germinate. Ninety percent of seeds germinate when sown, immediately after falling, and about half of the remaining seeds will germinate after 30 days. The copaíba tree seems to grow best when it is not interplanted with other species. It prefers partial shade during the seedling phase and full sun when planted out for the growth period.[14] However, little is known about ideal soil types and growing conditions for this tree. Because of its high value and powerful medicinal uses, it is well worth the effort to conserve and plant copaíba.

The makings of a management plan

There are no government restrictions on the extraction of copaíba oil for domestic use. However, in order to sell the oil, a management plan is a legal requirement. The plan must define what area is to be utilized, how many trees are to be tapped and what technique will be used to extract the oil. In addition, it is necessary to make a map indicating the location of each of the copaíba trees to be tapped. In Acre, collectors use maps of roads opened by rubber tappers to find copaíba trees. When they find a copaíba tree, they clear a small trail leading to it and mark its location on the map.[6]



Mapping trees: use the rubber roads

Andrea Alechandre,
Foster Brown,
Valério Gomes

Throughout the world, forest inventories generally survey only timber species, omitting useful vines, fruit and medicinal trees that are an essential part of local livelihoods. Some forest inventory methods sample quadrangles at random. But to map useful trees much of the effort of opening new forest paths could be saved by using "rubber roads", created by rubber tappers to access rubber trees. Researchers at the Zoological Park in Acre developed a simple method for rubber tappers to map copaíba trees in their areas. It is fast, easy and inexpensive; it offers reliable results and is well liked by communities. As researcher Andrea Alechandre says, "If you want to identify copaíba trees, go with a rubber tapper. He always knows."

Many local people and hunters who spend time in the forest already know where the valuable species are. However, taking the time to draw a map is helpful to systematize information. If local stakeholders are involved in a land dispute, or want to sell wood or copaíba oil, a map can be a useful tool for explaining the location and quantity of their resources. In addition to making use of existing trails and local knowledge, mapping involves the understanding of a compass and the measurement of an individual's pace.[15]

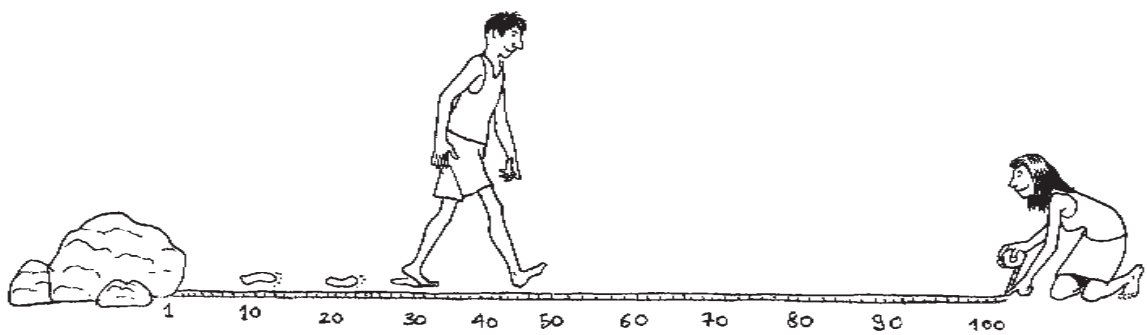
To measure your pace:

1) Measure a line on the ground of 100 m with a tape measure.

2) Walk the line three times and count your steps each time.

3) Add up the number of steps needed each time and divide by three. This gives you the mean number of steps per 100 m.

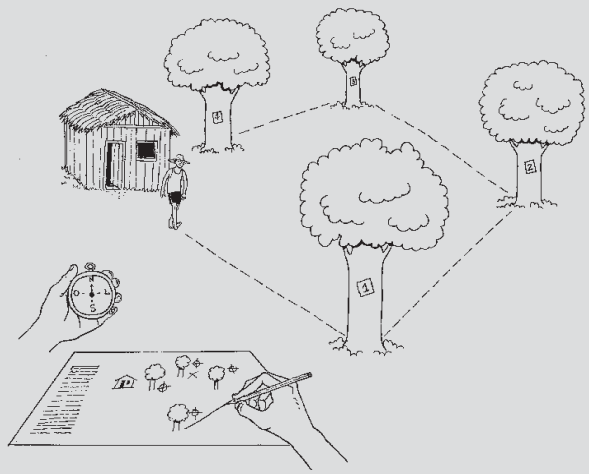
4) Divide the mean number of steps by 100. The result is the size of your step in metres (step/metre).



Mapping

Foster Brown, Andrea Alechandre, Carlos Campos

It is possible to measure not just one species, but the fruit trees, medicinal plants and fibres important to your community as well. Let's test the methodology with adult copaíba trees.



1) Choose a good starting point that will never change location, like your house or a bridge. Mark it on a piece of paper.

2) Draw a compass on the paper and mark the direction it is pointing. Next draw a line in that direction to the closest copaíba tree from the starting point.

3) Walk from your starting point to the first tree and count your steps. Divide the number of steps by the size of your step and mark the distance of the line on the map.

4) Draw another compass next to the first tree on your map. Draw a line in the direction of the next tree. Walk to the next tree counting the distance with your steps and repeat the process for all the trees.

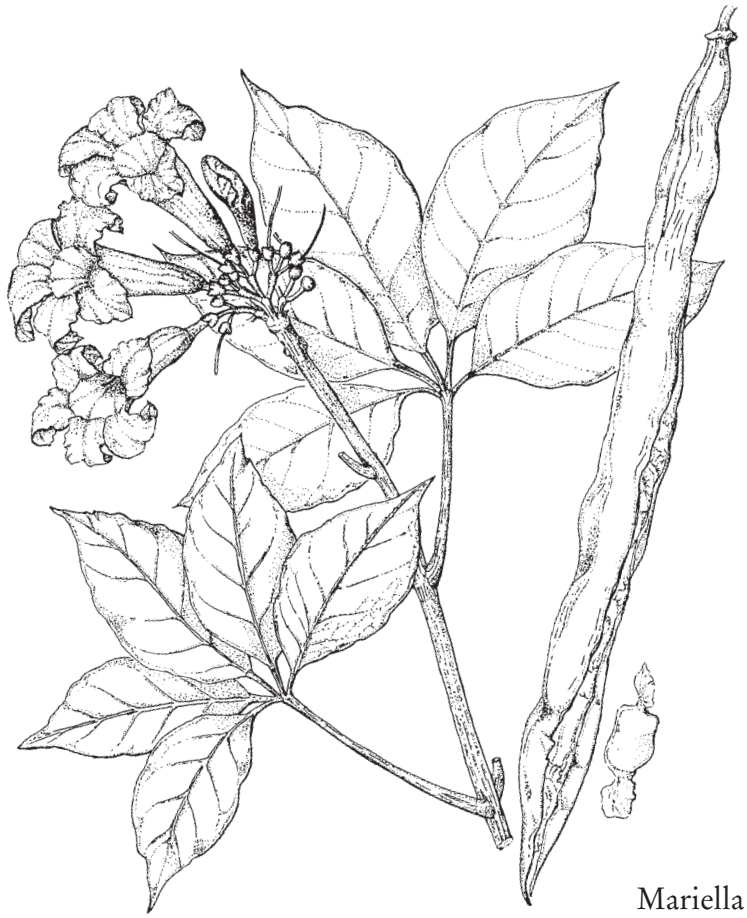
5) Number each tree on your map and measure the circumference of each. It is a good idea to identify each of your mapped trees with a numbered plaque.

When you finish, you will have a map of copaíba trees. With a compass and the map, anyone wanting to find the copaíba trees should be able to do so. They orient themselves in the direction noted on the map and walk the distance indicated. Using this method, three communities mapped 512 copaíba trees with more than 150 cm in circumference. They were then able to calculate that their 31 holdings contained more than 1 100 copaíba trees.[6]

[1] FAO 1987/Clay, J. and Clement, C. 1993/Rocha, A.A. 2001
[2] Rocha, A.A. 2001
[3] Dias, A.S. 2001
[4] Ferreira, L.A. 1999
[5] Alencar, J.C. 1981
[6] Leite, A. *et al*. 2001
[7] http://www.rain-tree.com/copaibaprod.htm, accessed March 2009
[8] IBGE, 2007
[9] Secretaria de Estado da Fazenda. 2008
[10] Estrella, E. 1995 / Ming, L.C.; Gaudêncio, P. and Santos, V.P. 1997
[11] Sydney Morning Herald September 19, 2006
[12] Shanley, P.; Hohn, I. and Silva, A.V. 1996
[13] Yungjohann, J.C. 1989
[14] Varela, V.P., Vieira, M.G. & Melo, Z.L 1995
[15] Amorex (unpublished) / Alechandre, A.; Brown, I.F. and Gomes, C.V. 1998

Ipê-roxo, pau d'arco

Tabebuia impetiginosa (Mart. ex. DC) Standl.

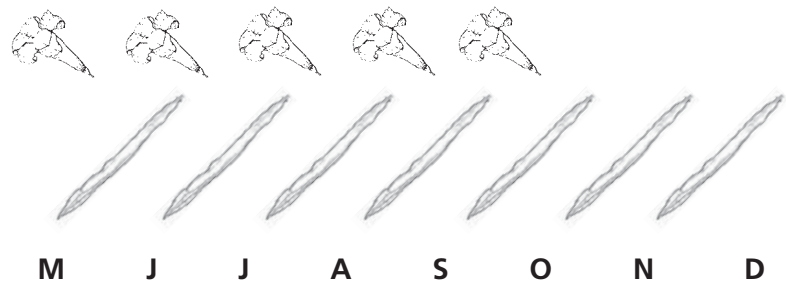


Mariella Mendes Revilla
Alexandre Dias de Souza
Mark Schulze

Ipê-roxo, also known as pau d'arco, is highly prized throughout Brazil and beyond, both for its high quality and attractive wood and for its bark, which has powerful medicinal properties. The bark of ipê is a renowned medicine, containing lapachol and other potent chemical substances. Sold under the name of "pau d'arco", it is used in home remedies to treat inflammation, allergies and tumours and to promote the growth of scar tissue. Ipê's extremely durable wood was used in the reconstruction of the famous Atlantic City Boardwalk in New Jersey, United States of America. Ipê does not need to be treated to resist rot, touting the environmental advantage of being chemical free. Over the last two decades, as ipê-roxo has become increasingly difficult to encounter in the forest, most medicinal plant collectors head directly to sawmills to harvest the bark from trunks waiting to be sawn. But some loggers are catching on and are beginning to sell this valuable bark, which has a vibrant market in Brazil, Europe and the United States of America. During the flowering season, ipê-roxo's canopy explodes with exquisite flowers and the petals fall like rain, leaving a soft lilac-coloured carpet on the forest floor. The tree can reach 40 m in height and 4.5 m in diameter. Ipê-roxo occurs throughout Amazonia but in relatively low densities, particularly in the state of Acre where it is considered rare. Ecological studies of ipê indicate that current extraction levels are placing this valuable species at risk.[1]

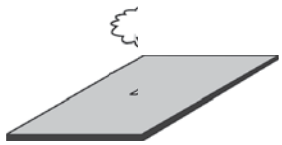
ECOLOGY

Flower and fruit seasons

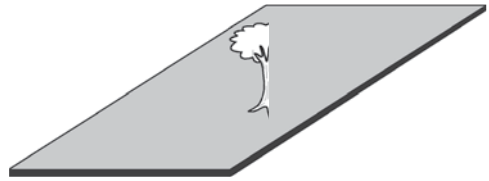


Ipê-roxo flowers from May through September and produces fruit between June and November. Shortly after the petals fall, the leaves fall, leaving the tree bare. About ten days later, fruit appears. However, this lovely spectacle does not occur every year; production varies and trees may not flower for two years in a row.

Density



0.04–1 tree/ha



0.5–1.5 trees/alqueire

The density of ipê-roxo is less than 1 tree/ha and its distribution is irregular. It grows in terra firme forests, and in Acre it favours forests with bamboo.[2] Ipê-roxo is rarely found in the várzea or wetland areas. Rising demand for ipê-roxo has made it increasingly scarce in Amazonia. In a 2004 survey, ipê-roxo timber was no longer being extracted from forests around many sawmill centres in the eastern Amazon where it previously had been one of the primary timber species.[3] Brazilian export data for ipê timber suggest that since 2004 at least 650 000 ha of forest were logged annually for ipê.

Production

Sixty percent of the bark is composed of water, signifying that every 100 kg of bark harvested will result in 40 kg of dried medicinal bark. The quantity of bark that can be sustainably collected from a living tree is not well known, as few studies have been undertaken on sustainable bark extraction. Among other factors, the amount that can be extracted without harming the tree will likely depend upon the tree's age, vigour and dbh. At present, most of the bark traded regionally is collected from logged trees at sawmills.

300 g of bark/tree/year (estimated)

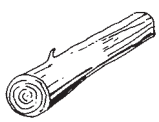
ECONOMIC VALUE

Ipê-roxo is sold under the name "ipê" for its wood and "pau d'arco" for its medicinal bark. Therefore, many people do not realize that the prized timber species also possesses powerful medicinal properties. The demand for ipê-roxo bark by homeopathic pharmacies, healers and the cosmetic industry is growing daily. In the herbal shops in Belém in 2009, 1 kg of bark was sold for US$3. In 2004, average sales of bark from one fair and four of the largest herb shops in Belém, totalled 250 kg/week. In Belém, a small bag with 200 g of bark sold for US$1.20–1.80. In addition, there are many herbal medicine laboratories that are grating ipê-roxo bark to make capsules.

Ipê-roxo is highly sought after by loggers because of the excellent quality of its wood. In areas where mahogany no longer exists, as in Tomé-Açu in the state of Pará, ipê-roxo is the most expensive timber species. In 2007, the selling price/m^3 of sawn wood in the domestic market was US$510 and in 2008 the price jumped to US$867.[4] Export prices in 2008 have averaged US$1 188/$m^3$ of sawn wood.[5] Consumers of both the wood and bark are generally uninformed that current levels of extraction of the tree for its prized timber, marketed as "green mahogany" in the United States of America, may be placing the species at risk.

USES

Inner bark: Tea, syrups, infusions and cough drops are made from the inner bark. In some areas it is used to combat serious diseases such as diabetes, leukaemia, cancer, anaemia, arterioscleroses, arthritis, bronchitis, cystitis, parasites, gastritis, cuts and inflammations. It is important to note that lapachol, an active ingredient in pau d'arco, is a napthoquinone and contraindicated for people on certain medications. Early cancer studies were stopped because of its toxicity at high doses; therefore, it is recommended pau d'arco be used under the supervision of a health professional. Sold in health food stores and pharmacies, in the United States of America it is used frequently for allergies.[6] In addition, many rural communities in the Brazilian Amazon use it to treat malaria.



Wood: Ipê wood is of excellent quality – heavy, with a density of 1.3 g/cm^3. Used in construction and in the fabrication of posts, boats and coal, the wood is also commonly used to make floors, boards and planks, becoming the preferred wood in the United States of America for decking. Native Amazonians who use traditional hunting methods use ipê to make bows.

Delicious tea

Tea made from the inner bark of ipê-roxo, often referred to as pau d'arco, contains a combination of substances that many users contend combat cancer as well as help in the growth of red blood cells and in the improved oxygenation of the body.[7] Unlike many medicines, ipê-roxo (pau d'arco) tea tastes delicious!

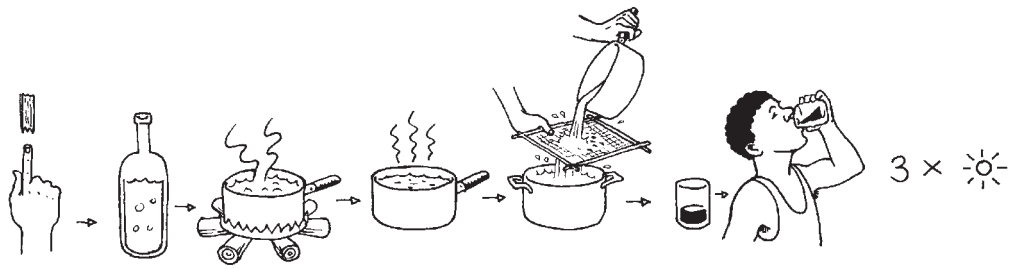
The secret to brewing pau d'arco

- Never boil or keep pau d'arco tea in containers made from aluminium, tin, lead or plastic. These substances cause a chemical reaction with various components of the tea when boiled, altering its medical effect. Containers of glass, ceramic, porcelain, clay, cast iron or stainless steel are better.

- Do not store the tea in the container in which it was prepared, because the particles of the bark can become bitter.

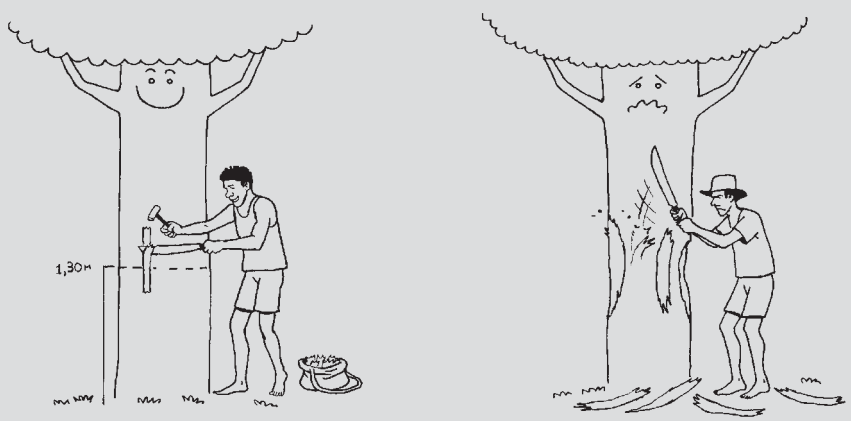
- Do not let the tea steep for very long because its aroma can become overpowering.

- Use 5–10 g of bark for each litre of water, cover and let simmer on a low flame. Take the pan off the stove and let the tea steep for 15–20 minutes. Strain the tea directly into the container in which it will be stored to be taken a little at a time.



Extraction of ipê-roxo bark

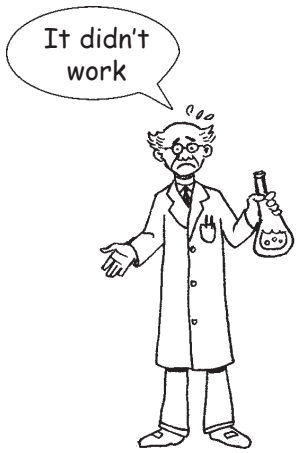
Ipê-roxo trees are principally threatened because of ranching, logging and fire. However, in remote regions or in regions where logging pressure is not yet high, trees can be threatened by a lack of knowledge regarding adequate techniques for harvesting the bark in a sustainable manner. Although the use of ipê-roxo bark has increased in recent years, there are few studies evaluating the impact of bark collection on the health of the trees. To generate basic information about the extraction of ipê-roxo bark, the Acre government undertook a study of its regeneration. The objectives were to learn how the bark regenerates and whether larger trees regenerate bark faster. Initial observations indicated that ipê-roxo has a potentially good capacity for regeneration: in two years, 40–50% of the extracted bark had grown back.



The forest pharmacy

Patricia Shanley and Lêda Luz

Even with pharmacies on every street corner stocked with modern medicines, Brazilians from upper, middle and lower social classes continue to buy medicinal roots, barks, leaves, oils and resins from native forests. Consumers say that traditional forest remedies are reliable, inexpensive and effective in treating sicknesses such as rheumatism, arthritis, herpes and nervous system disorders for which there are still no adequate medicines available in the pharmacy.[8]



Eighty percent of the people in the world regularly use plants to treat common illnesses. In addition, many medicines sold in pharmacies contain substances that were originally discovered in a plant. Considering the proven effectiveness of some traditional medicines, it is curious that scientists have not transformed more medicinal plants into pill form. The reason is that scientists simply lack the expertise to isolate the active substances in these chemically complex substances, such as copaíba oil, amapá and sucuúba latex, jatobá resin and pau d'arco bark.

Ranching, logging, farming and more recently soy plantations have transformed the Amazonian landscape, reducing forest cover and changing species composition in the forests that remain. To ensure that remedies continue to be available in the future it is essential to know which medicinal plants are most important, where they grow and in what frequency.

Below are some valuable medicinal tree species extracted by loggers in Pará.

Common name	Scientific name	Uses
Copaíba	*Copaifera* spp.	deep wounds, natural antibiotic
Andiroba	*Carapa guianensis*	sprains, rheumatism, insect repellent
Cumaru	*Dipteryx odorata*	rheumatism, muscular pain
Sucuúba	*Himatanthus sucuuba*	worms, herpes, uterine infection
Jatobá	*Hymenaea courbani*	tonic, colds, expectorant
Amapá, bitter	*Parahancornia fasciculata*	respiratory illnesses, tonic
Pau d'arco	*Tabebuia impetiginosa*	inflammations, tumours, ulcers
Ucuúba	*Virola michelii*	fever, hepatitis, generates scar tissue

What landscape possesses the most powerful medicinal plants?

There is an ongoing debate about whether the most powerful natural remedies are found in the primary forest, secondary forest or growing like weeds by the wayside. Some scientists argue that the most effective medicinal plants are those that grow in tough conditions, found in secondary growth forest or as invasive weeds.[7] Others believe that the trees of tropical forests, which struggle in warm climates against virulent insects and fungi, contain the most powerful remedies. To collect medicinal barks today, most eastern Amazonian collectors in logging frontiers frequent sawmills rather than forests. In Belém, a nine-year study of plants in the local markets showed that of the 211 medicinal plants being sold, 95 are native to Amazonia. Of the 12 most popular plants sold from 1994 to 2000, seven are native to the forest, and of these seven plants, five are currently harvested by the timber industry.[9]

Where the 12 most popular medicinal plants in eastern Amazonia originate



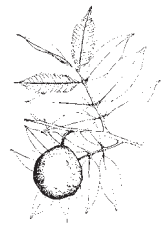

Plantations	Fields and roadsides	Secondary growth forest	Terra firme forest
1	**3**	**1**	**7**
guaraná (*Paullinia cupana*)	amor-crescido (*Portulaca pilosa*), mastruz (*Chenopodium ambrosioides*), quebra-pedra (*Phyllanthus niruri*)	sacaca (*Croton cajucara*)	andiroba (*Carapa guianensis*), barbatimão (*Stryphnodendron barbatiman*), copaíba (*Copaifera* spp.), pau d'arco (*Tabebuia impetiginosa*), marapuama (*Ptychopetalum olacoides*), sucuúba (*Himatanthus sucuuba*), veronica (*Dalbergia subcymosa*)

Where did our medicines go?

Because of the increasing incidence of fire and logging, some medicinal species are getting harder to find, not only in the forest but also in the market. Species with high medicinal value are increasingly being extracted for their timber. Some species, such as ipê-roxo, amapá, copaíba and jatobá only occur in mature forest, in low densities and are not domesticated. Rare in some areas, they are vulnerable to exploitation. A long-term study of the ecology and effects of logging on ipê indicates that this species is at risk and belongs on the CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) list like mahogany.[10]

Amapá: Amazonian invigorator

Silvia Galuppo
Campbell Plowden
Murilo Serra



Another powerful remedy used by both rural and urban populations is the bitter white latex which exudes from the amapá tree. Like pau d'arco, there is a strong need for more ecological, phytochemical and ethnobotanical research on this popularly used medicinal tree. It is traditionally used to treat respiratory conditions, gastritis and promotes the growth of scar tissue. Amapá is also used as an invigorating tonic, often by women after giving birth. Recent studies have demonstrated the analgesic and anti-inflammatory properties of two species of amapá (*Parahancornia fasciculata* and *Brosimum parinarioides*).[11] Amapá's powerful medicinal properties are widely known among Amazonians, and in 2005 it was one of the most widely used natural medicines in Belém, with a total of 10 560 litres being sold.[12]

There are two groups of Amazonian trees with edible latex that are called amapá: bitter amapá and sweet amapá. The bitter group is composed of a few species from the botanical family Apocyanaceae. Species from this family normally contain many types of alkaloids - strong chemical substances which can be effective in fighting illnesses. The most common species of bitter amapá is *Parahancornia fasciculata*. Some indigenous tribes in eastern Amazonia also use the latex from the species *Couma guianensis*. The sweet amapá group is composed of species from the genus Brosimum (from the Moraceae family). Nutritional analysis of *Brosimum parinarioides* demonstrates the presence of calcium, iron and magnesium.[13] Even though it is strong and widely used, many of its specific actions remain unknown.

Some collectors demonstrate a detailed knowledge of the ecology and anatomy of the tree and are using the same tool used to extract rubber from the rubber tree for the purpose of extracting amapá latex. The use of this tool results in greater latex production and less damage to the trees. A distance of 32 cm between cuts and a minimum tree diameter of 27 cm for initial extraction also correlate with higher productivity over the long term.[12]

A number of different species of amapá are relatively tall trees that are found in upland dry and flooded forests where the average density may reach 26 trees/ha. Because the different varieties of trees and latex may look similar, it is sometimes difficult to ascertain which species of amapá is being used. Dishonest merchants may take latex from a similar species and sell it as if it were the valued, medicinal species of amapá. To untangle the confusion, some key differences between the species are listed below.

Sweet or bitter amapá

	Family	Species	Common name	Leaves	Flavour of latex
	Apocyanaceae	*Parahancornia fasciculata*	bitter amapá	small, opposed	very bitter, taken with honey
	Apocyanaceae	*Couma guianensis*	black amapá	round	bitter
	Moraceae	*Brosimum rubescens*	muirapiranga	various types, alternating	not used
	Moraceae	*Brosimum potabile*	amapáí	small, slender, alternating	unpleasant
	Moraceae	*Brosimum parinarioides*	sweet amapá	large, thick, alternating	good, taken with cow's milk

Harvest with care

Campbell Plowden

As with pau d'arco, there are few studies about the ecology and physiological effects of extracting latex of amapá. In one study in the indigenous area of Tembé, in Pará, the two main varieties of amapá (*Parahancornia fasciculata* and *Couma guianensis*) had a combined density of 3 trees/ha. The fruits of the amapá tree are big, have a thick rind and are adored by monkeys. To harvest the latex, trees were wounded with a 1 cm wide diagonal cut twice a week for five weeks during two successive years near the end of the rainy season. In 1999, *C. guianensis* (called "black amapá") yielded an average of 100 ml of latex during the first cut, but the harvest declined to an average of 22 ml by the end of the experimental harvest. *P. fasciculata* yielded an average of 19 ml during the first cut, rose to a peak of 43 ml/tree then declined to an average of 28 ml/tree during the tenth and final harvest. Some Tembé said that latex should not be collected when the trees are bearing fruit since the latex is toxic then.[14]

In the cities and the countryside

Gloria Gaia

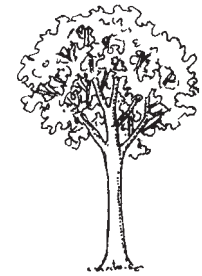
In the lively outdoor medicinal market in Belém, stalls display barks, roots, foliage and a brilliant array of colourful liquids, oils and resins. Some of the bottles of white liquid are amapá. The merchants sell two types: bitter and sweet. In 2008, a bottle of 500 ml of bitter amapá cost between US$6 and US$9. The bitter amapá is used by many people to treat malaria, worms, uterine infections, gastritis, anaemia, respiratory problems and even tuberculosis. Recently, people have begun to use amapá to treat cancer.

People in rural areas take a small teaspoon of amapá milk first thing in the morning before eating, for eight days. Afterwards they wait one week without taking it and, if needed, repeat the treatment. Children always take only half the dosage, a half teaspoon. Amapá milk is never taken pure. It is always mixed with water, milk, porridge or coffee. Sweet amapá is used to restore the energy of malnourished children. Usually, one tablespoon of sweet amapá is given twice a day.

MANAGEMENT

germination
2 weeks to
1 month

growth
seedlings: 5–75 cm
height/year
trees: < 1–5 mm
diameter/year

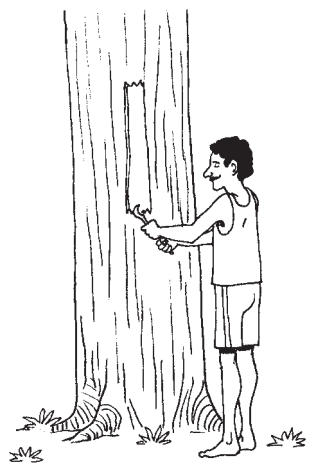


seed production
at 30–50 cm
in diameter

Ipê-roxo seeds are brown and have slender wings. The fruits are like green beans and need to be collected when they change from green to almost black, before they open and disperse their seeds. The seeds do not go through a dormant period; it is recommended to plant them within the first 20 days after collection. Seeds germinate in two weeks and the seedlings grow 5–75 cm/year in height. Once they are planted in the shade and the trees reach more than 10 cm in diameter, their growth slows to 1–5 mm/year in diameter. One study illustrates that if left in the shade, the majority die within the first year and the rest die in the second year.[15] When cultivated, ipê-roxo develops very well in full sun, both in single-species and mixed-species plantations.[16] However, when not tended, ipê-roxo saplings can be overwhelmed by vines and competing trees, so periodic clearing of competing vegetation is recommended for successful plantings.

Some people believe that the active medicinal substances of ipê-roxo are encountered in significant quantities in the bark when the tree is over 40 years old. Therefore it is worth the effort to look after older trees. When harvesting the bark, a few techniques to protect the tree's vigour should be employed:

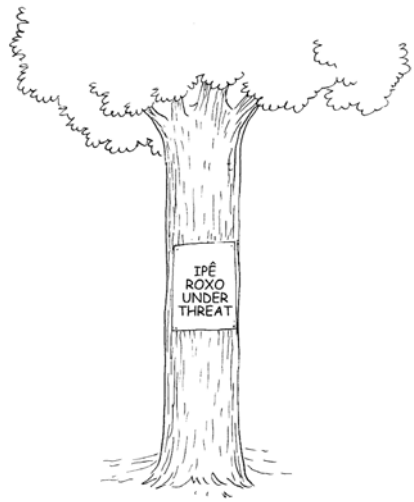
- Do not remove the bark from young trees with diameters of less than 30 cm.
- Do not remove a ring of bark around the trunk. This will kill the tree because the sap that feeds the tree needs to pass through the bark.
- The thinner the tree, the thinner the piece of bark that should be extracted, varying from 2 to 4 cm thick.
- Avoid extraction during the reproductive cycle (flowering and fruiting). It is preferable to extract the bark after the seeds are dispersed; this way, you will avoid interfering with the tree's reproductive cycle and allow new trees to grow.
- Remove rectangular pieces of bark in a vertical line going up the trunk: the long sides of the rectangle along the length of the tree, the short sides along the width of the tree. The bark should be removed at chest height and above.
- After extraction, be careful to avoid contaminating the section where the bark was removed with fungi, termites and other types of insects that interfere with its regeneration. It is worthwhile to observe and evaluate the regrowth of the bark each year to see how the tree reacts to the cut.



Banking on ipê

Timber from the ipê-roxo is so valuable that the ipê would seem to be the ideal species to manage. Indeed, ipê accounted for 9% of all timber exports from Brazil in 2004 and is the most common tropical species in the US$3 billion residential decking market in the United States of America.[17] However, it is one of the trickiest species to harvest from forests in a sustainable manner. Ipê-roxo presents two major obstacles for managing: first, saplings grow sparsely in the forest and thus cannot replace the adults which are extracted; and second, the growth rate is relatively slow: one plant can take up to 100 years to grow into an adult. Because ipê-roxo trees grow less than 2 mm/year in diameter on average, a 2-m (2 000-mm) diameter giant is likely to be many centuries old.[18]

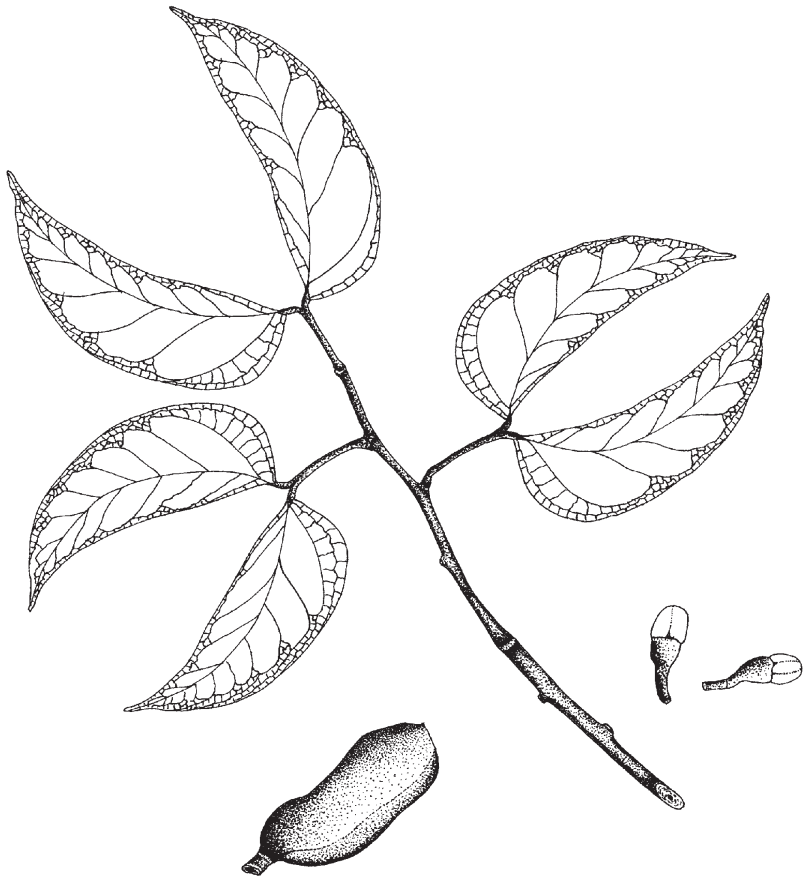
Logging operations typically cut down all of the adult trees in the forest, leaving few parent trees to produce seeds for the next generation and few young trees to take the place of the adults that were cut. The method used for harvesting ipê-roxo makes about as much sense as taking all of the money out of a savings account and hoping that in 30 years the balance of zero will somehow have generated enough interest to permit another withdrawal. There is no chance of this happening. For this reason, ipê-roxo is one of the most threatened species in Amazonia. Before cutting it down it is vital to consider the many benefits this tree can offer over the long term.



1 Schulze, M. *et al.* 2005 / Schulze, M. 2008
2 Oliveira, A.C.A. 2000
3 Lentini, M., Pereira, D., Veríssimo, A., 2005/ Schulze, M. *et al.* 2008a
4 Secretaria de Estado da Fazenda, 2008, www.sefa.pa.gov.br
5 www.aliceweb.desenvolvimento.gov.br
6 Lübeck, W. 1995
7 Stepp, J.R. and Moerman, D.E. 2001
8 Shanley, P. and Luz, L. 2003
9 Galuppo, S.C. 2004
10 Schulze, M. *et al.* 2008a
11 Souza, M.C.L. *et al*. 2003 / Projeto Dendrogene, Embrapa-Amazonia Oriental.
12 Serra, M. *et al.* 2010.
13 Galuppo, S.C. 2004
14 Plowden, C. 2001
15 Schulze, M. 2003
16 Schulze, M. 2008
17 SECEX, 2005 / USDA-FAS 2008
18 Schulze, M. *et al.* 2008b

Jatobá

Hymenaea courbaril L.



Patricia Shanley
Mark Schulze

The first-rate wood, curative bark, edible fruits and golden resin of the jatobá tree offer an outstanding assortment of uses for rural and urban families. The bark contains properties that fight the common cold, bronchitis and diarrhoea, and tea from the bark serves as a tonic to strengthen the body after an illness. The wood is extremely durable and for this reason it was used to make railroad ties for the Carajás mine in Pará, which carried some of the heaviest loads of iron in South America. Jatobá's resin, known as jutaicica, can also be used as medicine. During times of conflict, Indians used the resin on the points of their arrows to set fire to enemy villages. And finally, jatobá produces edible fruits that are beloved by local people, though little known outside of forest communities.

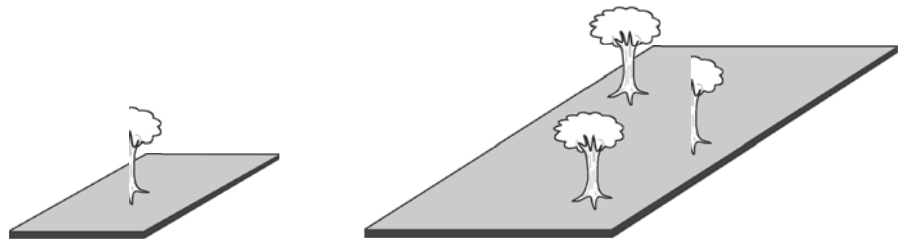
Jatobá is a tall tree, from 30 to 40 m, and has a straight trunk, reaching approximately 2 m in diameter (about 5 m in circumference). The bark can grow up to 3 cm thick. Jatobá is widely distributed throughout Mexico, Central and South America, extending all the way to Paraguay. It grows in terra firme forests and occasionally in tall várzea forests, and can also be found in poor and sandy soils.

ECOLOGY

Flower and fruit seasons

The jatobá tree flowers in the dry season and bears fruit 3–4 months later. In Pará, jatobá flowers from March through May and bears fruit from August through October. In Central Amazonia, it produces fruit from February to September[1] and in Acre, from May to September.[2]

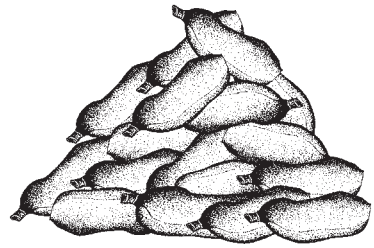
Density



Jatobá is widely distributed but rare (less than 1 tree/ha) throughout most of its range. Its abundance is diminishing because of the timber trade. It is exported as well as used domestically.

Production

Production varies greatly. Jatobá does not usually produce fruit every year; it often rests one year and produces the next. While some trees produce very little, others can produce up to 2 000 fruits, with each fruit containing 2–4 seeds. In any given year, 15–90% of the adult trees in a population may produce fruits.



an average of about 800 fruits/tree

Jatobá bark is approximately 40% water. Of 100 kg of bark, roughly 60 kg will be dry material. One tree typically produces about 15 kg of resin.

ECONOMIC VALUE

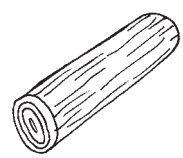
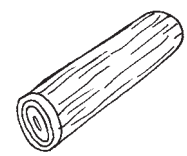
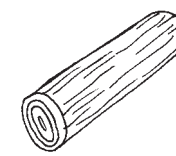
In 2009, in the Ver-o-Peso market in Belém, one jatobá fruit was sold for US$0.10, as opposed to US$0.03 in 2004. A litre of resin now costs US$3 and 1 kg of bark US$2, whereas in 2004, these cost US$1.50 and US$1 respectively. In Rio Branco, in 2002, the municipal market and the medicinal plant shops sold a 100 g bag of jatobá bark for US$0.70. Jatobá wood is one of the most prized on the international market. In 2008, 1 m^3 of sawn jatobá timber sold for US$336 domestically.[3] Sawn wood sold for export can fetch much more and in 2004 was almost US$400/$m^3$.[4]

Seeds for sale

Rocio Ruiz and Nívea Marcondes,
CTA, Acre

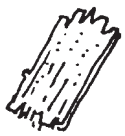
Not only can timber and fruit make money, but also forest seeds. With the rise in deforestation in Brazil, there has been a corresponding rise in demand for hardwood seeds to assist companies who need to meet federal reforestation regulations. A study in Rio Branco in 2005 illustrated that 1 kg of jatobá seeds (300 seeds) was sold for US$4. It is revealing to compare the price of a standing tree to the price of its seeds: at US$3/m^3, the average tree is worth less than US$21 in Acre, far less than a single crop of seeds, which may yield 10–15 kg. In addition to seeds from the jatobá tree, seeds from many other species like cerejeira (*Amburana acreana*), copaíba, cumaru (*Dipteryx odorata*), ipê-amarelo (*Tabebuia serratifolia*) and maçaranduba (*Manilkara huberi*) also fetch high prices at the market. In Acre, the Technology Foundation (Funtac) markets 11 seed varieties, with plans to increase this number. Seeds are a particularly useful commodity in more isolated regions, as they are easier to transport than timber.

The price of forest seeds vs the price of wood

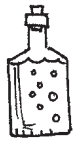
	Jatobá (*Hymenaea courbaril*)	**Ipê-amarelo** (*Tabebuia serratifolia*)	**Maçaranduba** (*Manilkara huberi*)
Price paid to collector/kg of seeds	US$4 	US$25 	US$4 
Price paid/m^3 of timber (standing trees)	US$3 	US$3 	US$3 

USES

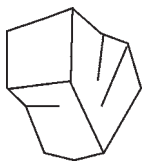
Fruit: The fruit can be eaten raw or used to make flour. It is believed to alleviate pulmonary problems.



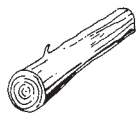
Bark: A tea made from the bark is used in certain areas to combat the common cold, diarrhoea, bronchitis, cystitis, pulmonary congestion, worms, weakness, bladder infections and cramps, as well as to aid in digestion and to treat prostate cancer. In addition, the bark and fruit can be used to fight coughs: just suck and chew on a piece like a lozenge.



Sap: When cut, jatobá excretes a valuable red sap. It can be used as fuel, medicine, vegetable varnish and sealant for canoes. Care should be taken when extracting the sap with a machete, as this can damage the tree. Liquid sap turns into solid resin (locally called jutaicica) upon contact with oxygen.



Resin: Called jutaicica, this golden resin is usually found at the base of the tree, oozing from holes in the bark made by insects, or forming in hard, transparent balls on fallen trees. Farmers sometimes find chunks of jutaicica in their fields where jatoba trees once grew. These are gathered and chewed to alleviate gas and stomach aches.[5] Jutaicica can be burned and used as an inhalant for colds and headaches. Jutaicica is also an excellent varnish, particularly for clay pots.



Wood: Hard, heavy and highly valued in the export market, jatobá wood is used in civil construction in the cities and used for making canoes in the country. It has outstanding value because of its durability, which is comparable to maçaranduba, jarana (*Lecythis lurida*) and other hard and resistant woods. Jatobá is exceptional because it does not splinter.

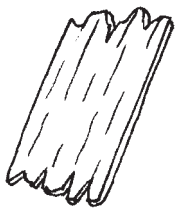
Game: Hunters wait for game (such as tapirs, pacas and monkeys) beneath the jatobá when the fruits are falling.

Leaves: The leaves possess a terpenoid, a chemical substance that kills fungi and repels ants and lizards. The leaves merit further study.

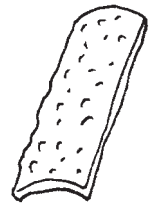
Secrets for making tea

To make jatobá tea for colds or as a tonic, boil three fingers of bark (20 g) in 1 litre of water for 15 minutes. Take one cup of tea three times a day.[6] The bark can also be used to make tinctures, lozenges or syrups.

Beware: jatobá is different from jutaí



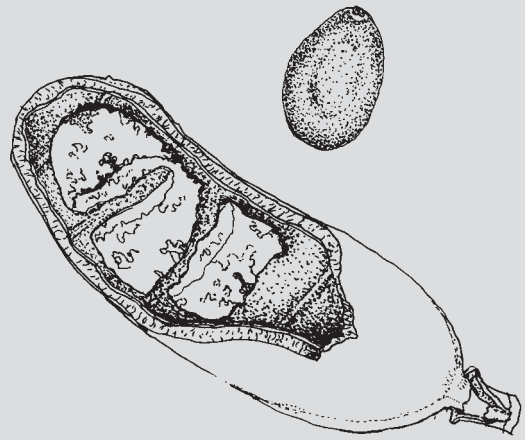
Be careful! Jatobá bark is very similar to other barks that are extremely toxic. Jatobá is often confused with jutaí (*Hymenaea parvifolia*) and the jutaí-da-folha-grande (long-leaved jutaí) (*Hymenaea oblongifolia*). However, there are noticeable differences: common jutaí has hard, leathery leaves, its trunk is less red and its bark is finer than that of jatobá. It is easier to differentiate big-leaved jutaí because its leaves are much larger and its trunk is redder than jatobá.



Jatobá advances rubber technology

Lênio José Guerreiro de Faria

Researchers from the Laboratory for the Engineering of Natural Products, at the Federal University of Pará, discovered that powder made from jatobá fruits can be used as a coagulator in the process of transforming latex from the rubber tree (seringa) into solid rubber. The standard process for removing the liquid from latex uses centrifuges, which require large quantities of energy. In contrast, using jatobá powder does not require any energy, as the powder concentrates the liquid and separates it from the rubber. A few communities have already tested the use of jatobá for making rubber.



Nutrition

The fruit is composed of 2–4 seeds (25–40% of its weight), surrounded by a sticky white pulp (only 5–10%) encased in a pod (50–70%). The protein value of jatobá flour is similar to corn and superior to farinha. One hundred grams of the fruit supplies 115 calories, 29.4 g of glycides and 33 mg of vitamin C.[7]

Recipes

Jatobá flour

Scrape the seeds with a knife to obtain the pulp. Next, grind the pulp with a mortar and pestle or blender and then sift. The flour that is produced can be used to make cakes, biscuits, breads and liquors.

Jatobá porridge

Ingredients:
– Milk, pulp, sugar, cinnamon

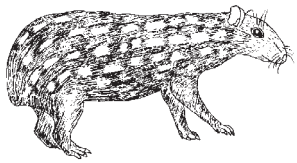
Preparation:
Remove the pulp from the seeds. In a pan, mix the pulp and the milk. Add sugar and cinnamon to taste and heat the mixture over a stove until it thickens. Serve warm.

Jatobá bread

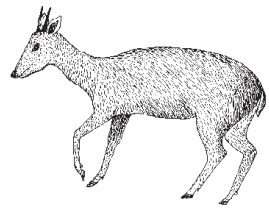
Ingredients:
– 2 cups jatobá flour
– 3 cups wheat flour
– 2 tablespoons yeast
– 1 tablespoon sugar
– 3 tablespoons oil
– 1 teaspoon salt
– 2 cups warm water

Preparation:
Dissolve yeast in warm water in a large bowl for 10 minutes. Gradually add the wheat and jatobá flour. Knead the mixture well on a cutting board or table. If necessary, add more flour until the dough becomes firm. Return the dough to the bowl and cover for two hours in a warm place without draughts, like an oven. Next, return the dough to the cutting board and knead well. Leave the bread to rise for another 30 minutes in a bread pan. Bake in a hot oven for 30 minutes.

WILDLIFE



Deer, paca, agouti and monkeys eat jatobá fruits. Monkeys are capable of knocking down quite a few fruit when they are in the trees. Just like us, they bang the fruit on the branches or exposed roots to open it. Tapir[8] and paca eat the fruits and scatter the seeds throughout the forest, helping to disperse the species to new areas.

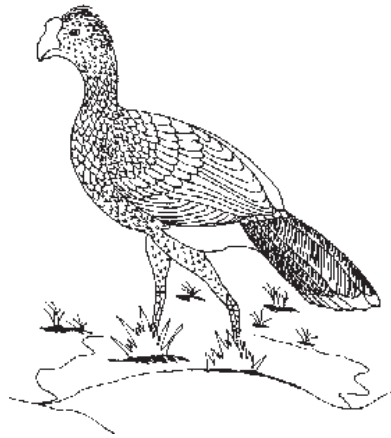


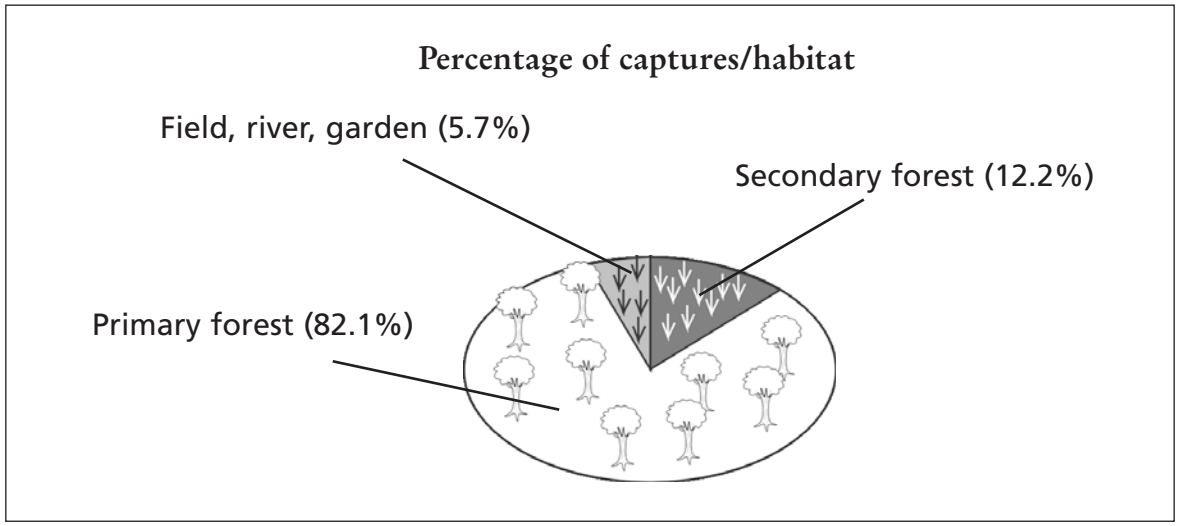
Wildlife habitat: primary and secondary forests

Margaret Cymerys

Forests are critical ecosystems for wildlife, offering them food and shelter; as forests are destroyed, wildlife habitats are threatened. Some species of animals can survive in logged and burnt over secondary forests, while others cannot. For example, tapirs, white-lipped peccaries and some primates are generally not found outside tall primary forests. Many birds including the large razor-billed curassow (*Mitu tuberosum*) that eat fruit and seeds are also only seen in the primary forest.

Other animals like paca, agouti, sloth and deer can live in secondary or primary forest and tend to remain in logged, farmed areas and areas that have suffered fires. The pie chart below shows where animals were captured by hunters in a community along the Capim River in Pará. The majority of the game animals were captured in primary forest (82%), demonstrating the importance of this habitat to wildlife and local livelihoods.[9] Without primary forests, wildlife diversity will diminish and it will no longer be possible to witness magnificent Amazonian wildlife like the harpy eagle (*Harpia harpyja*) and the ocelot (*Felis pardalis*).





MANAGEMENT

germination
20–180 days, or one week when scarified

growth
0.5 m to more than 1 m/year

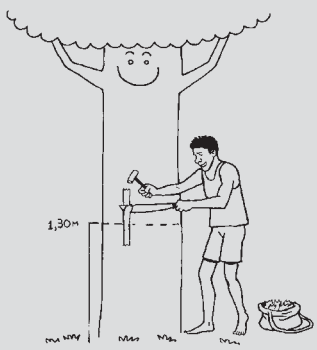
production
40 years in forest gap

Jatobá regeneration is exceedingly limited, perhaps owing to high predation of its seeds or because the majority of seedlings die within a few months in the shaded forest understorey.[10] However, given the multiple values of this tree, it is worthwhile to care for standing trees and to plant new ones. Growth and fruit production of standing trees, particularly smaller individuals, can be increased by cutting vines that compete for light in the tree crown and cause broken limbs, and by selectively removing trees of less valuable species that are directly competing for resources.[11] To plant, remove the pulp from the seeds and place them in pans in a shady, well-ventilated place. Seed dormancy can be broken by scraping their exteriors or by dropping them quickly in hot water and then transferring them immediately to cold water. After scarification, seeds germinate in one week. Cans, baskets or plastic bags with small holes in them can be used as receptacles for the seeds. Plant one seed per receptacle, 5 cm deep in the soil. Place the receptacles in the sun and water twice daily.

When the plant reaches 25 cm, transplant it to a permanent location that receives a lot of light (at the forest edge or in gaps in the forest canopy), preferably in the rainy season. Mix chicken manure, horse manure or corn husks in the soil around the hole where the plants are to be placed, making sure the planting holes are large enough for the growing roots to breathe comfortably.[12] When transferring the seedlings, be sure not to break the clump of soil that surrounds the roots. Alternatively, scarified seeds can be planted directly in forest openings and tended by periodically cutting back competing vegetation.[10] Because of their high value, many farmers take care not to disturb jatobá sprouts in the ground when they tend their crops. They protect the seedlings until they are large enough to be transplanted.

Removing bark with care

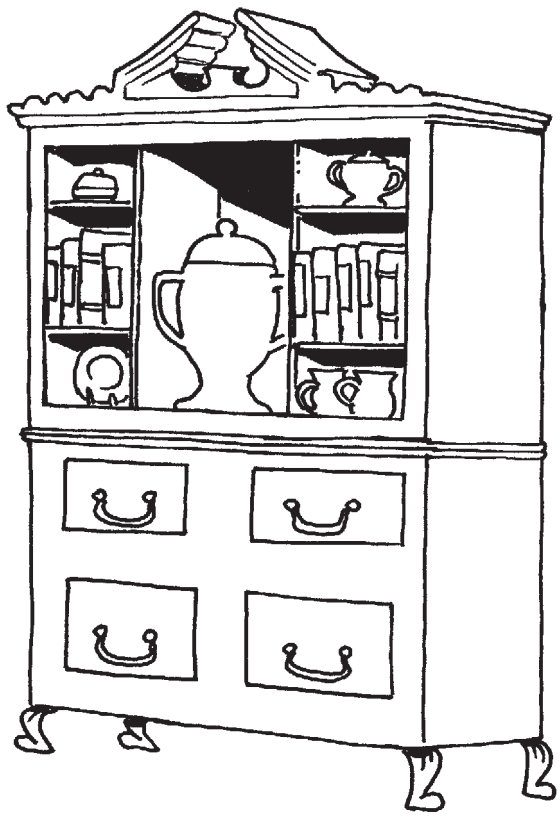
Mariella Revilla
Alexandre Dias de Souza



Take care when removing jatobá bark. A study in Acre showed that the bark has limited potential for regrowth. Although 40–50% of ipê bark regenerates after two years, only 10% of jatobá bark grew back. Jatobá bark regenerates slowly because it is attacked by insects, primarily bees, which feed on its resin. Most bark collectors throughout the state of Pará now frequent sawmills where they are able to collect substantial quantities of bark from the jatobá timber that is being processed.

Furniture or medicine?

In 2003, mahogany was recognized as a species threatened with extinction by predatory logging in the majority of areas where it occurs. Mahogany extraction is now regulated by legislation that specifies how the species is to be managed and the quantity of timber that can legally be harvested. The mature populations of jatobá and mahogany are equally threatened by predatory logging, and neither regenerates well in disturbed forests. Recovery of jatobá populations from a single timber harvest may take more than 100 years, even under the best of conditions.[13] Because few small trees and seedlings of mahogany and jatobá are present in a typical forest, when 90% or more of the adults are logged in a typical operation, it has an enormous effect on the populations of mahogany and jatobá alike.[14] However, jatobá differs from mahogany in that it has medicinal as well as timber value. Unfortunately, jatobá is still not legally protected and continues to be threatened by overexploitation in the majority of Amazonia. In addition to affecting the long-term supply of wood, unsustainable harvesting will also reduce the availability of jatobá's irreplaceable medicinal products.



Although jatobá was little known outside the Amazon until recently, the wood is increasingly marketed to the United States of America and Europe (sometimes as 'Brazilian Cherry') for use in furniture and flooring. In the mid-1990s, the 'discovery' of

jatobá timber by importing countries caused it to jump from the class of a low-value species, only worth harvesting from forests near sawmills, to the class of an export species in high demand. By 2004, jatobá had become one of the more valuable timbers in the Amazon, intensively harvested from forests across the basin.[3] In the United States of America market alone, the value of jatobá imports exceeded US$13 million in 2007 – the first year jatobá lumber imports were recorded separately from other tropical species – and are on pace to surpass US$40 million in 2008.[15] With this market accounting for 30% of timber exports from the Amazon, total exports may well exceed US$100 million. In contrast to the globally marketed timber, medicines derived from jatobá bark and sap are primarily marketed and used locally. However, local populations often benefit more from jatobá medicines than from selling logging rights to timber companies, which pay only a tiny fraction of the timber value to the landowner (a tree sold to loggers for as little as US$50 can yield more than US$600 worth of sawnwood).[3] While Jatobá flooring and furniture is of high value to consumers, and jatobá logging can be enormously profitable, the jatobá tree may bring more value to local communities when left standing.

1 Clay, J.W.; Sampaio, P.B. & Clement, C.R. 1999
2 Almeida, S.C.B. 1999
3 Secretaria de Estado da Fazenda 2008
4 Lentini, M., Pereira, D. & Veríssimo, A. 2005
5 Levi-Straus, C. 1997
6 Shanley, P.; Höhn, I. and Silva, A.V. 1996
7 IBGE, 1999
8 Oglethorpe, J *et al*. 1997
9 Cymerys, M., Shanley, P. & Luz, L. 1997
10 Schulze, M. 2008.
11 Schulze, M. 2003.
12 FAO 1987
13 Schulze, M *et al*. 2005.
14 Schulze, M. *et al*. 2008b.
15 USDA-FAS 2008

Mahogany, mogno

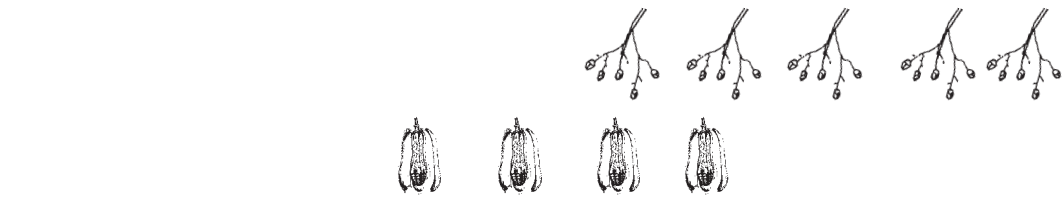
Swietenia macrophylla King

James Grogan

Perhaps more than any other tree, mahogany connects Amazonian forests to the world outside through its gorgeous, durable wood. Many loggers have penetrated the heart of the forest in search of this valuable wood, often referred to as ‘green gold’. Mahogany trees are easy to identify from the ground owing to their massive buttresses, up to 5 m high. Mahogany forms a broad crown from a few large branches, with leaves that shine like no others in the forest. It is distributed in southern and western Amazonia and in the forests along the Atlantic coast of Central America. Mahogany should be treated well as its timber is valued at four times the price of any other wood.

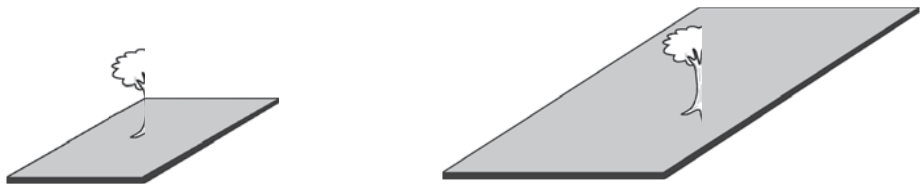
ECOLOGY

Flower and fruit season



Mahogany flowers in the Amazon between July and November, from the middle of the dry season until the beginning of the rainy season. Fruit reach full size in the crown by the middle of the rainy season, but the seeds inside are mature only at the beginning of the following dry season, from May to August. Fruit capsules pop open as the tree drops some or all of its leaves early in the dry season, and the wind disperses the winged seeds.

Density



Mahogany occurs at low densities in South America compared to Central America and Mexico. In southwest Amazonia, in the Brazilian state of Acre, Peru, and northwest Bolivia, densities are typically one tree in 5–20 ha where mahogany occurs, or on average about 0.1 tree/ha. It occurs more frequently in southeast Amazonia in the Brazilian state of Pará, along the banks of seasonal streams and smaller rivers at densities up to 2.5 trees/ha and even up to 6 trees/ha in local groups. But these populations were nearly completely logged out during the 'mahogany rush' of the 1980s and 1990s.

A whale of a species

Viewing a map of South America, mahogany's distribution looks like a great whale with its head starting in Pará, Brazil, its body passing across southern Amazonia and its tail rising up west and north towards the Atlantic Ocean, covering parts of Brazil, Bolivia, Peru, Ecuador, Colombia and Venezuela. In Central America, mahogany can be found along the Atlantic coast, from Panama to Mexico. Some researchers believe that it is widely distributed in Mexico and Bolivia because hurricanes and floods have allowed mahogany to flourish in these regions by opening large swaths of forest for regeneration.[1]

Production

an average of 3 000 seeds/tree

Mahogany produces two valuable commodities: extremely beautiful wood (easy-to-work and prized by people all over the world) and seeds.

Mahogany trees begin to flower and fruit annually when they are about 30 cm in diameter, though even smaller trees are capable of producing fruit. The rate of fruit production generally increases as the tree grows in diameter, though some small trees are capable of producing many fruit, and some large trees rarely produce fruit at all. High fruit production for a tree 30–70 cm in diameter is around 50 fruit capsules. Trees larger than 70 cm in diameter may produce up to 200 fruit in a single year, though this is rare (the most fruit ever counted on a single tree were 780 on a 132 cm diameter tree in Acre). Fruit production by individual trees and by groups of trees varies widely from year to year, as trees often "rest" between years with heavy fruit set.

A single fruit contains up to 60 large, winged seeds, but on average only 35–45 of these will germinate. Fruit size may vary considerably, both within a tree's crown and among different trees. Larger fruit produce larger seeds that are more likely to germinate and will produce larger seedlings. Even though most seeds fly less than 100 m from the parent tree, they are difficult to collect on the ground once dispersed, and they quickly lose the ability to germinate once exposed to the elements. The seeds are best collected from the crown, before the fruit capsule bursts open, by using proper tree-climbing equipment and an extendable pruning pole to sever the fruit where it attaches to the tree's smallest branches. The larger branches should not be cut just to bring down a few fruit – this will reduce fruit production in years to come.

300
SEEDS
US$4

2 360
SEEDS
US$2

56
FRUITS
US$4

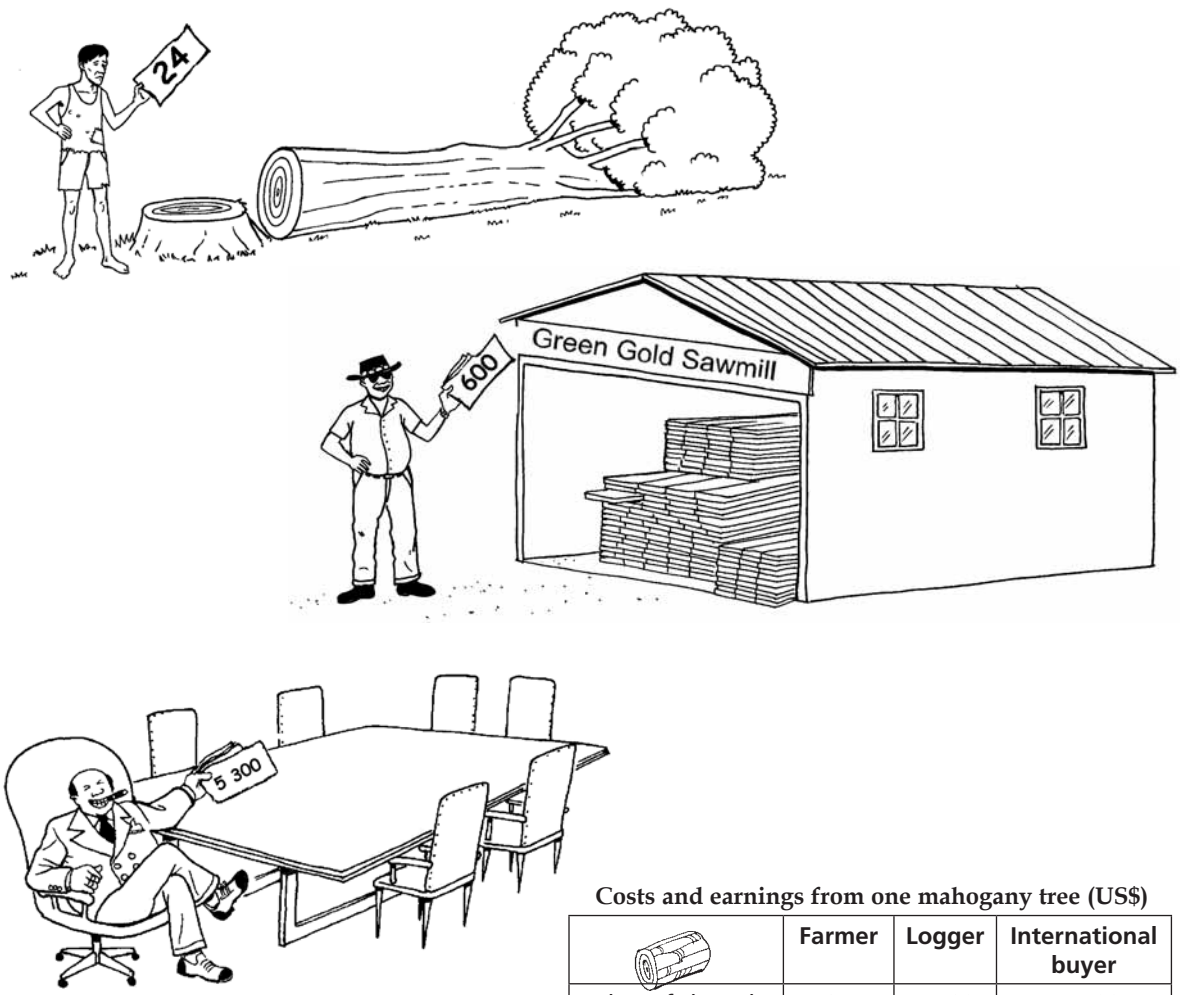
2 500
SEEDS
US$50

A cooperative of communities near Brasiléia in Acre, called Nossa Senhora da Fátima, collects mahogany seeds and seeds from other valuable timber species to sell profitably throughout Amazonia. The cooperative employs community members who are trained as tree climbers and collectors. One kilogram of mahogany seeds contains between 2 000 and 3 000 seeds after the wings have been removed. It takes about 50–75 fruit capsules at 40 seeds/capsule to produce 1 kg of cleaned seeds. In 2000, this cooperative earned about US$50/kg for the mahogany seeds that they collected, dried and packaged for sale.

ECONOMIC VALUE

Mahogany is the most valuable timber species in the Brazilian Amazon, worth up to four times the value of its nearest competitor. One cubic metre of first-quality sawn mahogany – imagine a solid cube of stacked mahogany planks, 1 m wide by 1 m long by 1 m tall – is worth about US$1 800 when it departs the docks of Belém or Paranaguá for the United States of America or Europe. A single large tree, 80 cm in diameter or a bit larger than 250 cm in circumference, on average can produce more than 2 m^3 of sawn timber worth about US$4 100 if the wood is of high quality. However, smallholder farmers and Indigenous Peoples who sell mahogany trees to loggers rarely receive more than US$6–24/tree, if they receive any money at all. Similarly, mateiros (woodsmen) who search the forest for mahogany, chainsaw operators who fell the trees, and logging crews who drag the trees out of the forest and transport them to the nearest sawmill are poorly paid. In fact, most of the tree's value goes to the middlemen who finance mahogany's harvest, processing and resale to foreign buyers.[2]

Earnings from a typical mahogany tree (2.4 m^3) along the production chain

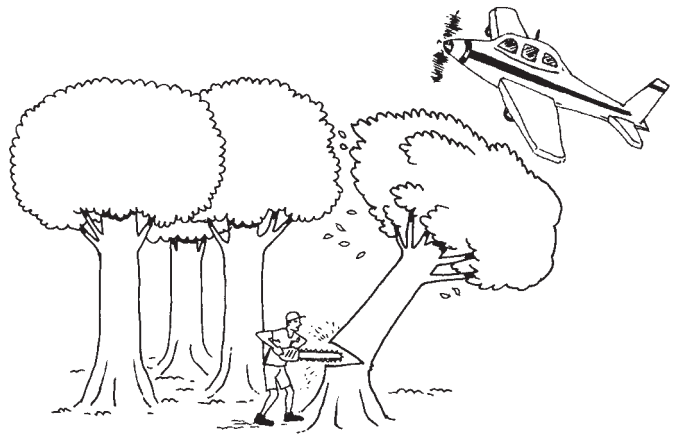


Costs and earnings from one mahogany tree (US$)

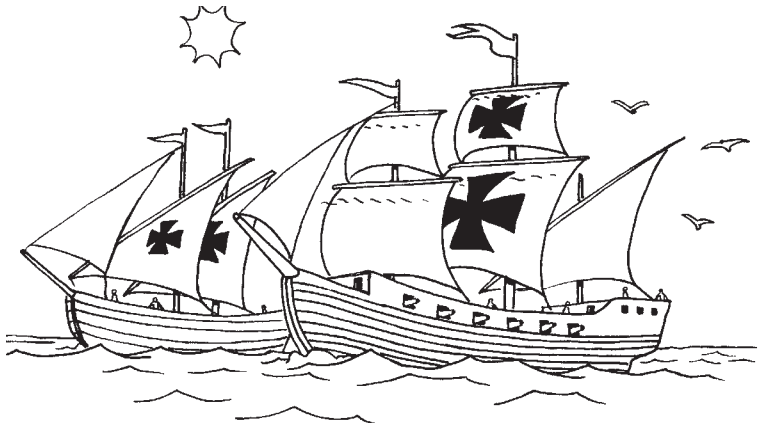
	Farmer	Logger	International buyer
Value of the sale	24	1 400	17 700
Costs	0	800	12 400
Earnings	**24**	**600**	**5 300**

USES

Mahogany is highly valued because its wood combines many rare qualities. It has a beautiful colour and grain; it is lightweight yet exceedingly strong and resistant to rot; and it has excellent workability – just ask any carpenter. For these reasons, it is a luxury wood used throughout the world for producing high-priced furniture, panelling, musical instruments and yachts. Mahogany's extraordinary value has pushed loggers into the heart of Amazonia where people have never heard a chainsaw before. The loggers fly in, using small planes to spot mahogany crowns in forests far from the nearest road or settlement. Loggers will try to buy trees cheaply unless landowners learn to negotiate fair prices.

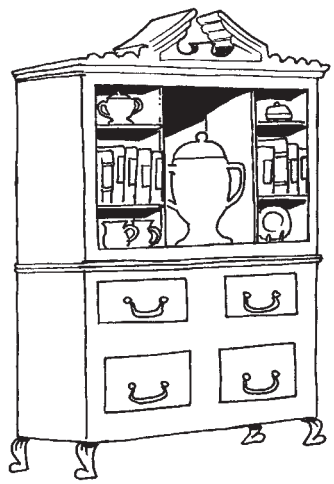


The cannonball test



In the sixteenth century, after the Spanish arrived in Central and South America, they discovered that mahogany was a superior wood for shipbuilding than the European timbers used up until that time. It resisted rot in warm, tropical waters and had the enormous advantage of not splintering when hit by cannonballs, absorbing the impact without shattering and injuring sailors with flying wooden shrapnel. When the English defeated the Spanish Armada in a great naval battle in the sixteenth century, their main prize was the Spanish fleet, built largely out of mahogany.

The English are primarily responsible for the modern-day use of mahogany as a luxury wood in furniture. They discovered in the eighteenth century that mahogany's great strength allowed massive bureaus and wardrobes to be built on legs so thin and delicate that they looked insufficient to bear their weight. This style was so popular that even the royal family insisted on having furniture built from mahogany.[3]

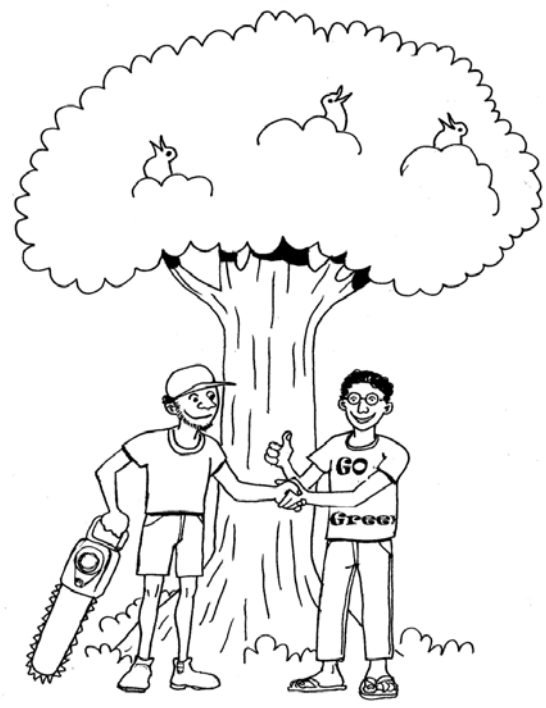


Consumers, communities and conservation

By shopping for and requesting certified sustainable forest products, consumers can help communities and governments maintain functioning forest ecosystems. Although nearly every North American and European has heard of mahogany, how many consumers know where this timber comes from, and at what cost? Since the 1970s, mahogany has been under intense exploitation pressure to supply international consumers, leading to commercial extinction across most of its range in South America. Mahogany received additional protection when it was listed on CITES (Convention on International Trade in Endangered Species) Appendix II in 2003, but this is no guarantee that significant natural populations will survive in the wild.[4] More than any other Amazonian resource, including gold, mahogany has catalysed the invasion of previously unexploited forests and Indigenous Areas across Amazonia by loggers, ranchers and industrial farmers.

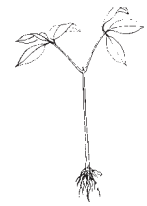
The majority of mahogany is logged illegally, extracted from uninhabited government lands and indigenous areas hundreds or even thousands of kilometres from the nearest legally registered management plan. Often loggers fell every mahogany tree they can find, including trees too small to harvest legally and large hollow trees with no commercial value (but that still flower and produce seeds each year). Predatory logging ignores sustainable management guidelines that require the retention of small trees to provide future harvests and large 'mother' trees to produce and disperse seeds representing future generations of mahogany trees.[5]

Yet mahogany could also represent the vanguard of positive change in Amazonia. If consumers demanded certified forest products, foresters and governments alike would have an incentive to sustainably manage their forests. By far the most valuable timber tree in Amazonia, mahogany could provide great incentive for management plans that allow for continued commercialization while maintaining healthy populations of trees in the forest, thus ensuring harvests for generations to come.



MANAGEMENT

germination
2–4 weeks after
wetting the seeds

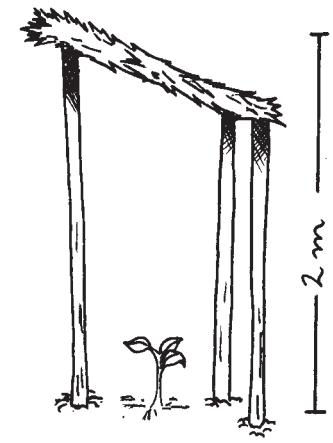


growth
1–2 m/year
in the first years

seed production
when the trunk reaches
30 cm in diameter

Seeds and seedlings

Mahogany seeds will germinate within 2–4 weeks once they have been watered. Break off the wings and plant the seeds tip down in well-draining soil (for example, sandy soil), nearly but not quite buried. In the nursery, use black polyvinyl planting bags 10–12 cm in diameter by 30 cm deep to allow the seedling to root deeply. It's best to try to use the same kind of soil in the nursery that the seedling will encounter in the forest after planting. Keep the soil damp, but not too wet, or else seeds will catch fungal infections and die. The best overhead cover is half shade using a single layer of babaçu or inajá leaves suspended about 2 m over the plantings.



Once the seeds begin to germinate, the seedlings will sprout leaves quickly, standing 15–25 cm tall, with 4–8 simple leaves. They will rest for about a month before producing new leaves again – some of these will be compound leaves, and if the seedling is healthy, it can grow 10–15 cm during the second flush. The best time to plant seedlings into forest gaps or into agricultural clearings is after the second batch of leaves has sprouted. Prune off all but the highest four or five leaves to reduce heat and water stress when planting in bright sun. Dig a hole the exact size of the seedling bag with a posthole digger and slide the seedling soil core into this hole intact, making sure to re-establish soil contact between the seedling and the forest soil.

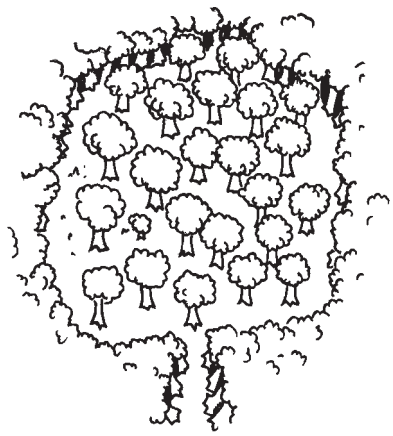
It is also possible to plant mahogany seeds directly into gaps and agricultural clearings, especially in areas that have been cleared by burning, as the burned areas offer reduced root and above-ground competition. Keep seeds dry after collecting them, because there is a tendency for moulds and fungi to damage them without any sign of attack.

Wait until after the rainy season has begun to plant seeds, so they will germinate more quickly. This will reduce the time they are exposed to forest animals, like rats and agoutis, and to insects that eat or damage seeds. If possible, loosen the soil before planting to about 30 cm depth with a posthole digger, refill the hole, and then plant the seed at the soil surface. Plant two or three seeds per site to make sure at least one survives to germinate and grow. Later, if necessary, weed out the small or less vigorous seedlings. Mahogany grows especially well beside dead trees or palm stumps that do not sprout.

Growing and tending

Mahogany seedlings prefer a lot of light – the more the better. Plant seeds or seedlings as near as possible to clearing centres, at a spacing of 8–10 m. It is best to orient a long clearing east-to-west so that the sun will pass overhead longer during the day.

Mahogany is capable of growing very fast under the right conditions – in a clearing with lots of sunlight, in fertile soil and without vines smothering its crown. Some seedlings can grow up to 2–3 m/year during the first years. Secondary vegetation growing near the seedlings can help them hide from the shoot borer moth, whose larval caterpillars eat expanding stem tissues and destroy the sapling's straight-as-an-arrow form. It is also good to plant mahogany at low density and widely spaced, so that one fast-growing seedling does not attract the shoot borer to its slower-growing neighbours.



Mahogany needs care, but not too much. Once mahogany is growing well in small- to medium-sized clearings, it needs tending only every two or three years. Vines should be cut if they've climbed onto its crown, and competing trees can be cut if they are casting too much shade on the mahogany trees. In the long term, these efforts may be well compensated. Mahogany is likely to be much more valuable by the time the next generations – your children, and their children – wish to cash in.

[1] Snook, L.K. 1996 / Gullison, R.E. *et al*. 1996
[2] Veríssimo, A. *et al*. 1995
[3] Raffles, H. 2002
[4] Blundell, A.G. 2004 or Grogan, J. & Barreto, P. 2005
[5] Grogan, J., Barreto, P. & Veríssimo, A. 2002

Piquiá

Caryocar villosum (Aubl.) Pers.

The Indians wander three or four miles back from the bluff looking for piquiá fruits... Forest monarchs, these are; the branches, contrary to the rule of forest-trees, are spreading and rough, like an oak, but vastly larger than any oak I ever saw.

Herbert H. Smith, 1879

Patricia Shanley
Jurandir Galvão
Margaret Cymerys

The piquiá is a majestic tree that can reach astonishing heights of 40–50 m. It has a trunk of up to 2.5 m in diameter (over 5 m in circumference) and an enormous crown that is easily spotted in the forest. It can be found throughout Amazonia, with the greatest concentrations in upland forests of the large estuary region.[1] The grapefruit-size, tawny fruit fall freely from the tree. Children scoop them up to bring home, as the yellow, oily, rich pulp of piquiá must be boiled before eaten. Although not sweet, the savoury fruit are appreciated by Amazonian families who delight in their unusual scent and flavour.[2] The wood's interlaced fibres provide extra resilience, giving it a superior quality and making it a favourite for boatbuilding. Rich in carbohydrates and protein, piquiá flowers are a prized food source for forest animals. When the tree is in flower, avid hunters place small hunting stands near the tree to wait for game to arrive and nibble at the thousands of large golden yellow flowers scattered on the ground.

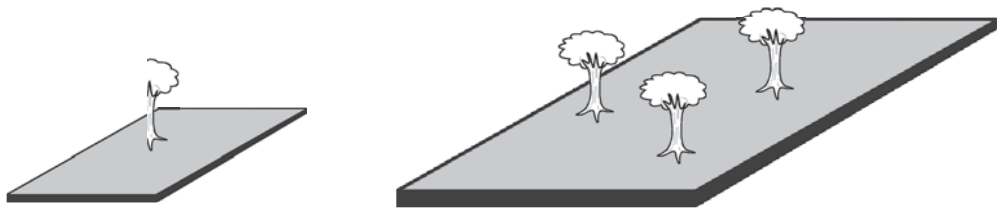
ECOLOGY

Flower and fruit seasons

J F M A M J J A S O N D

In Pará, the piquiá tree produces flowers in the dry season, from August until October, and fruit during the rainy season, from February until April. The leaves may fall either in the beginning of the flowering season or as the fruit begin to appear on the tree.

Density



0.4–0.6 trees/ha

2–3 trees/alqueire

Higher densities, from 2–7 trees/ha, occur in some regions, possibly because of indigenous management.

Production

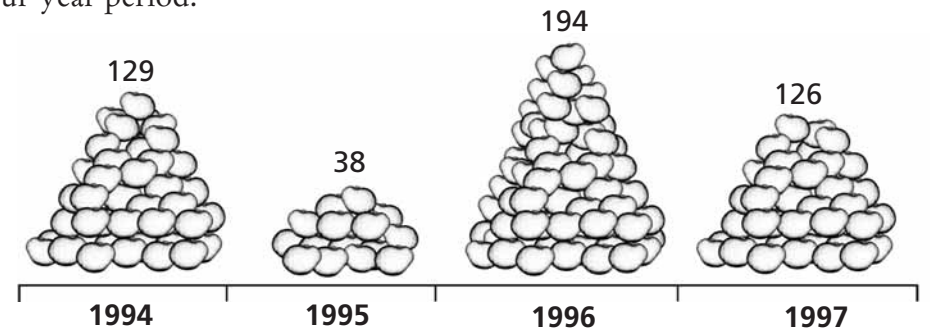
Most piquiá trees do not produce fruit every year. Many trees rest one year and produce the next. Over a five-year period along the Capim River (1993–1998), between 20% and 33% of 100 piquiá trees produced fruits each year.[3]

In Boa Vista, a 45-minute boat ride from Belém, locals have managed piquiá and other fruit trees for generations. One grand old tree there is called Queen Piquiá for the exceptionally flavoursome fruit she produces. Piquiá trees are renowned for producing both bitter and "sweet" fruit. Consumers warn that it is useful to know your fruit merchant so that you can be sure to purchase delicious piquiá.

an annual average of 350 fruits/tree

How many fruits per year?

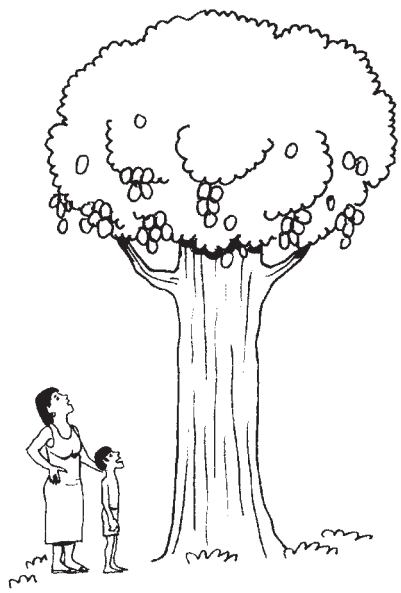
During the flowering season, piquiá trees blanket the earth below them with thousands of lovely yellow flowers, encircling the tree and mirroring the crown above. Each flower has a bouquet-like centre with hundreds of long, thin stamens. During one season, a tree in the Capim region tossed 14 000 flowers/day, approximately 120 000 flowers over the whole season. However, a multitude of flowers does not necessarily indicate that a tree will produce a multitude of fruit. This impressive flower production resulted in approximately 400 fruit. Another individual tossed 2 600 flowers and produced only 45 fruit, while a different tree with 1 700 flowers produced 40 fruit. Yet another tossed 10 261 flowers and produced 300 fruit. Still, scouting out which trees are producing flowers each year can offer a good idea as to which trees may bear fruit. But anticipating how many fruit is difficult. As Antonino from the Capim River region says, "Piquiá has a secret that no one is able to discover." The average fruit production of 100 piquiá trees varied substantially over a four-year period.[3]



Economic value

At the beginning of the harvest in January 2009, piquiá fruit in the Ver-o-Peso market was selling for US$ 0.40 each. During the same time frame in 2008, one small fruit at this market cost US$0.30 and a large one cost US$0.50. In 1998, one piquiá fruit in the Belém outdoor market fetched between US$0.13 and US$0.40. In 2004, in Belém's 28 major open air markets, about 343 000 piquiás were sold; in Ver-o-Peso alone, 108 000 piquiás were sold. During 2004, the sale of the fruit generated approximately US$47 300[4]. In 2008, a litre of piquiá oil sold for US$21.

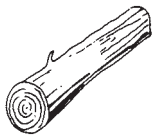
Piquiá wood is exceptional for boatbuilding. Consequently, the occurrence of piquiá trees near boat factories has declined. Piquiá is also favoured by rural communities for building canoes and is often cut down along riversides. To ensure a supply of fruit without a long walk to the forest, it is useful for rural families to conserve some trees near the village. One Capim family keeps a big piquiá about 500 m from their house. The children of the family, Neca, Antônia, Simeão and Jaime, know when the fruits are in season and run through the forest to be the first to collect them. In the month of March alone, the family ate 868 piquiá fruits. If they had bought these in the closest farmers' market of Paragominas, the fruit would cost about US$400.



Uses

Fruit: The pulp can be boiled in salted water. The most delicious piquiá are fragrant with bright yellow pulp. Underneath the pulp, there is a layer of slender, sharp spines, so it is critical to be careful when biting into a fruit. To attract customers, merchants sometimes open the thick brown rind of the piquiá to reveal the golden pulp inside.

Wildlife: The flowers attract many species of animals, especially paca, agouti, deer, coati and armadillo.



Wood: The wood of the piquiá is of high quality – compact, heavy, slow to decompose and useful for pieces with large dimensions. Piquiá wood is prominent in the construction and boatbuilding industries and is often used for reinforcing the internal structure of riverboats. In rural villages, canoes carved of piquiá have the advantage of lasting up to ten years. A canoe of piquiá can be packed full of forest fruits, sacks of manioc flour, bananas and a large family without trepidation, owing to both its stability and the reliability of the natural paraffin sealant typically used as a finish. Fences and gates to corral cattle may be constructed of piquiá because it is water resistant and does not splinter easily.

Oil: The oil from the pulp of piquiá can be used in cooking and is especially good for frying fish.

Seed: The seeds are an excellent source of nutrition; the seed's oil has potential utility in the cosmetics industry.

Rind: The rind is rich in tannins. It can be used as a substitute for the oak gall in the making of ink as well as to dye hammocks and yarn. The rind can also be used to make soap.

Nutrition

Piquiá is an excellent source of calories and energy. The fruit is composed of 65% rind, 30% pulp and 5% seed. The pulp is 72% oil, 3% protein, 14% fibre and 11% other carbohydrates. Piquiá flowers are also rich in nutrition, offering wildlife an excellent food source. The flowers are composed of 71% carbohydrates, 8% protein and 3% fat.

Piquiá oil

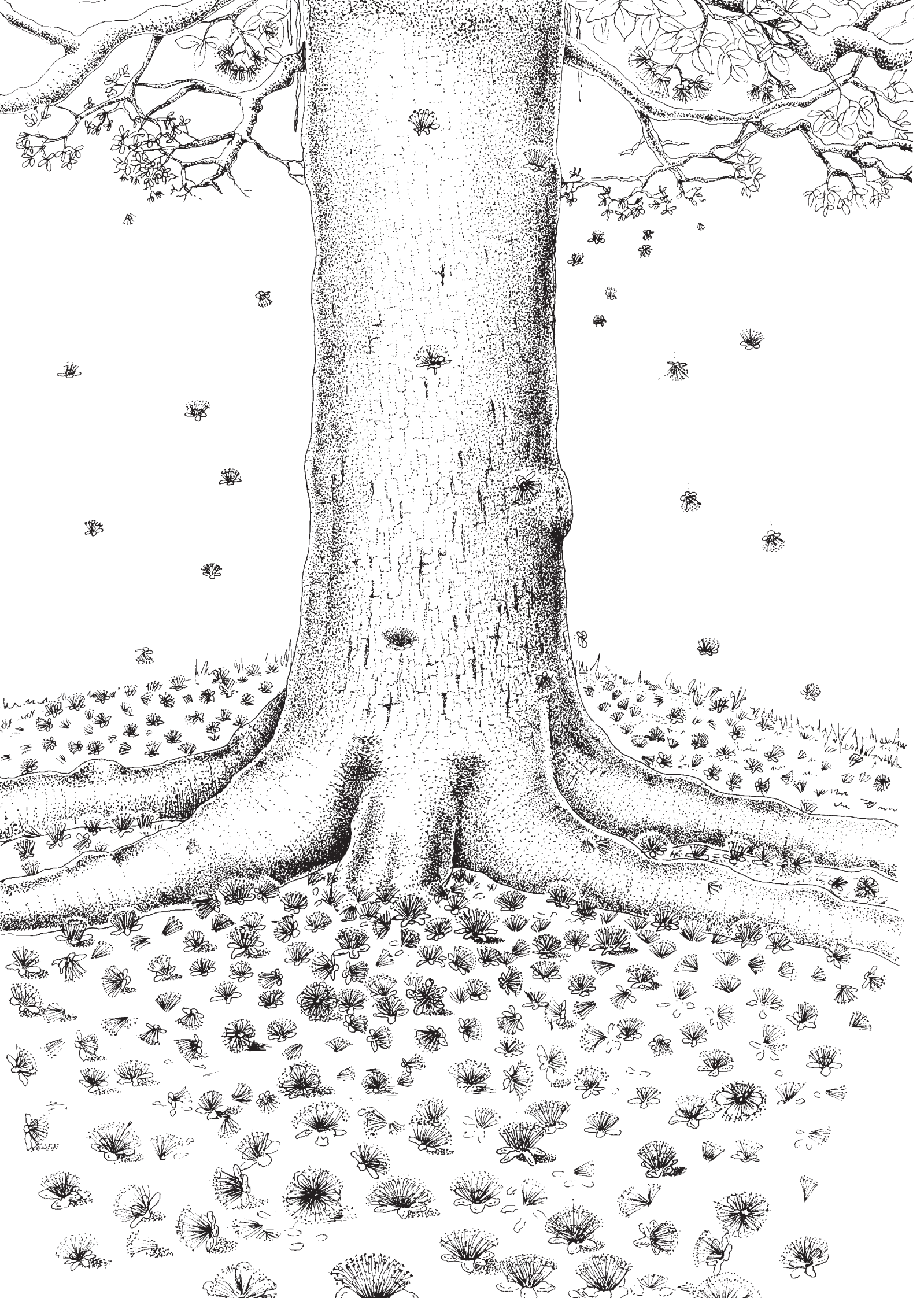
During a good harvest year, Senhorinha of the village of Nanaí, Pará, was able to gather so many fruits that she could extract all the oil she needed for the entire year. "Making our own piquiá oil means that we don't spend money that we don't have," she explains. To extract the oil, Senhorinha suggests the following: Let the fruits ripen for three or four days. When soft, boil them for one hour and pour out the water. The next day, grate and knead the pulp well, cooking over a low flame without water. Finally, take the pulp out bit by bit as the oil melts. Three dozen piquiá can produce approximately 2.5 litres of oil.

Recipes

Piquiá soap

Ingredients:
– 1 18-litre can of peeled piquiá
– 5 litres of water
– 500 g of caustic soda
– 50 g of paraffin or silicate
– linen sacks
– 1 large empty can
– 1 wooden spoon
– several wooden boxes

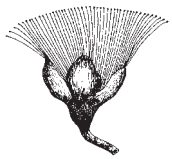
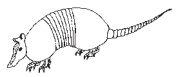
Preparation:
Dissolve the caustic soda in water. Leave the piquiá fruit to soak in this mixture for 12 hours. Next, remove the rinds with a wooden spoon. Mix the piquiá, water and caustic soda together until they form a dough-like texture. Add the paraffin bit by bit. When the soap is a good consistency, spoon it into the wooden boxes and wrap the boxes within linen sacks. Let the soap rest for 12 hours, and then cut it into bars. Always remember that the caustic soda is toxic and direct contact should be avoided. The can used to contain the caustic soda and water should not be reused for other purposes.

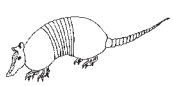


WILDLIFE

Food fest for wildlife

The amount of game captured beneath fruit trees during one season (September 1993–August 1994) in the Capim Region of Pará shows how important flowers and fruit are for the nourishment of wildlife and people.

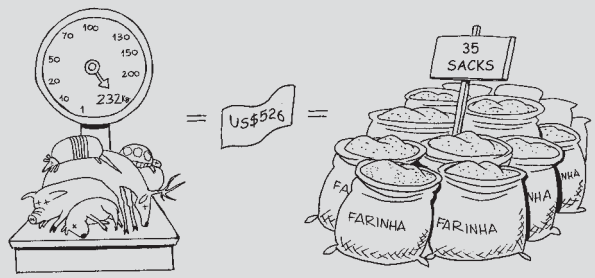
Tree	Number of animals	Total weight
Piquiá 	18  pacas	232 kg
	4  red brocket deer	
	4  nine-banded long-nosed armadillos	
	1  seven-banded long-nosed armadillo	
	1  agouti	
Copaíba 	1  red brocket deer	63 kg
	1  yellow-footed tortoise	
Tatajuba 	7  yellow-footed tortoises	60 kg
	1  red brocket deer	
	1  agouti	

Inga 	2 	pacas	40 kg
	2 	agouti	
	1 	collared peccary	
	1 	brown-throated, three-toed sloth	
	1 	mealy parrot	
Uxi 	3 	nine-banded long-nosed armadillos	38 kg
	1 	paca	
	1 	red brocket deer	
	1 	agouti	
Maturi, Matamatá 	5 	pacas	31 kg

The local meat market

The piquia tree is the favourite of many hunters as they say her flowers "call" game animals. For example, in the flowering season, Raimundo builds a blind near a piquiá tree and waits for his dinner to arrive. In 1995, during only two months of the flowering season, he was able to catch 67 kg of game underneath the piquiá trees. About 40% of the game's weight is inedible parts, such as bone, skin and hair.[5] Sixty percent is edible, resulting in about 40 kg of game meat. If Raimundo bought an equivalent quantity of beef in the nearest meat market, he would have paid US$151, about the same value he would earn selling ten sacks of farinha. At the local community store where you can only find the more expensive dried beef, he would have paid US$222, about the value of 15 sacks of farinha.

During three months of piquiá flowering, seven hunters from one community along the Rio Capim in Brazil caught 18 pacas, 4 deer, 4 armadillos and 1 agouti beneath the piquiá trees. This game weighed 232 kg. The community caught four times more game under the piquiás than any other tree. This game provided about 139 kg of edible meat that would have cost US$526 in the Paragominas markets, which is the equivalent of the price earned from 35 sacks of farinha. Managing fruit trees and wildlife make it possible for rural villagers to continue to obtain needed sources of protein from common and rapidly producing species such as rodents, while protecting more vulnerable wildlife and forest biodiversity.



Piquiá forever?

Dendrogene Project[6]

Pau-rosa (*Aniba rosaeodora*) trees have been harvested for perfume since the colonization of Brazil. For this reason, it is now difficult to find them in Amazonia. This same fate could befall the piquiá tree as it is highly valued for its wood as well as its fruit.

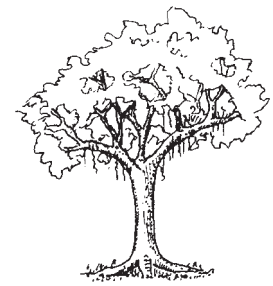
Piquiá trees reproduce and bear fruit through pollination. The piquiás depend on a nectar-eating bat, Thomas's nectar bat (*Lonchophylla thomasi)*, to carry pollen from one tree to another. In the dark of night, this tiny bat, weighing only 8–15 g, visits the crown of the piquiá tree and buries his head into the flowers to lap the sweet nectar within. For the bats to survive and continue their pollinating function, it is important to leave enough piquiás in the forest.[7]

Predatory logging and fire has reduced the piquiá population, making it less likely that there will be several nearby piquiá trees flowering at the same time. The greater the distance between the piquiás, the less chance that the little *Lonchophylla thomasi* will be able to successfully pollinate them.

MANAGEMENT

germination
2 months to 1 year

growth
fast initially, then 1 m each year for 10 years



production
after 10–15 years

It is difficult for a piquiá tree to take root and grow in the deep forest because its seedlings do not grow well in shade. If you want a forest full of piquiá, it is best to plant seeds in clearings in the forest or openings in the canopy where light can penetrate. In the community of Nanaí, Pará, Paulo planted 70 piquiá trees nine years ago. Today, they are over 8 m high. In a few years, Paulo will have far more piquiás than he could ever eat, and he plans to sell the surplus in the local market. Due to its rapid growth, the piquiá tree can be effectively integrated into agroforestry systems.

Domingos Meireles, who makes his living producing fruit in the Transcametá region of Pará, says that a piquiá tree that re-sprouted close to his house produces between seasons. Nightly, the family tosses its organic food waste out of the window and onto the roots of the tree. Domingos declares, "Recycling our compost through the roots and into the body of the piquia tree has given it added strength and has sweetened the flavour of its fruit."

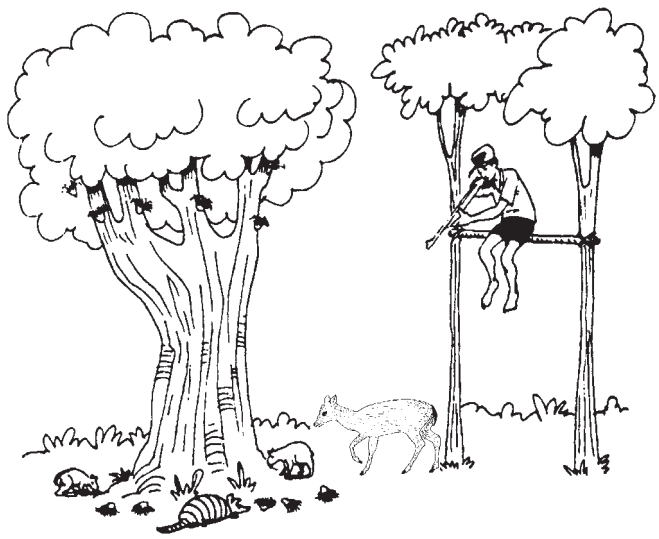
To enrich secondary growth forest, plant 50 piquiás/ha. With an estimated 200 fruits/tree, this could yield six tonnes of fresh fruit/ha, or:

– 1 tonne of pulp
– 90 kg of seeds
– 330 kg of tannins
– 105 kg of pulp oil
– 30 kg of seed oil.

Connections between wildlife, people and fruit

Many species of wildlife survive by eating fruit.[8] For example, in the rain forest, a grey brocket deer's diet consists of 87% fruit, and the larger red brocket deer consumes 81% fruit. Fruit makes up 59% of the diet for the collared peccary from western Amazon, 66% for the white-lipped peccary and 34% for tapirs. Paca, agouti, monkeys, parrots, macaws and other wildlife also depend on fruit for their survival. Likewise, most of these trees depend on the animals to disperse their seeds. Forests with various trees that flower and bear fruit at different times of the year are able to support more frugivorous animals. To ensure that there is a continuous supply of game in their forests, some communities conserve and manage fruit tree species, especially those that wildlife most enjoy. The composition and quantity of game are key indicators of a forest's health and abundance.

Certain fruit trees, such as bacuri, uxi and piquiá, are also favoured by loggers, making them "conflict of use species". To ensure a fair deal, villagers need to negotiate well and to remember the "invisible income," – fruit, game and medicine – which some species provide when determining the sale price of a log. It is also instructive to note that for each tree extracted, up to 27 trees can be damaged during the logging process.[9]



[1] Prance, G. & Silva, M.F. 1973
[2] Cavalcante, P.B. 1991
[3] Shanley, P 2000
[4] Serra, M. *et al*. unpublished manuscript.
[5] Silvius, K, Bodmer, R.E. & Fragoso, J.M.V. 2004
[6] Kanashiro *et al*. 2002
[7] Albuquerque, D. 2002
[8] Bodmer, R.E. & Ward, D. 2006
[9] Johns, J., Barreto, P. & Uhl, C. 1998

Rubber tree, seringueira

Hevea brasiliensis (Willd. ex A. Juss.) Müll. Arg.

Alexandre Dias de Souza
Renaxon S. de Oliveira
Edson Luiz Furtado
Paulo Yoshio Kageyama
Raimundo Graça S. Freitas
Pedro de Albuquerque Ferraz

One hundred years ago, when the rubber industry was strong, there were thousands more rubber tappers in the Amazon region than there are today. In those days, latex production generated a substantial amount of cash. Rubber barons wanting to impress the world with their wealth and sophistication attempted to transform sleepy jungle towns like Manaus and Belém into elegant, cultured cities, with parks and fountains, opera houses and public buildings in the grand European style. For poor farmers from northeast Brazil, the false promise of riches from rubber extraction offered a chance to escape grinding poverty, and a large part of that population migrated to the region to attempt to make their fortune tapping rubber. But the rubber tappers often had to fight for their rights and for the rubber tree forests. The state of Acre only belongs to Brazil because the rubber tappers fought Bolivia for possession of it at the end of the nineteenth century.[1] In the 1980s, the concept of extractive reserves, where large tracts of forest are set aside for exclusive use by non-indigenous forest-dependent populations, grew out of the rubber tappers' ongoing struggle to halt the advance of loggers and cattle ranchers into their areas.

The rubber tree became an extremely important species for the modern, industrial world. When latex is transformed into rubber, it can be used to make many useful products, such as tyres and surgical gloves. Rubber trees are native to Amazonia, but today there are many rubber plantations around the world, principally in Southeast Asian countries such as Malaysia and Indonesia. In Amazonia, most latex continues to be extracted by hand in the traditional manner by more than 100 000 rubber tappers and their families. Rubber trees naturally occur in Brazil, Peru, Venezuela and Bolivia, and various species of the genera Hevea are dispersed throughout the region. Of all the species, *Hevea brasiliensis* produces the largest quantity and best quality of latex and is the primary source of rubber production by rubber tappers in Brazil.

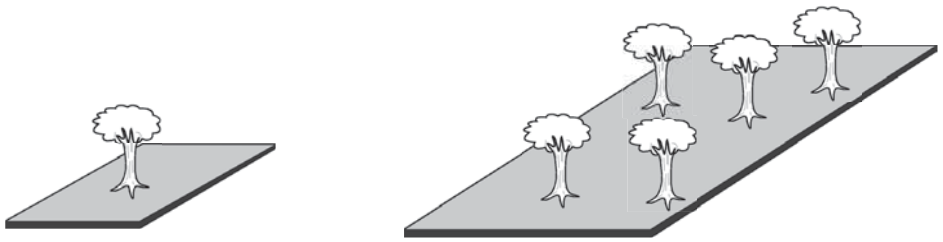
ECOLOGY

Flower and fruit seasons

J F M A M J J A S O N D

The rubber tree flowers from the end of July through September and produces between 250 and 500 fruits (from 1 to 2 kg) that release their seeds in February and March. The fruits normally break open and the seeds are dispersed by animals, rivers and streams. The latex tapping season begins after the fruits fall, in the early dry season. In the Tapajós region, in Pará, latex is extracted only in the wet season due to low production during the summer.[2]

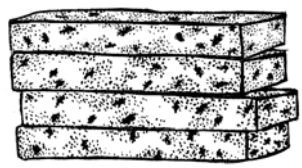
Density



1 tree/ha 5 trees/alqueire

The rubber tree is found in low densities in the forest, as there are only 0.07–3 individuals/ha. In conventional plantations, there are between 250 and 600 rubber trees/ha. In the Tapajós region, farmers have a long tradition of planting rubber tree seeds and other seeds in their fields, creating agroforestry plantations which have densities of up to 700 rubber trees/ha.

PRODUCTION



an average of 1.5 kg of dry rubber/tree/year

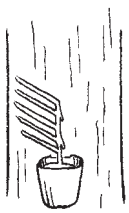
A rubber tapper working in a native forest can tap between 140 and 160 trees/day, collecting between 15 and 20 litres of latex. Each tree produces an average of 4.5 litres of latex/year, which is transformed into 1.5 kg of dry rubber.[3] The rubber tappers take two breaks in the rubber harvest: once to collect Brazil nuts when they are in season, and again when the rubber trees lose their leaves. A rubber tree lives up to 200 years and, if managed properly as outlined below, latex can be harvested for many decades. In the Tapajós region, a large number of rubber trees were planted in agroforestry plantations, increasing the number of trees that can be tapped each day.

ECONOMIC VALUE

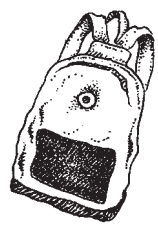
After harvesting the rubber, a rubber tapper uses an acid (in Acre they often use the milk of gameleira, *Ficus dendrocida*) to coagulate the latex and make a thick blanket of rubber called "raw smoked sheet". This sheet is stored and sold. The government of Acre is helping with the commercialization of raw, natural rubber. With the Chico Mendes law, rubber tappers receive US$0.41 from the government in addition to the market price of rubber (which in 2008 was US$0.77–0.94/kg), which means that a rubber tapper earns US$1.18–1.35/kg. Extracted natural rubber is still highly sought after. In 2006, Brazil produced more than 175 723 tonnes of coagulated rubber, with a minimum of 3 942 tonnes produced by rubber tappers, generating more than US$4.7 million in revenue. The states of Amazonas and Acre are the largest producers of rubber latex in Brazil, with 51.9% and 35.7% respectively.[4] Some latex extracted by rubber tappers is sold to factories outside the region for processing.

Extractive cooperatives in Acre are adding value to rubber, increasing its price and production. In Xapuri, the cooperative is on its way to founding the first latex factory to produce concentrated latex used in the production of condoms. There are also several cooperatives in Amazonia working in the production of vegetable leather, a leather-like finished product, used in bags, backpacks and other products.

USES



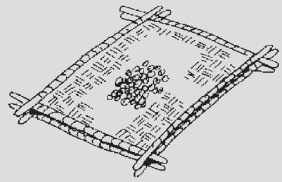
Latex: Natural rubber is an elastic material called latex obtained from the sap of the rubber tree. Rubber is used extensively in the production of tyres, and various other components and accessories of cars and motors. It is also used to make waterproof fabrics, shoes, backpacks, toys and condoms. Liquid latex is used extensively in the manufacturing of flexible masks, for clinical uses and for special effects in feature films.



Seed: Long ago, the Aztec Indians used rubber tree seeds as money. They are used today as jewellery.

A blessing from above

Once upon a time, an Indian warrior was punished by the chiefs of his tribe and obliged to carry water in a basket made of wild vines. The gods of the tribe took pity on the great warrior and taught him to coat the bowl with latex from the rubber tree. When the chiefs saw that the warrior succeeded in carrying water in the basket, they decided to forgive him.[5]

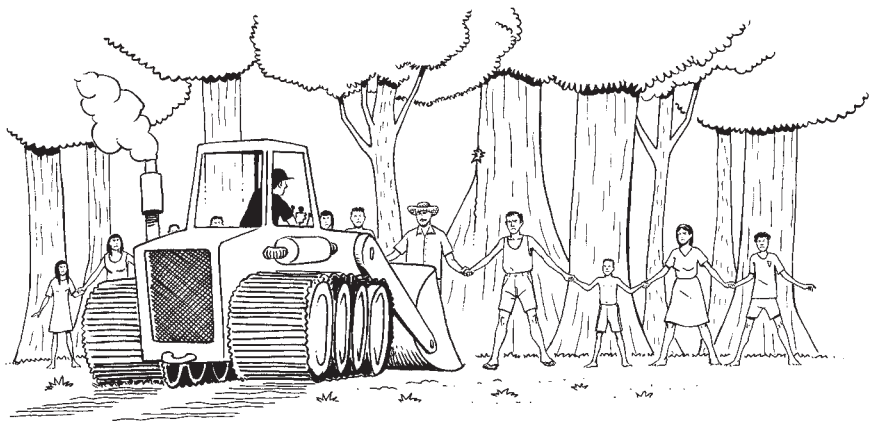


How to extract latex

Rubber trees are usually divided into areas worked by individual families. One area covers between 400 and 600 ha, containing between 450 and 600 trees distributed along two to four rubber trails Before dawn, the rubber tapper gathers his headlamp, knife and a rifle in case some game is spotted, and heads off to the rubber trail. The rubber tapper works one looped trail per day. He makes diagonal cuts in the bark of the trunk, one below the other, using a knife called a *cabrita*. After the last cut, he places a bowl or cup on the tree to collect the latex as it drips from the incisions. Along the way, the rubber tappers may hunt wild game for lunch, arriving back home at about 11 a.m. In the afternoon, he follows the same route to collect the latex that has accumulated in the bowl, walking between 6 and 10 km/day.

Standoff: ranchers vs. rubber tappers

In the 1970s and 1980s, the Brazilian government granted a number of incentives to cattle ranchers to open up the Amazonian frontier. Many rubber tappers were expelled from their areas so that the forest could be transformed into pasture. In Acre, under the leadership of activist Chico Mendes and others, they devised a way to protect their forests. When loggers arrived to clear an area for cattle, a large group of rubber tappers and their families would gather together side by side holding hands, sometimes circling trees, thus preventing the tractors from entering the forest. Often the tractors would turn back, leaving the forest intact. These confrontations became known as “empates”, which in local terms means a standoff.

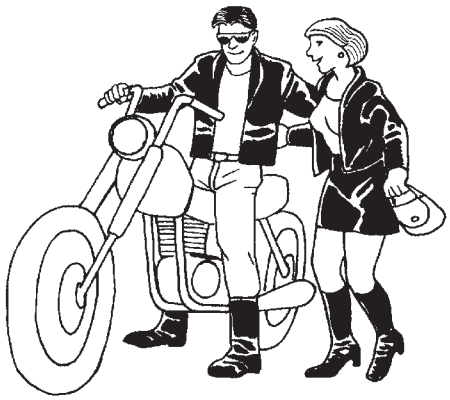


FLORA fashion

Since 1994, rubber producers in Acre have had the benefit of the Forest Products Market (FLORA) at which they can sell directly to consumers or negotiate larger deals with companies.[6] In 2004 and 2005, between 25 000 and 30 000 people visited the event annually, resulting in about US$22 780 in sales each year. Here the communities, cooperatives, local artisans, women's associations and small businesses come to sell their goods.

Rubber is sold in its original form, or transformed into inexpensive sandals, toys or figurines of birds and other forest animals. Next to the stand selling low-cost traditional products, a new, pricey, chic product called "vegetable leather" can be found. Vegetable leather is made from cotton fabric coated in latex, smoked and vulcanized so that it resembles animal leather. Many of these products are shipped to upscale stores in the United States of America and France.

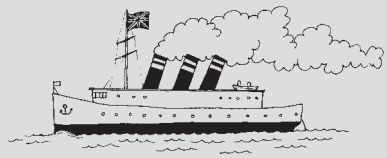
An unusual assortment of shoppers display interest in the vegetable leather booth, including well-to-do women searching for the latest fashions, environmentalists eager to be ecologically correct and motorcyclists seeking to swap pieces of their animal attire with vegetable wear.



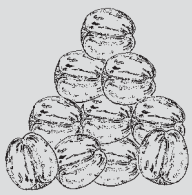
WILDLIFE

Rubber seeds are large, 2.5–3 cm long, and can provide nutrition for many forest and river animals. Peccaries will crush the shell and eat the seed. In the flooded forests where rubber trees grow, many fish feast on the seeds. Black-finned pacu, locally known as tambaqui, use their strong jaws to crack open rubber seeds and feast on them. Black piranha use their razor-sharp teeth to open the shell and consume the rubber seeds.

Travelling seeds: Asia supplants Amazonian production



Visitors to Brazil, wanting to experiment with planting rubber trees in other countries, dispatched seeds to Europe. The first seeds that were sent did poorly, and it was only in 1876 that the Englishman Sir Henry Wickham succeeded in bringing 70 000 healthy seeds from Boim, on the Tapajós River, near Santarém, to the Royal Botanical Gardens in Kew, England. The seeds were carefully wrapped in banana leaves and survived the journey to form the basis of rubber plantations in the British colonies in Asia. Since the fungus that attacks the seeds in Brazil is absent in Asia, the seedlings grew well, and the cultivation and improvement of rubber made the countries of that region the greatest plantation producers in the world. It was a crushing blow to the Brazilian rubber market and it spelled the end of the dream of infinite wealth in Amazonia.[7] This dream was revived briefly during the Second World War, when Brazil supplied the Allies with rubber for the war effort.



Cruel fortunes

When the Portuguese arrived in Brazil, they saw the Indians playing with a heavy black ball made of rubber. This centuries old discovery of the Indians, anticipated the later invention of the rubber tyre, which transformed the industry and spurred a feverish rubber boom around the world. From 1880 to 1911, the demand for Amazonian rubber was enormous, with Brazil exporting 80 000 tonnes annually. This led to such extravagances as the construction of the Manaus Amazon Theatre, an opera house located mid-way up the Amazon River and at the time only accessible by river. But such riches rarely reached the rubber tappers, who toiled on in wretched conditions.

To increase production and retain labourers in this difficult work, the rubber barons imposed a system of debt peonage on the Indians and caboclos who collected and processed latex. In this system, rubber tappers could buy household products sold by the barons, but prices were inflated. The rubber tappers could never earn enough to purchase everything they needed, so they would fall into debt and in this way were forced to work indefinitely for the barons as virtual slaves.

Management

germination
10 days

growth
1 m/year

production of latex
after 25 years in the forest
after 10 years in plantations

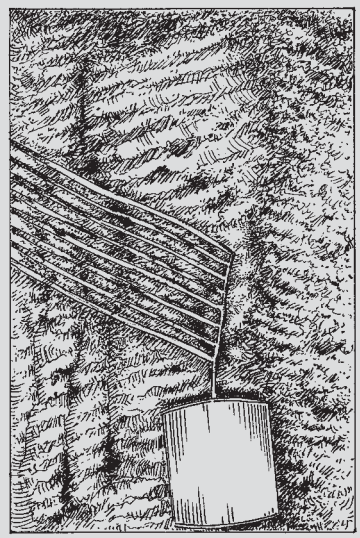
Rubber seeds need to be planted quickly; within 30 days of being collected, half the seeds will fail to germinate and, after 45 days, only 10% will still germinate. Once planted, the fertile seed will begin to germinate in ten days. In the forest, a rubber tree needs light to grow. As competition for light is intense among the various species, the great majority of seedlings are unable to develop. In lower Acre, less than 20% of the rubber trees are greater than 60 cm in diameter, and they begin to flower only after 25 years.[7] In plantations, the maximum production of latex is attained at around 20 years and this level of extraction continues for another 40–50 years.

When it is time to tap the tree, it is important not to cut very deeply. Ideally one should cut no more than 2–3 mm deep. Do not tap thin trees as this greatly reduces the trees' growth. Mature rubber trees produce little latex the first time they are tapped, but production increases over time. Rubber tappers say that rubber trees which have not been tapped before are stubborn, but that they become tame after a while.

Agroforestry in the rubber grove

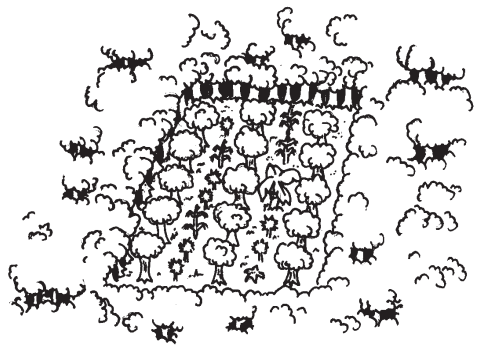
Götz Schroth

In the Tapajós region, where the fungus *mal-das-folhas* is less prevalent, rubber tappers have enriched their agricultural fields by planting rubber trees together with other fruit- and wood-producing species. For over a century, these plantations have evolved into real agroforests as they have been extensively managed. When prices have fallen, however, management has ceased and the forests are temporarily abandoned.[2]



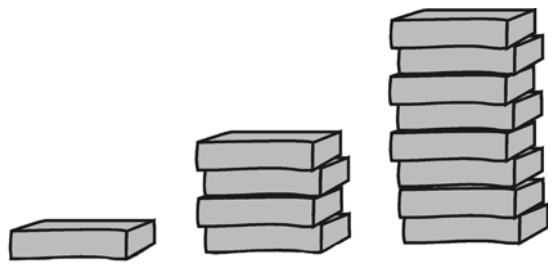
When prices were low in the 1980s and 1990s, a few rubber tappers cut down their rubber forests to plant crops. Others refused to do this, saying that these forests were meant to live forever. With recent increases in rubber prices in Brazil, many who traded their forests for fields are regretful. As one rubber tapper said, "Even if your rubber forest isn't useful to you today, it may be useful for your children tomorrow."

New extractivism



For 40 years people have been trying to plant rubber trees in Amazonia in order to increase production. In plantations, trees are much closer to one another, facilitating the rubber tapper's work. However, rubber trees in plantations in Brazil are vulnerable to *mal-das-folhas*, or leaf blight. This fungus moves rapidly from one tree to another.

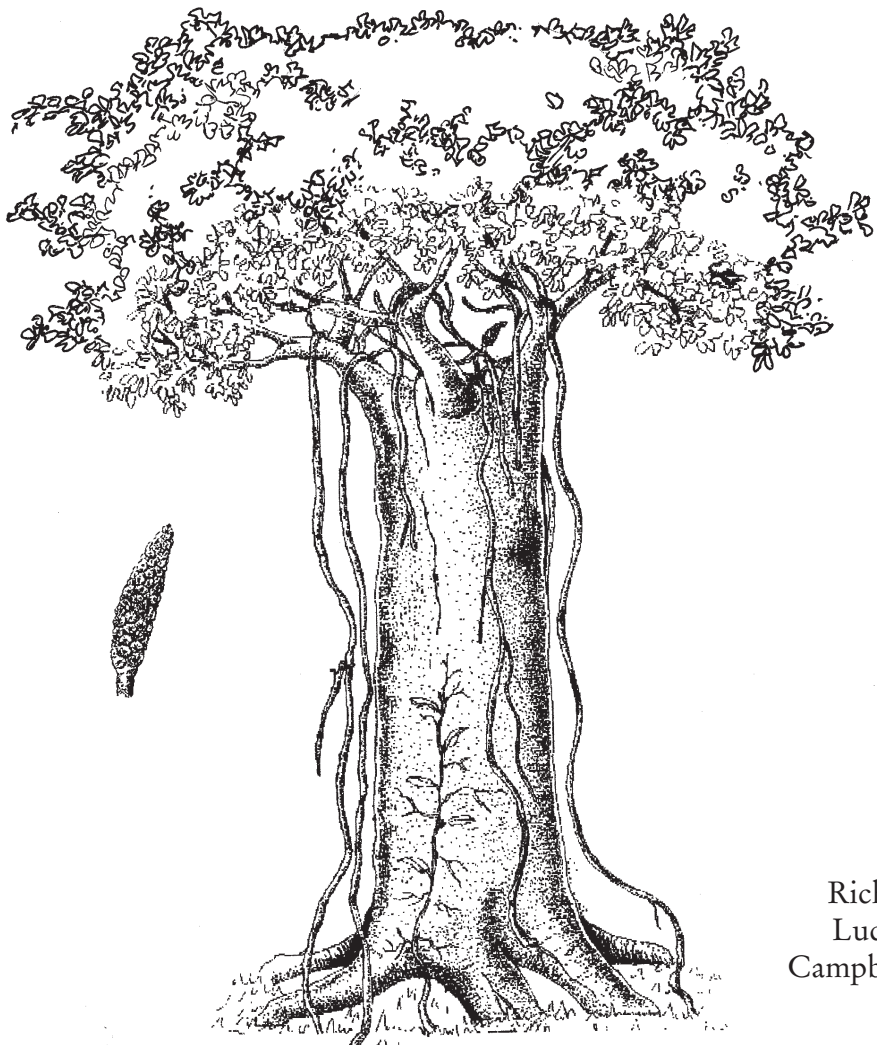
In Acre, mixed plantings are being experimented with in small clearings in the forest. Rubber trees are planted together with other species like manioc, coffee, banana and orange. Each tree is planted in a 4 x 20 m area. In these areas of plantings, called Islands of High Productivity (IAP),[8] researchers believe it is possible to extract between 400 and 800 kg of rubber/ha/year.[9] In native rubber forests, a rubber tapper extracts an average of 1 kg of dry rubber/ha/year. There are two kinds of IAP: those from seeds and those from clones. In seed IAPs, seeds are taken from the most productive rubber trees and planted in the ground, protected from animals by pieces of bamboo. In clone IAPs, new trees grow from sprouts that have been bred to produce more and to have a greater resistance to *mal-das-folhas*.



1 Tocantins, L. 1979 / Dean, W. 1989 / Moro, J. 1993
2 Schroth, G. *et al.* 2003
3 Vasconcelos, S.S. 2001
4 IBGE 2006
5 Neves, C.A. 1981
6 Wallace, R.H. *et al.* 2008
7 Dean, W. 1989
8 Fadell, M.J.S. 1997
9 Maciel, R.C.G.; Saldanha, C.L. & Batista, G.E. 2000

Titica

Heteropsis spp.



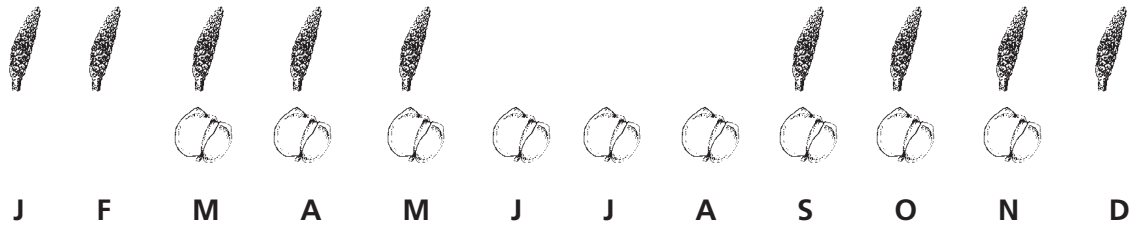
Richard Wallace
Luciano Pereira
Campbell Plowden

During a dark, rainy night in the forest, a small house covered with palm fronds is struck by gusting winds and pelting rain. Inside, seven worn out hammocks hang. Wrapped tightly inside, like cocoons, six children and their parents sleep soundly. In spite of the raging weather, the house will not collapse in the night. Like thousands of Amazonian homes, it is stitched together with the strong and flexible aerial roots of a forest vine locally called *cipó titica*. Tremendously versatile, titica roots are used to tote game home from the hunt, to make strainers for producing manioc flour and to weave baskets to carry fruit. Titica is also used to make hats, furniture and sturdy pack baskets for horses. The availability of titica has declined in areas of heavy harvest and where logging and fire are prevalent. This scarcity has required rural people to travel ever-greater distances to collect it.

Titica is a secondary hemi-epiphyte, a vine that germinates on the ground and climbs to the canopy where the mother plant establishes itself. From high up the trunk of its host tree, a few aerial roots descend from the mother plant in search of the soil. These aerial roots, also referred to as vines, are harvested for use. Titica vine refers to numerous species of the genus *Heteropsis* which produce aerial roots, 13 of which occur in Brazil, Guyana, Venezuela and Peru, preferring terra firme forest.

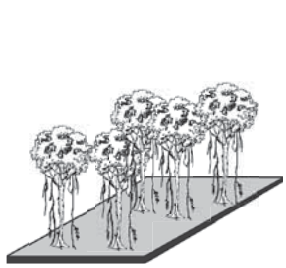
ECOLOGY

Flower and fruit seasons

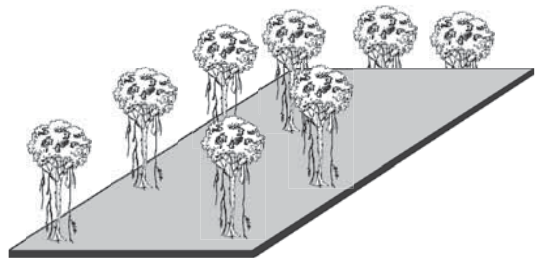


The flowering and fruiting period of the vine varies greatly throughout Amazonia. However, in most of the Brazilian Amazon, the vine flowers between September and May, and fruits from March through November. In Suriname, titica fruits between April and July.[1] The aerial roots of titica may be collected throughout the year.

Density



143–453 trees
host titica vine/ha



686–2 174 trees
host titica vine/alqueire

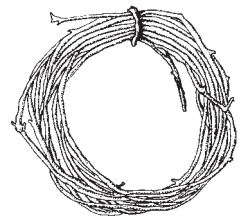
The density of trees hosting titica vines varies considerably, from one tree to over 400 trees/ha (see table below). Titica grows best in mature closed forest. It can thrive on a wide variety of host trees, but is rarely found on certain palm trees and pioneer species, as the trunk and bark of some of these trees are generally unfavourable to climbing vines. Unlike many vines, titica does not climb to the tallest and sunniest parts of a host tree canopy. This apparent aversion to strong light may explain its virtual absence in secondary forests. One study in Pará found only 2 titica plants/ha in an area recovering from a fire 20 years earlier.[2]

The number of mature vines/ha – those that are ready for harvest – also varies. In one study of trees hosting titica vine, 36% of the roots had the potential to be commercially exploited, because the roots were long, thick and had few knots – desirable characteristics for making crafts.[3]

Variation in the density of titica vine in Amazonia

Location	Number of trees hosting titica/ha	Number of mature roots/ha
Tembé Reserve, Pará, Brazil[3]	143–453	554–1 748
Jaú National Park, Amazonas, Brazil[4]	1–5	–
Guyana[1]	61–232	997–1 175
Porto de Moz, Pará, Brazil	36–176 (mean 85)	180–944 (mean 457)

Production



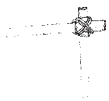
average of 50 kg fresh root and 13 kg dried root/ha

The production of titica varies greatly from place to place – both the number of roots/tree as well as the number of trees hosting the vine. A study in Pará found an average of 3 roots/plant. One root weighs an average of 175 g. On average, 0.5 kg of titica root is collected from each tree, so the plant yields about 36–88 kg of fresh roots/ha. Once the bark and the unusable sections of root have been removed and the roots dried, 7–18 kg remain ready for sale. An average of 350 kg of titica roots/ha have been extracted from Amapá state, but this high yield may be related to the recent start of commercial harvest there.[5]

Economic value

In cities close to Belém, in Pará, the price of dried titica in the 1990s varied between US$1 and US$2/kg. In 2004, 1 kg fetched an average of US$1 without bark. In 2008 in Rio Branco, 1 kg with bark sold for US$1.18 and without bark for US$1.77. Because it requires intensive labour not only to collect titica from the forest but also to remove the bark, some collectors prefer to sell the vine with the bark still on the plant.

Uses

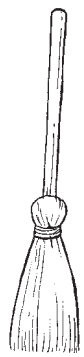
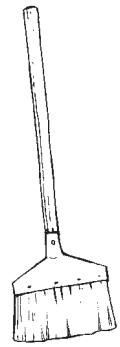


Construction: Titica roots are used to bind housing frames, to construct fencing and as a substitute for nails in rural areas.

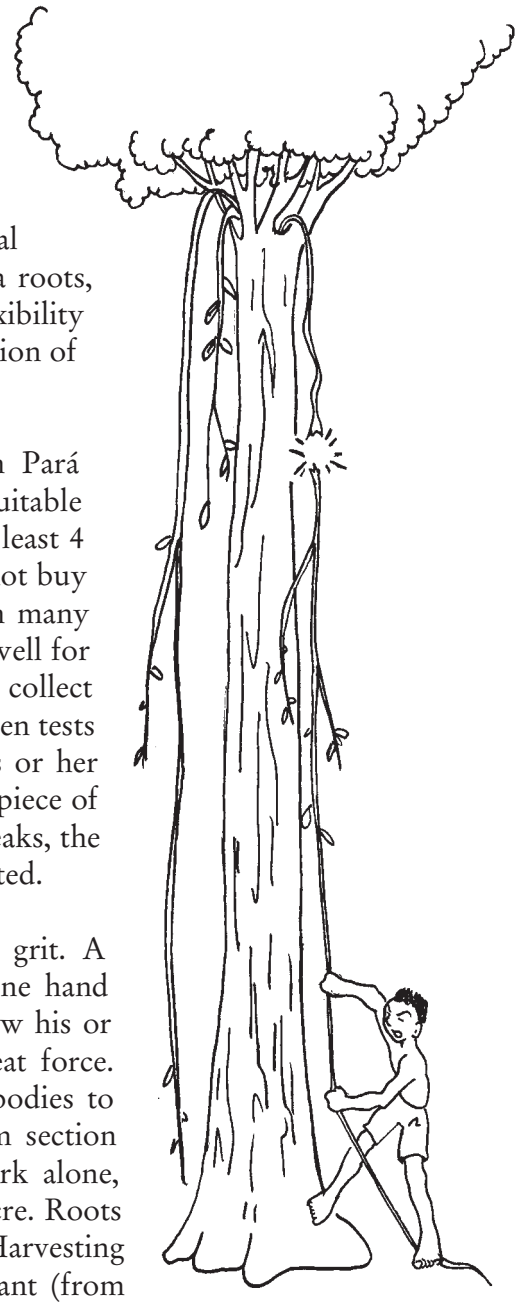
Domestic utensils: Baskets, bags, brooms, strainers, saddlebags and wicker furniture are made with titica roots.

Which broom lasts longer?

The African and Amazonian tradition of sweeping the ground in the front of your home to keep the area free of plants and debris is rough on brooms. When there is no titica available, women grumble that scrawny plastic brooms are costly and last but a scant while as compared to the robust, hand-crafted titica brooms.

	Titica	Plastic
		
Cost	**US$2.20**	**US$4.50–6.70**
Durability	**1 year**	**6 months**

How to collect titica vine



A collector needs to know not only how to identify titica but also where it grows, which roots are best to harvest and how to extract them from high in the canopy. It takes an experienced eye to identify titica correctly because there are often many types of hemi-ephiphytic vines hanging on the trees. The aerial roots of other vines may look similar to titica roots, but they lack titica's unique strength and flexibility and may break when bent during the construction of baskets or furniture.

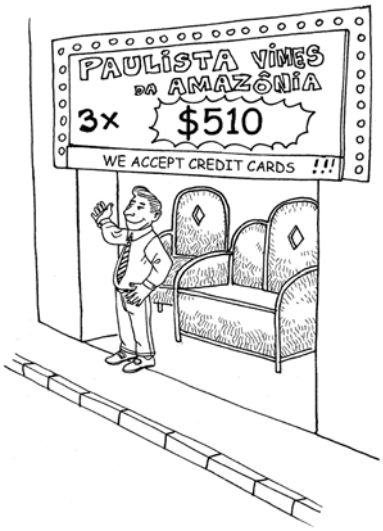
Before harvesting a titica root, harvesters in Pará consider three factors to determine if it is suitable to use and sell. First, collectors select roots at least 4 mm in diameter because furniture makers do not buy very thin ones. Second, they avoid roots with many knots or nodes as these sections do not work well for lashing and weaving. Finally, harvesters only collect tough and flexible mature vines. A collector often tests the readiness of a root strand by scraping his or her fingernail across the bark and bending a small piece of the root in half. If it is green underneath or breaks, the strand is too young and not ready to be harvested.

Harvesting titica requires strength, skill and grit. A collector usually grabs the aerial root with one hand just above his or her head, and the other below his or her shoulder, and jerks sharply and with great force. Some collectors use the full weight of their bodies to help break a root by standing on the bottom section of a taut root. Although most collectors work alone, working in pairs is common in Amapá and Acre. Roots generally break at 5–10 m from the ground. Harvesting rarely dislodges the well-anchored mother plant (from which branches with roots, leaves and flowers emerge), but when pulling on a root finally forces it to break, a hail of leaf debris and branches – and sometimes spiders, biting ants and snakes – can rain down on the collector.

After a root is brought to the ground, harvesters remove any knots, which form weak spots in the vine and reduce its usefulness. Collectors carry the vines home where they generally remove the bark using a knife. Although drying and bark removal lessen the weight by half, most customers prefer debarked vine and the bark is much easier to remove soon after harvest than if it dries and hardens on the vine. Once the bark has been removed, the pale golden roots are tied in long bundles of several hundred strands or rolled into a large doughnut shape until they are sold or used. Artisans store the bundles in a cool, dark place so the roots do not buckle or become stained by fungus.

Prices of sofas: São Paulo vs. Amazonia

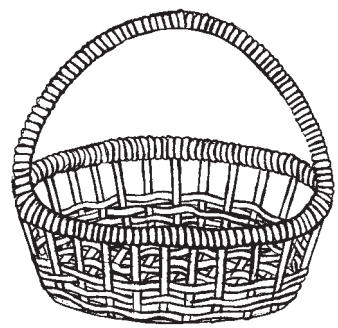
In Amazonian cities, artisans traditionally make sofas, chairs and baskets from titica roots. In addition, roots of titica and other vines have long been extracted in large quantities for shipment to industrial furniture manufacturers in São Paulo and other southern Brazilian cities. Even the seats in the first class cabins on the trains in Rio de Janeiro and São Paulo are made with titica.[6] In Macapá, Amapá, a handcrafted chair of titica cost US$119 in 2004. During the same time frame, in the metropolis of São Paulo, one titica chair manufactured industrially cost US$1 530. Although forest peoples may not always be able to sell fine crafted products, it may be possible for them to engage these markets by providing managed, fair-trade raw material.



Craftsmanship adds value

Transforming raw fibres into crafts greatly adds to their value. Some people who harvest titica have increased their income by learning to shape it into finished products. In 1997, in Rio Branco, Acre's state capital, 1 kg of titica without bark sold for US$2. In one hour and with less than 1 kg of titica roots, a craftsperson could make a bread basket that sells for US$17. One skilful artisan from Rio Branco said that he had a list of orders from his neighbours and that his clients prefer handcrafted goods because they often are of better quality than manufactured goods. And if a handmade product breaks or wears out, consumers know where to go to get it fixed.

In Rio Branco, artisans carefully process titica roots before fashioning them into products. Dry roots are first soaked in water to make them less brittle and easier to bend and shape. They use a file to smooth and reduce the roots until they are the right thickness to make baskets, serving platters, flower vases, magazine holders or chairs. Fibre crafts are now found in supermarkets, snack shops and restaurants, as well as available by individual order for custom-made products. The diverse assortment of fibre crafts now available can be seen at the city's open air Sunday market and at Acre's Annual Forest Products Fair.[7]



Titica: a tool for hunters

Many hunters use titica to construct hunting blinds in trees. The roots are used to tie a wooden pole or plank between two trees, or to a tree and a standing support pole. The hunter sits on top of the plank to wait for unsuspecting game to pass by below. To boost their chances, hunters place hunting stands on or nearby trees with falling fruits or flowers which attract game animals.

MANAGEMENT

germination
9 months

growth
cut roots, when they survive, grow about 1–2 m/year

production
20–66 years

Even under ideal circumstances, titica grows very slowly and is vulnerable to intensive harvesting. It takes up to 66 years for titica to grow, from the climbing stage to when the first root reaches maturity in the ground.[1] Several studies in Brazil and Guyana have shown that most of the roots that were severed in experimental harvests died within six months. Taking too many roots can kill the plant itself. Heavy harvesting has virtually wiped out titica populations in some regions. In areas where only a portion of mature roots had been collected, the total combined growth of all surviving harvested roots was 0.8–2.4 m/year.[2] This slow growth rate means that it will take many decades for titica to recover before roots may be commercially harvested again. A study on *Heteropsis flexuosa* in Amapá found that if the growing tip of the root is not damaged the root can grow up to 1 m/month during the rainy season, but roots that have been cut or broken during collection stop growing.[6] Thus it is necessary to leave some roots intact to nourish the plant and allow new roots to grow for a minimum of four to five years. For successful successive extractions, it is important to take a few management precautions when harvesting titica vine.

Management tips

Per tree:

- Avoid collecting more than half of the roots from any individual titica plant, being sure to leave at least two thick roots intact. Harvesters in Guyana only take roots hanging down from a branch; they leave all roots wrapped around the trunk of the host tree.
- Take extra care when harvesting during the dry season. Titica mortality is higher when water is scarce.

- Only harvest mature roots because immature ones are not strong.
- Leave roots which have less than 1.5 m between knots because artisans and furniture makers only use stems that are free of these bulges.

Per area:

- Establish zones of extraction where roots are collected in rotation systems.
- Extract the maximum possible number of vines in heavily logged areas, and from trees that are going to be harvested.
- Once a year, in Porto de Moz, Pará, women in the Emanuela Women's Asociation clean between the root strands, removing the dead ones and anything else that might impede their healthy growth.[8] The debris from the cleaning is spread on the ground, maintaining soil humidity and discouraging undergrowth.

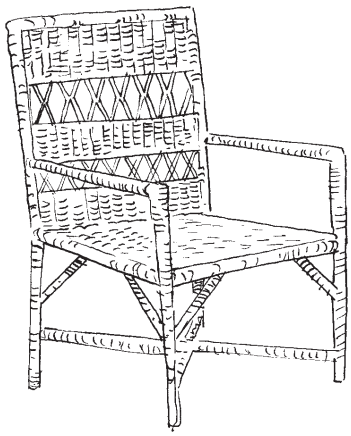
Legislation: challenges for small producers

Titica is an important resource for Amazonian extractors and artisans, both for home use and for bringing important cash income into the household. However, increasing demand for this durable and multi-use aerial root for industrial-scale production has raised new concerns regarding the future sustainability of titica extraction and placed in question continued local access. A major challenge now facing extractors is the sustainable management of titica, and the development of management initiatives that provide local peoples' continued access while regulating unsustainable extraction. This, in turn, brings up new questions: How can local communities engage larger regional and national markets? How can extractors achieve long-term sustainable management of this valuable and important forest resource?

Since small-scale extractors provide fibres and fibre-based crafts to local markets, they now compete for their raw materials with large-scale enterprises that harvest – and frequently over-harvest – titica for industrial-scale production. For example, as titica populations in southeastern Amazonia declined, large industries transported scores of workers from these regions to harvest the roots in the northeastern Amazonian state of Amapá. Teams of 60 men mounted on mules scoured the forest and extracted all the titica they could find. Artisans from Amapá protested, as they were left with little material to ply their trade.

In 2001, the government of Amapá responded to complaints from these artisans and passed the first state law in Brazil requiring management plans to extract titica. The law defines the period, the quantity and the location of legal harvests, as well as establishing norms to obtain a harvesting license. Local collectors, however, have difficulty in navigating the state bureaucracy for management plan development and approval. A better approach might include a system that allows local people to harvest small amounts of titica for subsistence and commercial activity, but closely regulates and manages large-scale harvesting. The process to develop legislation could be participatory and could bring together diverse stakeholders, including local communities, artisans, industry players and government agencies. An example of this might be found in the state of Amazonas, which went through an extensive process of consulting with a wide range of people who had experience studying and working with titica before passing their regulations of titica harvest.

Rural women manage titica



Maria Creuza
Maria Olivia

With so many forest management specialists, why is it that no one knows how to manage titica vine? The Emanuela Women's Association, in Porto de Moz, Pará, discovered this when they began to research the production potential of titica. Finding no professional forester or botanist to advise them, they went into the forest to experiment and to discover for themselves the secrets of this mysterious plant.

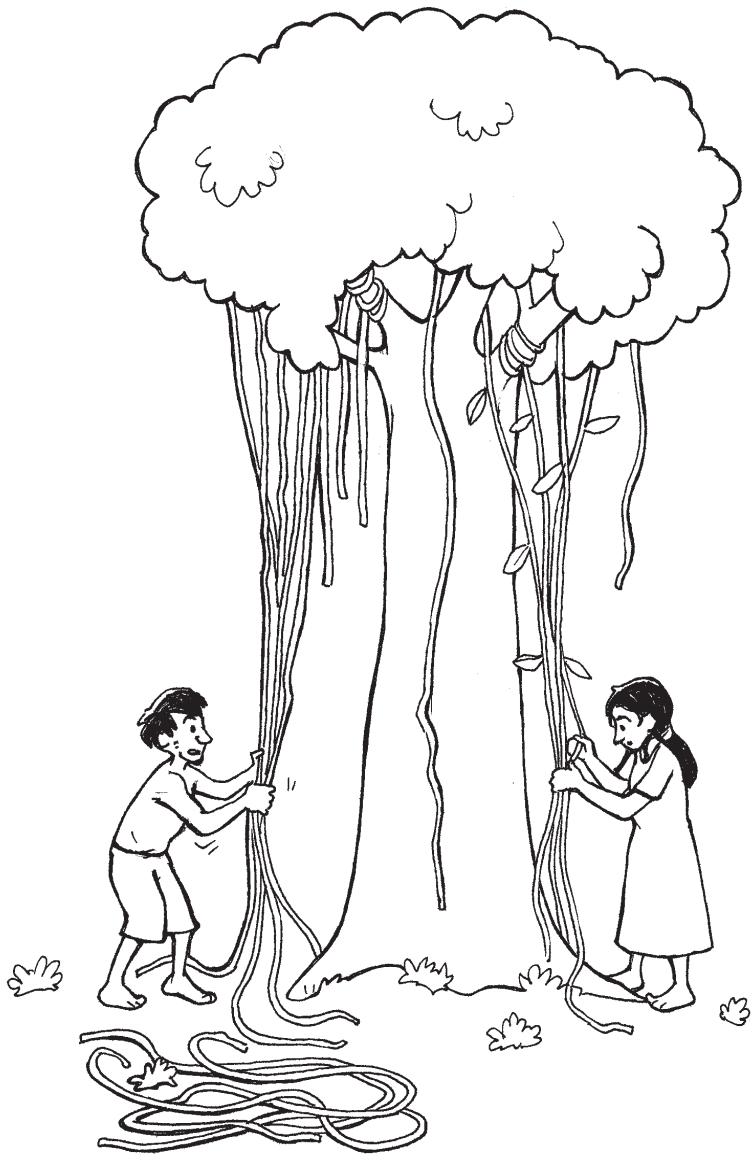
They developed methods for inventorying, managing and extracting the vine. Each woman in the Association, composed of 35 women from seven communities, was responsible for researching the production of titica in her own plot of forest. The inventory was conducted along a 250-m transect where plants were counted within 5 m on both sides of the centre line. The women recorded the number of trees that had titica growing on them, the number of aerial roots hanging from each tree, and lastly, they identified the green and the mature roots. Based on their initial inventory, they estimated that they could harvest and produce 150 kg of titica roots without bark from a forest area of 50 ha. Next, they estimated that each woman could harvest enough roots to bring 5 kg of roots to a furniture making workshop sponsored by the Association. A longer-term study would be necessary to actually determine sustainable yield; however, the social network the women developed to regulate harvest is a crucial step towards ensuring sustainability.

At the workshop, each strand of dry root was separated into three thinner strands that included one central and two outer parts. Each of the three strands is scraped with a knife and then sanded smooth. Next, the women apply one layer of sealant and three layers of varnish. If the root's bark had been removed days after it was collected and had left marks on its surface, the women discovered that three washings in caustic soda turned it white again.

Using this home-grown technique, the women of Porto de Moz began making chairs, baskets, mirror frames, trunks, suitcases, jewellery boxes, shelves and fruit display vessels. Prices in 2004 ranged from US$3.40 for a mirror frame to US$34 for a chair, using 1–5 kg of titica for each object. Even considering the time needed to make the crafts, the women noted it was far more profitable to sell finished products than either unprocessed roots for US$0.50/kg or roots with bark removed for US$0.85/kg. For the first time in their lives, the women of Porto de Moz have been able to walk around town with their own money in their pockets.

Contrasting collection styles: women and men

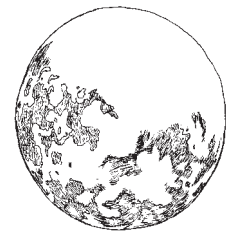
In Porto de Moz where titica extraction is relatively new, women are more experienced in collecting titica and making crafts from their roots than men. Women note, "He sees the vine and straight away hacks down many strands on the tree. When we come to a tree, we are more careful; we first test the vines and then only collect the mature ones that are useful for making things."



Titica and Amazon folklore

As with many plants that are widely used by forest people in the Amazon, there are many popular beliefs about the biology and harvesting of titica. Since titica has small flowers and knobby green fruits that are well hidden in the canopy of the host tree, several legends relate to the plant's reproduction. In Amapá, some caboclos believe that if someone sees the flower or fruit of this plant, the world will end. Many indigenous people believe that titica regenerates from the legs of dying tucandeira ants (*Paraponera* spp.). Although this may seem like a strange connection, observations of these ants attacked by *Cordyceps* fungus show that the fruiting bodies that emerge from the dead ants resemble the tiny anchor roots that secure a climbing titica stem to its host tree.

Collectors in Porto de Moz adamantly assert that the phase of the moon must be considered when collecting titica. Although a full moon may act as a torch, lighting one's way to the trees, there is no sense in trying at that time. They say that during full moons titica is brittle, weak and pale and breaks when doubled over. Therefore, they prefer to harvest titica in the new or quarter moon when the roots are strong and flexible.



As commercial demand for products like titica increases, there is a need to appreciate indigenous and other forest people's knowledge about the biology and harvesting of these plants. These lessons should be combined with research-based studies of harvesting effects and sustainable management to offer economic opportunities for forest-based communities and to ensure long-term conservation of the species.

[1] Hoffman, B. 1997
[2] Plowden, C., Uhl, C. & Oliveira, F. de A. 2003
[3] Plowden, C. 2001
[4] Durigan, C.C. 1998
[5] Pereira, L.A. 2001
[6] de Carvalho, A.C.A. & de Queiroz, J.A.L. 2008
[7] Wallace, R. & Ferreira, E. 1998
[8] Emanuela Women's Association, 2003

Uxi, uchi

Endopleura uchi (Huber) *Cuatrec.*

Patricia Shanley
José Edmar Urano Carvalho

Until recently, uxi was known disparagingly by the middle class as the "fruit of the poor" because it was so inexpensive. Today its rich, woody flavour has gained popularity and the green egg-sized fruit fetches a good price in the market. Uxi's large oval pits are covered with a thin oily pulp which can be eaten raw, but it is most loved in ice cream, in addition to being a widely sold popsicle flavour in Belém. Other parts of the tree are also used: the bark has medicinal properties, and artisans cut and polish the star-patterned pits into unique amulets that are believed to bring good fortune and to protect the wearer from ill.

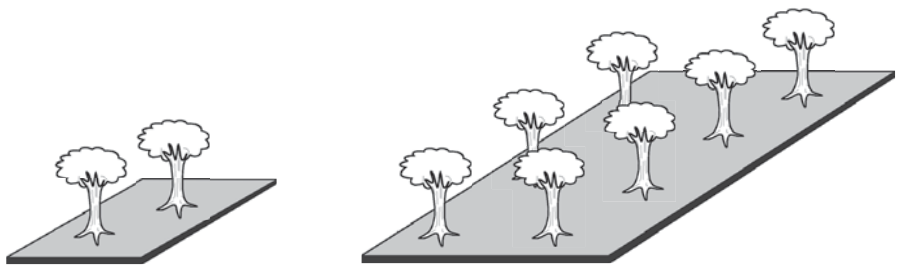
Uxi is native to the Brazilian Amazon. The uxi tree is quite large, reaching from 25 to 30 m in height, 1 m in diameter and 3 m in circumference. It can typically be found in terra firme forests, frequently in the region of the Pará river estuary and the regions of Bragantina, Guamá and Capim, on the western side of Marajó near Breves.[1]

ECOLOGY

Flower and fruit seasons

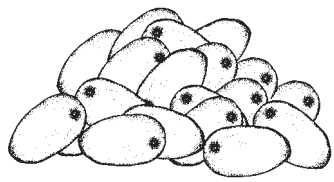
In Pará, the uxi tree flowers from October through November and bears fruit from February through May. In managed areas near Belém, like Boa Vista, Viseu and Mosqueiro, some trees produce between seasons, in the months of July and August.

Density



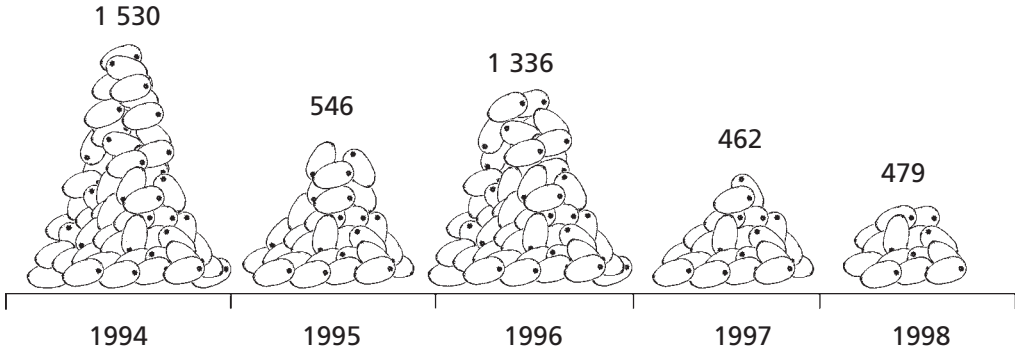
Uxi can be found in densities of less than 1/ha; however, in some forests up to 9 uxis/ha may occur. In intensively managed areas, such as on the islands close to Belém, as many as 35 mature uxis can grow in 1 ha.

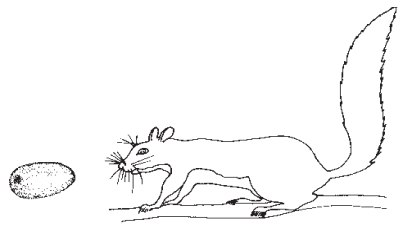
Production



an average of 1 000 fruits/tree

Many uxi trees produce fruit every year, but the number of fruit varies. For example in 1994, the average production out of a sample of 24 trees was about 1 530 fruits/tree. In 1995, the average production for the same group of trees fell to 546 fruits/tree. A tree can bear as many as 3 500 fruits in a good year, with the majority of trees producing between 700 and 2 000 fruits. In years when the tree rests, average production falls to between 400 and 500 fruits. Over a five-year period, 80% of a sample group of 24 trees produced every year. Below is the average production of these 24 uxi trees.





If a villager intends to produce uxi to sell, he or she must be sure to reach the tree before the armadillos, paca, agoutis and deer, who love the savoury fruit as much as people do. Squirrels can even gnaw through the extremely hard endocarp to eat the small seeds. And one must be careful, because the macaws and parrots knock down the fruits even when they are green. Along the Capim River, in Pará, some villagers never look up to the top of the uxi tree. They believe that if they spot an uxi fruit on the upper branches, they will depart from this life that same year. Fortunately, the small, egg-shaped fruit are well camouflaged and difficult to discern in the lofty crown.

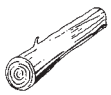
ECONOMIC VALUE

In 2004, in the ten major Belém fairs, about 477 000 uxis were sold, generating more than US$22 100. In Belém in 1995, one uxi went for US$0.05, and in 1998 one uxi cost US$0.07. In 2008, each uxi cost an average of US$0.12. In Ver-o-Peso in 2008, you could buy five uxis for US$0.59. In between fruiting seasons, the price of the fruit is highest. The pulp of uxi is also increasingly in demand; in 2003, 1 kg of pulp cost US$1.30, and by 2009, pulp prices had risen to US$3. Uxi powder, found inside the seed, is another valuable product in today's market; it is used for its medicinal and cosmetic properties, and 1 kg costs US$7.

As recently as the 1980s, when there were plenty of uxi trees close to Belém, dozens of boats used to land at the "rock" (as the Ver-o-Peso market was known), piled high with thousands and thousands of uxis. Today, it is rare to see a boat loaded exclusively with uxi, and sometimes buyers complain that there is insufficient supply to meet the demand. Fortunately, there are estuarine communities near Belém that manage, plant, prune, clean and protect uxi and in this way are able to supply the markets in the city. Some families earn 20% of their annual income from selling uxi fruit.[2] Communities in the municipality of Acara supply the Porto do Açaí market each Wednesday and Saturday with about 25 000 uxis. Uxi has risen in value in recent years, appearing in the large supermarkets and becoming a popular ice cream flavour. Furthermore, one uxi sapling, which is difficult to find for sale, can cost up to US$9.

USES

Fruit: The fruit is used to make  frozen ice treats,  ice cream, juice, and oil.



Wood: The wood of the uxi is of average quality, extracted by the timber industry and used in carpentry.

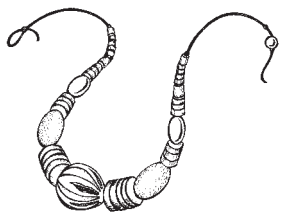
Bark: Teas made from the bark are used to treat high cholesterol, diabetes, rheumatism and arthritis. In 2001, a Brazilian TV programme showed how tea made from uxi bark could be effective in lowering high cholesterol and in healing rheumatism and arthritis. After the programme aired, many medicinal plant shops began to sell the bark.

Wildlife: Numerous species, such as paca, peccary, tapir, squirrel, deer and macaw feast on the fruit of uxi.

Oil: Uxi produces good quality oil, used both for frying food and for its medicinal properties.

Seed and endocarp: Squirrels eat the small (2–3 cm) seeds hidden deep inside the hard, fibrous endocarp (pit). Artists use the egg-shaped, star-like endocarp in crafts and to make amulets. Powder produced from the endocarp relieves itching and is also used as a cosmetic foundation. When the endocarps are burned, they produce smoke that deters insects.

Cosmetics, jewellery and a talisman



Cut an uxi endocarp and within it you will find a powder used to cover skin blemishes and relieve itching. To discourage mosquitoes or ward off evil spirits, broken uxi seeds are lit on fires inside a can. The smoke does the trick!

When the endocarp is cut through the middle, various star shapes are revealed. These can be used as beads to make beautiful necklaces, earrings and belts by cutting the seed into thin discs.

In the Macapá fair, in the Brazilian state of Amapá, a small, elderly woman carefully appraised a variety of seed necklaces for sale. She showed most interest in a particular one. The craftsperson, Delomarque Fernandes, commented that the large, central bead was uxi. Delighted, the woman placed her weathered hand firmly over the uxi pit and proclaimed, "Then this necklace is mine, as uxi has a special power!"

In Belém, Delomarque makes beautiful jewellery (necklaces, rings, bracelets and earrings) usings parts from various regional trees. The palm trees she uses are tucumã, inajá, babaçu, dendê, murumuru, mucajá, jupati, mumbaca, açaí branco, regional açaí, bacaba and coconut. In addition to palms, Delomarque likes to use uxi, uxirana, tento, cedro and Brazil nut. She says, "The jupati is

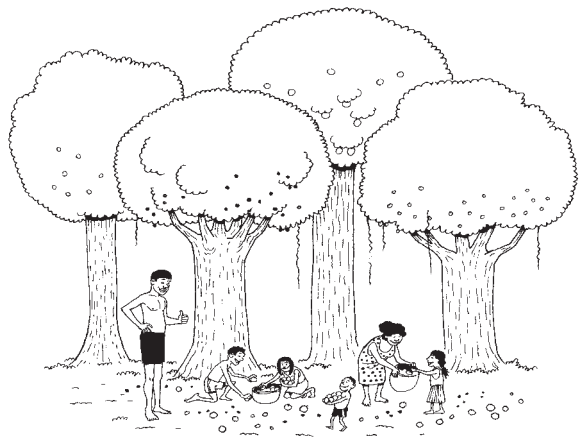
our discovery, no one worked with jupati or uxi before. It's a marvellous discovery that makes unique pieces." Some small Amazonian seeds, such as açaí, are being purchased in bulk at low prices and shipped to São Paulo to be industrially processed into jewellery. But jewellery from hard-to-work, unique fruits such as uxi and jupati are still hand crafted in Belém.

New clothes from fruit sales

As an experiment, a Mothers Club of a village along the Capim River gathered about 400 fruits (uxi, piquiá and bacuri) and for the first time ever, took them by boat to the fruit market in Paragominas. The mothers sold almost all of the fruit and bought enough used clothing for ten families, caustic soda to make soap and a little pig to rear. Walking through town on Sunday, after Mass, girls and boys proudly wore their "fruit clothes". The little pig grew fat and was eventually sold.

One family, one hectare, ten years

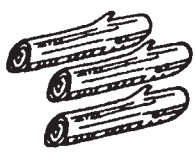
Mangueira, Maria, Neca, Simeão, Marcidia and Poca



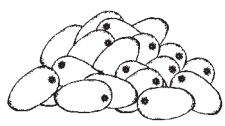
Mangueira's family marked off 1 ha of forest containing one piquiá, one bacuri and two uxi trees. For ten years, they counted and weighed all the fruit and game they had caught on this piece of land. With these data, they were able to perceive the invisible income they had earned from this 1-ha plot. They compared this value with the money they would have earned had they sold the trees on this hectare to loggers.

They noted that the quantity of NWFPs extracted from the hectare varied from year to year. For example, in 1993 the family ate 2 544 uxis. In 1994, they ate 3 654 uxis, but in 1995 and 1997, not a single one. Did they get sick of eating uxi? No! The uxi trees on that hectare simply did not produce in 1995 or 1997. Consequently, some years they caught a lot of game under the uxi trees, and others not.

Income from 1 ha over ten years (timber vs. fruit)



US$26



US$872

Mangueira's family consumed 14 248 fruits from that 1-ha plot during a ten-year period. These fruits could earn US$1 307 if they were sold in the Paragominas fair. If we discount the substantial costs associated with collection, transport, time and perishability, the net profit

would be approximately US$872. If sold to a logger, Mangueira would earn US$26/ha (US$129/alqueire) and all the trees of commercial value would be extracted, including the fruit and medicinal trees.

Like many fruiting trees, uxi, piquia and bacuri produce fruit for many decades. Having learned to see the "invisible income" that the forest has to offer and the important contribution fruit trees make to the health and nutrition of his family, Mangueira decided to conserve his forest for his grandchildren and great-grandchildren. The initiative of Mangueira's family has helped to teach other forest families in the region about the value of the standing forest.

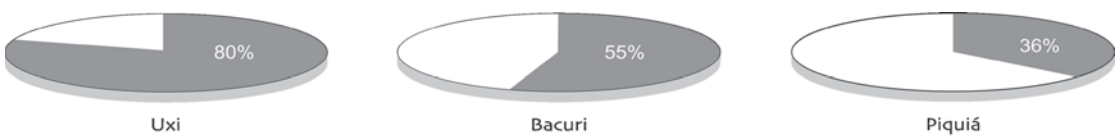
Fruit consumed by Mangueira's family from a 1-ha plot

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	No. fruit	US$/ fruit	Income US$
Piquiá	937	0	0	430	0	0	0	0	0	208	1 575	0.13	205
Bacuri	298	417	0	618	0	0	0	0	0	814	2 147	0.17	365
Uxi	2 544	3 654	0	1 321	0	0	2	0	2 500	505	10 526	0.07	737
Total	**3 779**	**4 071**	**0**	**2 369**	**0**	**0**	**2**	**0**	**2 500**	**1 527**	**14 248**		
											Gross income		**1 307**
											– Est. costs (33%)		435
											Est. profit		**872**

Which tree species is the most productive?

A distinguishing characteristic of tropical trees is that many forest species produce fruit only every other year. Between uxi, bacuri and piquiá, which do you think produces more often? A five-year study demonstrated that uxi is the species which produces most consistently, as many uxi trees produce annually. On average, 80% of the 24 uxi trees studied produced every year. In contrast, 55% of the 16 bacuri trees and 36% of the 68 piquiá trees produced each year.

Average percentage of trees producing per year 1994–1998, Capim River area



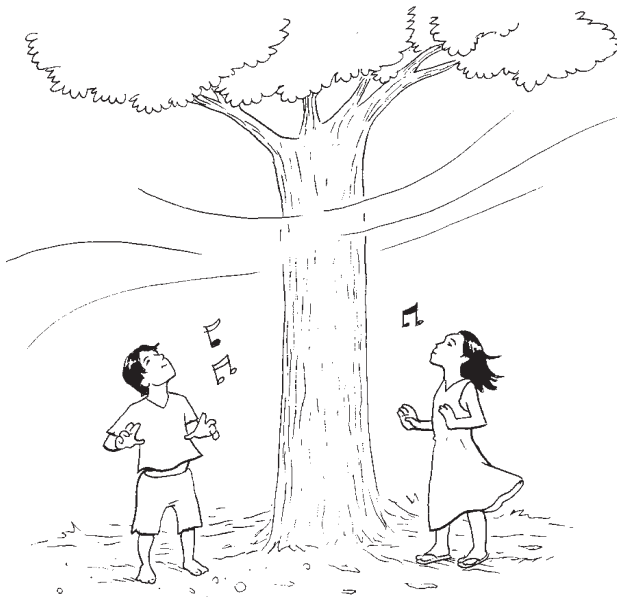
Fruit or timber?

In 2001, a community upriver from Mangueira's family sold 140 alqueires (672 ha) of forest for US$3 010, receiving US$22/alqueire. From each alqueire, the loggers took ten trees, each one for US$2.15. In one of these alqueires, there was an uxi tree that produced an average of 1 000 fruits each year. If the community had access to the Paragominas fruit market, 120 km away, they could have sold each fruit for US$0.03 and earned US$34. Subtracting the costs of transportation and labour, they may have earned US$22, the same value received from the loggers for the alqueire. By leaving the trees standing, they might have eaten fruit from the hectare every year instead of realizing only one timber sale.

Whistling to call the wind and fruit

Ronaldo Farias

Sometimes, a group of hungry kids in my neighbourhood with a craving for fruit would gather and whistle together. My mother had taught us a special whistle to call the wind that would then bring down the fruit. We were taught to whistle and wait, whistle and wait. Then we would chant: "Send the wind, Saint Lorenzo!" The more children who whistled, the stronger the wind blew. The more we believed, the more we whistled. When we believed, the wind came, the fruit fell and we ate.



NUTRITION

Composition of uxi pulp[3]

Protein:	1%	Lipids:	15%
Carbohydrates:	4%	Fibre:	21%

Uxi is an excellent source of calories: each 100 g of pulp contains 284 calories, six times more than oranges. The fruit pulp is low in sugar and high in fibre. Uxi also strengthens the body with important vitamins, contributing close to the World Health Organization's recommended daily allowance of vitamin C (with 22 mg/100 g) and vitamin E (with 6.8 mg/100 g). Uxi has more vitamin B than many fruits, with 0.13 mg of vitamin B_1 and 0.10 mg of vitamin B_2/100 g of pulp.[4] Each 100 g of uxi pulp also has 7.8 mg of iron. In addition, 100 g of uxi pulp has between 10 and 21 g of fibre; fibre helps to maintain a healthy intestinal track.

Uxi is also rich in minerals: each 100 g of pulp has 460 mg of potassium, 64–96 mg of calcium, 53–70 mg of magnesium, 30–46 mg of phosphorus and 22 mg of sodium. Furthermore, the oil is rich in phytosterols (1.4 mg/100 g of oil) more than double that of soybean oil. The presence of phytosterols in food reduces the level of cholesterol in the blood and has possible anticarcinogenic effects. Uxi oil is also a good choice to use in cooking because it is high in oleic acids (7.4%), similar to olive oil and avocado oil.

In the community of Nazaré in the Rio Capim region, Nenzinho and his family ate 1 123 uxis in just one month. His neighbours, the João Brito family, ate around 6 000 fruits! If they had had to purchase these, the estimated value would have been between US$177 and US$413. Caboclos say that during the uxi season, no one gets a cold or a cough. Other villagers proudly remark that they gain weight. Neusa do Limão is happy to say she gains 2 kg during uxi season.

Uxi crème

Ingredients:
pulp of 15–20 ripe uxis or 300 g of frozen pulp
1 can of condensed milk (395 g)
1 can of cream (300 g)
sugar to taste

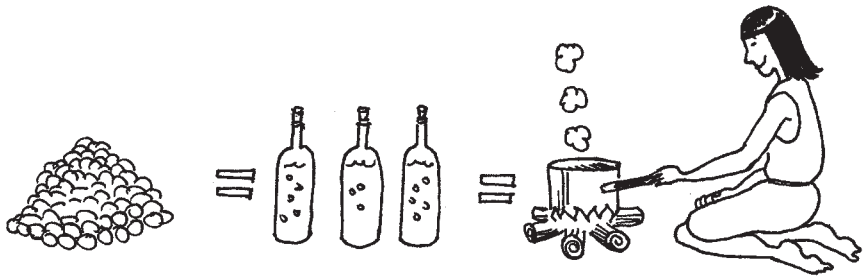
Preparation:
Wash the fruits and remove the peel with a knife. Scoop out the pulp with a spoon. Beat the cream, the condensed milk and the pulp by hand or in a blender for three minute). Pour the mixture into a mould and place in the refrigerator for two hours. Decorate as you please.

Uxi sweets

Ingredients:
500 g of uxi pulp
500 g of sugar
1/2 cup water

Preparation:
Mix the sugar, the pulp and the water until smooth. Heat the mixture over a medium flame, stirring constantly, until the mixture easily pulls away from the pan. Remove from the stove, cool, cut and serve.

Uxi oil by Senhorinha



Senhorinha of Nanaí is one of the few villagers who recall how to extract uxi oil. She related that uxi oil is of high quality and can be used both in cooking and as medicine. Senhorinha recommends uxi oil to treat sinusitis in children (rub warm oil on their noses) and for intestinal gas in adults (rub the warm oil on the belly).

To extract the oil, select 500 ripe fruit and wash them carefully. Grate them and put the pulp and the rind in a basin with water. Place the mixture over a flame and mix with a spoon while it boils. The oil is ready when the water evaporates. If you are using only a small amount of pulp, it requires approximately one hour to extract the oil; with 500 fruit it takes about two hours. Five hundred meaty fruit can potentially yield 2.5 litres of oil.

Fresh skin with uxi soap

Gloria Gaia

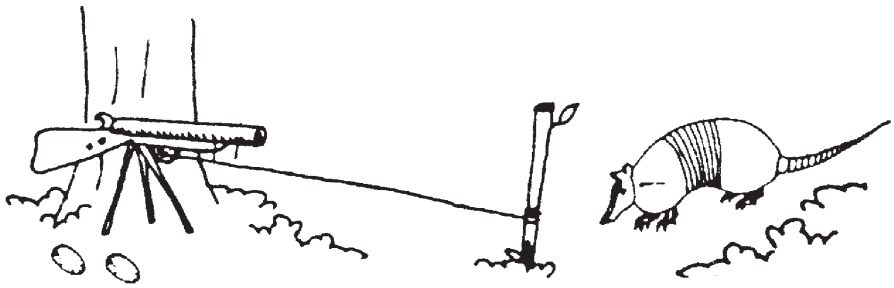
Ingredients:
200 grated uxis yields approx. 2 kg of pulp
1 small can of caustic soda (250 g)
1 litre of water
500 g of glycerine
150 g of breu jutaicica (The breu jutaicica – a tree resin – adds fragrance and binds with the soap.)

Preparation:
Dissolve 250 g of caustic soda in 1 litre of water. Add the uxi pulp and place over a low flame, simmering for 20 minutes. Next, add the glycerine and the breu jutaicica. The soap will acquire a very thick consistency. Place the soap in moulds to cool.

WILDLIFE

Uxi fruit has an important role in the diet of wildlife. In one study on uxi production, animals consumed up to 80% of the fruit that fell from the trees. Deer, tapir, collared peccary, white-lipped peccary, armadillo, paca, agouti, coati, monkeys, macaw and other birds eat uxi. Tropical squirrels patiently gnaw the hard, thick endocarp until they reach and eat the small seeds within.

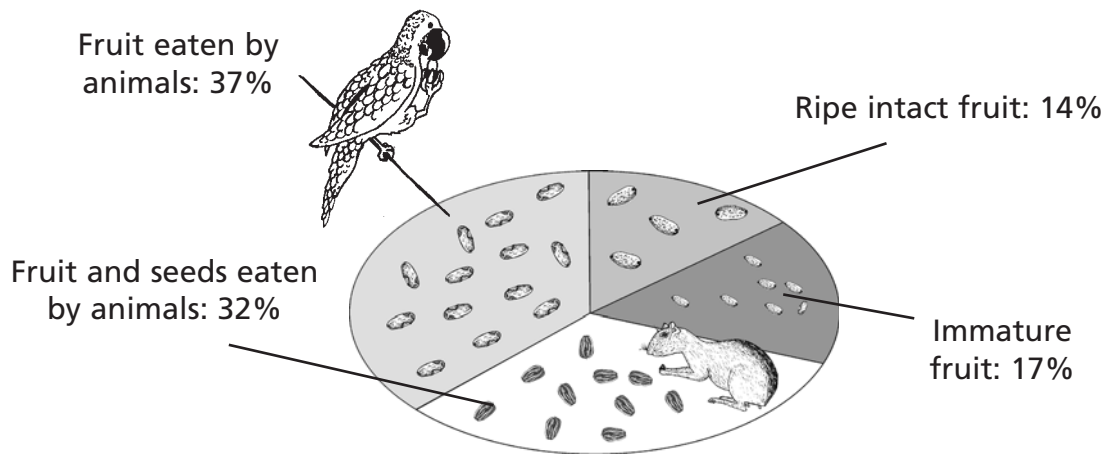
Sometimes hunters place loaded guns with tripwires along wildlife paths near the uxi trees to catch agoutis and armadillos. During the rainy fruit season, a hunter named Chuva from a village along the Capim river, often placed these traps near uxi trees. At this time of the year it was as if Chuva had a meat market alongside his home because he and his family caught and ate an armadillo almost every day. Although hunters generally place warning signals made of plants nearby traps, it is wise to use caution when walking in areas where hunters use tripwires.



Sharing the pie with wildlife

Destiny of the uxi fruit from 24 trees in the Capim region

Let's look at what happened to the fruit production of 24 uxi trees in three Capim River communities. Only 14% of the fruit was left over to eat or to sell.



Management

germination
10–16 months

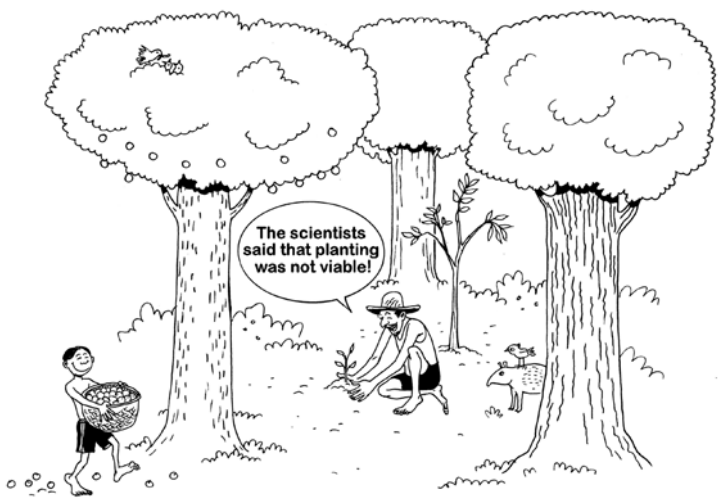
growth
slow in the shade,
up to 1 m/year in the sun

production
in plantations,
begins from 7–15 years

In 1972, the distinguished Brazilian authority on edible fruits, Paulo Calvacante, published in his classic work *Frutas Comestíveis da Amazônia* that uxi is hard to manage and, unless the fruit prices improved, would be economically unviable to domesticate.[1] Indeed, in the following three decades, the increasing value of uxi fruit has incentivized peri-urban communities to work on improving the productivity of uxi. Today, there are scores of families near Belém that are planting, managing and transporting millions of fruit to market. In the municipality of Acara, practices for increasing the density and improving the production of uxi include: enriching the area to be planted, cutting the vegetation that competes for nutrients and light, fertilizing with natural compost, using fire to control ants on the trunk and the branches and cleaning beneath the trees every six months to make it easier to spot fallen fruits. As Senhor Roxinho says, "when we rake the leaves and clean the forest floor, we always push the compost towards the uxi trees."

When uxi fruit fall from the tree and become bruised, villagers leave them on the ground. In this way they ensure a substantial number of good seeds are available for natural regeneration the following year. To enrich the forest with uxi trees, wise producers say, "You have to move the young ones carefully because uxis are tricky." Caboclos only select the saplings that have sprouted naturally and choose saplings from trees that produce the plumpest and tastiest fruits. When an uxi tree begins to age and fruit production declines, it is cut down to offer space and sunlight for younger trees to grow.[2] The wood does not go to waste, but is valuable for construction.

Wise caboclos



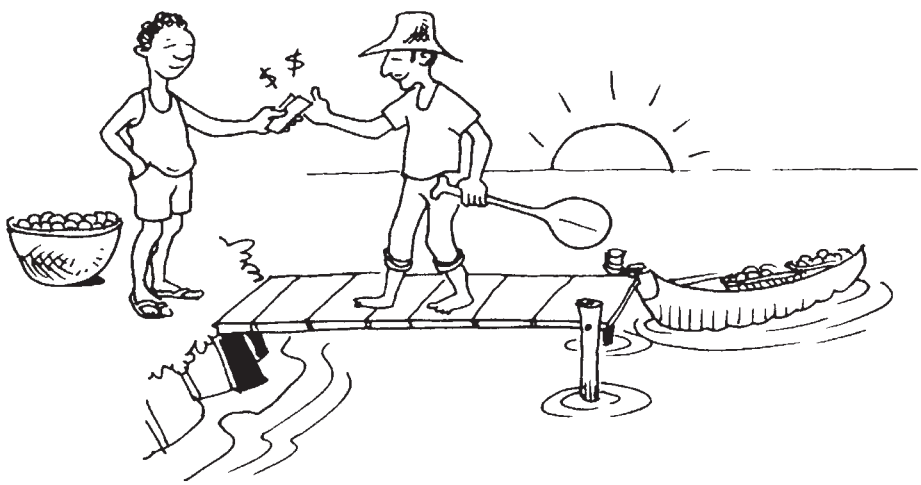
Income from the "fruit of the poor"

Sr. Roxinho

Roxinho's peri-urban home in the municipality of Acara, a 40-minute boat ride from Belém, initially had 6 uxis on 1 ha. After 30 years, he has 60 uxis on 10 ha. Sometimes he even cuts down a cupuaçu or another fruit tree in favour of an uxi. To discover the economic value of uxi, Roxinho and a group of researchers marked off 1 ha of his property and kept track of all the fruits that were sold from this hectare. During the harvest of 1996, in only two months (February and March), Roxinho earned US$475 selling uxis from that hectare. Even discounting the costs of transportation and labour, uxi is more profitable than other fruits because it produces large quantities. In one year, an average of 20% of Sr. Roxinho's and his neighbours' income originated from the sale of uxi fruit.[2]

Apart from uxi, Roxinho has many other fruit trees on his land, like biribá, pupunha, piquiá and cupuaçu. The diversity of productive fruit trees on his property is due to his hard work, experimentation and innovative management practices. Without discounting all the expenses, he earned US$1 181 in 1996 from fruit sales from that one hectare alone.

To ensure production into the future, Roxinho is careful to choose the best seeds from the most productive trees to plant. The harvest of uxi supplies most of his income and his neighbours' incomes as well. His family waits for the uxi season to be able to buy extra things for the house or for the children, such as clothing, books, notebooks, tools and pans. And guess what kind of wood he uses to build his house?



Uxi dispersers

Enrico Bernard

Uxi is a favourite food of some fruit-eating bats. Through sight and smell they are able to locate the ripest fruits on the trees. The bats grab the fruits and twist them until they are released from the tree. With the fruit in their mouths, they fly to a safe place to savour their treat. Bats don't eat the whole fruit; they just nibble the thin layer of tender and delicious pulp and drop the large fibrous seed. When they are done, the bats will either race back to the same tree or search for another one with more fruits until they are satisfied. Rarely will they stay in the same tree while they eat because there are often predators around the tree, such as owls, falcons, opossum and even other carnivorous bats. The wise bat will fly far away to escape being attacked.

The bats that eat uxi are generally large. One common species called the great fruit-eating bat (*Artibeus lituratus*) weighs between 40 and 80 g and can be up to 70 cm long from wing to wing. When a bat grabs an uxi and takes it far from the mother tree, it is acting as a seed disperser. In this way, new uxis can grow far from the shade of the mother tree where no uxis had existed before.

[1] Cavalcante, P.B. 1991
[2] Shanley, P. & Gaia, G. 2004
[3] Marx, F. *et al*. 2002
[4] IBGE 1999
[5] Carvalho, J.E.U., Müller, C.H. & Benchimol, R.L. 2007