MAHOGANY EXTRACTION IN THE EASTERN AMAZON: A CASE STUDY

Adalberto Verissimo, Paulo Barreto, Ricardo Tarifa, Christopher Uhl
Instituto do Homem e do Meio Ambiente da Amazonia
Belém, Para, Brazil

INTRODUCTION

In Brazilian Amazonia the mahogany tree is distributed in an arc from Rondonia in the west through Mato Grosso to Pará in the east. Over this range, mahogany is most concentrated in an area of about 250,000 km^2 in the south portion of Pará state. Para exported an estimated one million cubic meters of mahogany over the past eight years (DEPEC, Cacex), or 87% of the mahogany exported from Amazonia. The total value of mahogany exported by Pará State during this period is estimated at 400 million dollars.

The extraction of mahogany in Pará State began during the sixties in the Araguaia river basin. By the early seventies mahogany logging was spreading northward up Pará Highway 150 through the municipalities of Redenção, Rio Maria, and Xinguara. At that time, the south of Pará was largely forested. Now, twenty years later, things have changed. More than 40% of these municipalities has been deforested. Most of this cut forest has been converted to cattle pasture.

Meanwhile, the front of mahogany logging has moved west toward the Xingu River with sawmills now concentrated in the towns of Tucumã and São Felix do Xingu. The distance between the extraction areas and sawmills has grown from only a few kilometers in the early 80's to 300-500 kilometers at present.

Due to the importance of mahogany extraction in Pará, this paper will focus on that state. We will first discuss the ecological impacts of mahogany extraction and then "secondary" impacts associated with this logging.

CHARACTERISTICS OF THE REGION UNDER STUDY

We conducted our research in the block of land defined by the Belém-Brasília Highway and the headwaters of the Xingu River (4º-6º South of the equator). The soils of the area are latosols. The forest is evergreen. The annual rainfall is close to two meters. A period of low rainfall extends from July to November and mahogany extraction is concentrated in these months.

The indiginous people (Kayapo Indians) occupy the central portion of this region and until the 1970s these Indians experienced only limited contact with Whites. However, human penetration into the region increased dramatically in the 1980s. Now more than two thousand kilometers of logging roads have been established. Colonists, ranchers, and loggers are making use of this infrastructure to obtain legal title to these territories.

ECOLOGICAL IMPACTS OF MAHOGANY LOGGING

We located three logging sites (200-400 ha in size), situated in a triangular pattern (with about 300 km between sites), to determine the intensity of mahogany extraction (i.e., number and volume of mahogany removed per hectare) and the damages associated with mahoagny extraction. Our measurements were taken immediately following logging operations.

Size and Abundance of mahogany trees. The number of trees extracted per hectare in our study areas varied from 0.3/ha in Area 1 to 2.1 trees/ha in Area 3 and averaged 0.9/ha (s.d. = 0.8). Harvested individuals ranged in diameter from 36 to 155 cm. The average volume per harvested trees was 5.4 m^3 (n = 245, s.d. = 3.7), and the average volume extracted per hectare was 5.1 m^3 (s.d. = 4.5).

Mahogany trees tend to occur in small clumps in the forest. Several or even tens of kilometers may separate the mahogany clumps. Mahogany clumps tend to occur in low-lying areas. Because of this clumped distribution, it is extremely difficult to estimate the regional stock of mahogany and all such estimates should be regarded with skeptism at the present time.

Ecological damages associated with mahogany logging. Damage is caused by the felling of trees, movement of large machinery, and opening of logging roads. We determined that the felling of a single mahogany tree causes an average canopy opening of 358 m^2. Summing the area affected by road and log landing construction, each felled tree affects an average area of 1,450 m^2 of forest. Meanwhile, for each cubic meter of mahogany extracted, we registered close to three cubic meters of damaged volume. Expressed in terms of density, we found that for each extracted mahogany tree, 28 trees, with dbh >10 cm, were damaged. The majority (68%) of these damaged trees had been toppled or uprooted, 29% had been broken, and the rest (3%) had severe damage to the trunk.

Although these numbers may appear alarming, recall that mahogany is very sparsely distributed over an immense region. Hence, the impact on a given hectare of forest or square kilometer of forest landscape is not worrisome. It is likely that this landscape has experienced disturbances more severe than mahogany logging (e.g., forest fires) over the past 1000 years.

The forest after logging. The prospects of a second mahogany harvest in the near future are dim. The stock of mahogany trees between 10 and 45 cm dbh (the stock for the next cut) is only 0.3 trees/ha (s.d. = 0.57). Considering natural mortality, it is unlikely that this stock could produce a second harvest.

The density of other commercial tree species is also low: 6.2 trees > 40 cm dbh per hectare or 26 m^3 per hectare of wood. Meanwhile, there were 12.5 trees > 40 cm dbh per hectare (38 m^3) that had no present wood value or that had defects in the trunk or crown.

If all the commercially valuable species were extracted, the average value collected for roundwood delivered to the sawmill (dbh >45cm) would be only $830/hectare (s.d. = 670). This value is half that registered for commercial species found in forests in the north of Para following selective logging (Uhl et al, 1991). **Hence, with the exception of mahogany, these forest are remarkable poor in timber resources.**

Regeneration in logged forest. We found an average of 2.9 plants/m^2 (n = 3, s.d. =0,97) in regeneration study plots (twenty 5 x 5 m plots per study area). The majority (95%) of the seedlings and saplings in these plots were of species without wood value at present, with only 5% of this regeneration in the commercial species category. In mixed species forest in northern Pará the density of regeneration of commercial species is three times greater than that registered in this study.

Among the commercial species found in the regeneration, mahagony was quite scarce. To increase the size of our mahogany regeneration sample, we ran two kilometer transects through the forest in each of our three study areas in seach of mahogany seedlings. But mahogany regeneration was only found in one of the three study areas and, even in this case, at extremely low densities.

Surprised by this lack of regeneration, we decided to visit four sites where mahogany had been extracted in the recent past (3-9 years previously). In these sites we located the old mahogany stumps and then established one 5 x 15 m plot at the base of the mahogany stumps. We expected to find vigorous regeneration of mahogany in these old mahogany gaps. However, we found mahogany seedlings/saplings in only 31% of the 70 mahogany gaps that we located. The average number of mahogany trees per plot was 0.59 (s.d. = 1.34).

Scantness of mahogany regeneration in felling openings seems to be associated with the scarcity of mature mahogany trees after logging. In the majority (89%) of the clearings without mahogany regeneration (n = 48) there was not a single mature mahogany tree nearby. Meanwhile, in half of the 22 clearings where regeneration was taking place, at least one older mahogany tree was found closeby.

Poor regeneration of mahogany might be the result of the absence of seed trees. Also, most mahogany trees are cut between March and June, before the mahogany fruiting season (July to October). If mahogany were felled between October and November, when the majority of mahogany trees have already dropped their seeds, seedling establishment and growth would be favored by the new light gaps.

The absence of mahogany in the middle size range (10-40 cm dbh) is also striking and suggests that the mahogany population may be sensescent. It is possible that the present mahogany populations established after widespread disturbances, such as fire, several hundred years ago and have not been able to effectively reproduce since such disturbance events. However, this is just speculation.

SECONDARY IMPACTS OF MAHOGANY EXTRACTION

While the direct impact of mahogany logging on the forest appears to be minor, indirect impacts are significant. Because mahogany is sparsely distributed over a huge area, thousands of kilometers of logging roads have been opened up in search of this species. For other, less valued species, it is not cost effective to transport logs much beyond 80 km from forest to mill but for mahogany extraction distances extend to 500 km. The extremely high value of sawn mahogany justifies these high extraction costs.

A closer look at mahogany extraction region in southern Pará (Fig. 1) reveals that the immense area bounded by Pará Highway 150 on the east,

the TransAmazon forest to the north, and the Cuiaba Santarem Highway to the west is rapidly being opened up by logging roads (Fig. 2). On official maps this region appears as a sea of green forest dotted with indian reserves.

In 1991 we studied land settlement patterns along one of the principal logging road in the region known as Morada do Sol (Home of the Sun) which extends north from the city of Tucumá. This road is 400 km long (Fig xx) and was begun by loggers in 1985. Over the seven years of its existence it has grown approximately 60 km per year.

In 1985 the region cut by this road was almost completely covered by forest. Humans were extremely rare. At this time, Indian populations were concentrated to the south and east (Kayapó) and to the north (Bakajas), while a group of early colonists was concentrated near the city of Tucumá. But over the past seven years, loggers, colonists and ranchers have used this logging road to gain access to the land, converting the logged forest into agricultural fields and pastures for cattle.

All of the colonists that we interviewed along this road (n = 62) were originally from other states of Brazil. A majority of them (60%) had practiced slash and burn agriculture along Pará Highway 150 before settling along this road.

The migration route of these agriculturists coincides with the movement of loggers in search of virgin mahogany forests. The colonists are distributed along the first 70 km of the road. The average size of their homesteads is between 50 and 100 hectares. Forty-two percent of the area occupied by colonists has been deforested in seven years of occupation. Initially, colonists cut forest to plant food crops. After crop harvest, these lands are being planted to pasture. By 1991, the majority (88%) of the homesteads studied had pasture planted.

While the colonists are located along the first 70 km of this road, seven large landholders, five of whom are sawmill owners have control of the lands along the subsequent 330 km of road. Based on our surveys, the property in the hands of these seven is about a half million hectares. As mahogany is removed from these larger holdings, cattle pastures are being established.

Rariching is proving to be a lucrative land use in eastern Para. Ranching profits average $25.00/ha on unimproved pasture and $50.00/ha on improved pasture (IMAZON, unpublished). Given the poor stocking of

timber species in this forest, it is not surprising that both small and large holders opt for ranching after mahogany extraction.

SWETENIA MACROPHYLLA: A THREATENED SPECIES?

In eastern Amazonia close to 350 species of trees have current or future timber value. Researchers at the Amazon Institute of Man and the Environment (IMAZON) have developed a simple screening procedure to determine which of these 350 species is apt to be threatened by logging activities. The result: 46 of the some 350 timber species are potentially endangered by wood harvest activities.* Mahogany is among the potentially endangered species. Some of mahoganies characteristics that make it sensitive to logging pressure are: i) irregular fruit production; ii) scarcity of seedlings and saplings in natural regeneration; iii) inability to sprout from cut trunks; and iv) high insect predation on the seeds. Mahogany also has characteristics that should favor its persistence such as: i) good regeneration capacity in areas of abundant light; and ii) a reasonable density of mature trees throughout its range in Amazonia.

PROSPECTS FOR SUSTAINABLE MAHOGANY EXTRACTION

We have pointed out that mahogany is poorly represented in the medium and small size classes in this forest. Its scarcity in the regeneration suggests that mahogany populations that are now being logged may have grown up as even-aged stands after large-scale disturbances.

Mahogany loggers could do three things in extraction areas to encourage mahogany regeneration: 1) leave seed trees to seed in areas opened during logging; 2) confine tree cutting to the end of the dry season to assure the presence of freshly fallen seeds after tree removal; and 3) hand disperse seeds into the mahogany gap openings after harvest. Even if these measures were adopted, the cutting cycle would still be long because of the seeming absence of mahogany trees between 10 and 45 cm diameter in the forests of the region. If we assume a diameter increment of 0.8 cm/yr (SUDAM 1979) and a reliance on seedling regenation for the next cut, a second harvest of mahogany might not be possible for another 70-100 years.

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* Switenia macrophylla also appears on a list of 108 endangered speices published by the Brazilian Society of Botany. This list was published in January,1992 by the Brazilian Institute of the Environment (IBAMA).

A second option is to plant mahogany in degraded pastures and second-growth forests. The five biggest sawmills in southern Pará have begun to experiment with mahogany plantings in cut-over areas. Although mahogany grows reasonably well in these areas, attack by the shoot borer, Ypsypila grandella is frequently a problem. More time is needed to evaluate these pilot experiments.

CONCLUSIONS

Mahogany occurs over a immense region of the southern Amazon but its distribution is very irregular. At present there is no good estimate of the remaining stock of mahogany.

Damage resulting from mahogany extraction, when considered at the landscape level, is low primarily because of the low density of large mahogany trees.

Based on a very limited sample, it appears that small mahogany trees (seedlings, saplings and poles) are rare in logged mahogany forests. Hence, it might be many years (as many as 100) before a second cut would be possible. But we wish to stress that this conclusion is based on very limited information.

The most significant impact of mahogany logging appears to be in the opening of roads. Each year hundreds of kilometers of primary roads and thousand of kilometers of skid trails are opened up as loggers continue their search for the high value mahogany trees. In a period of two decades, an immense block of uninterrupted forest (250,000 square kilometers in the south of Pará, Fig. 1) has become latticed with a loose network of logging roads.

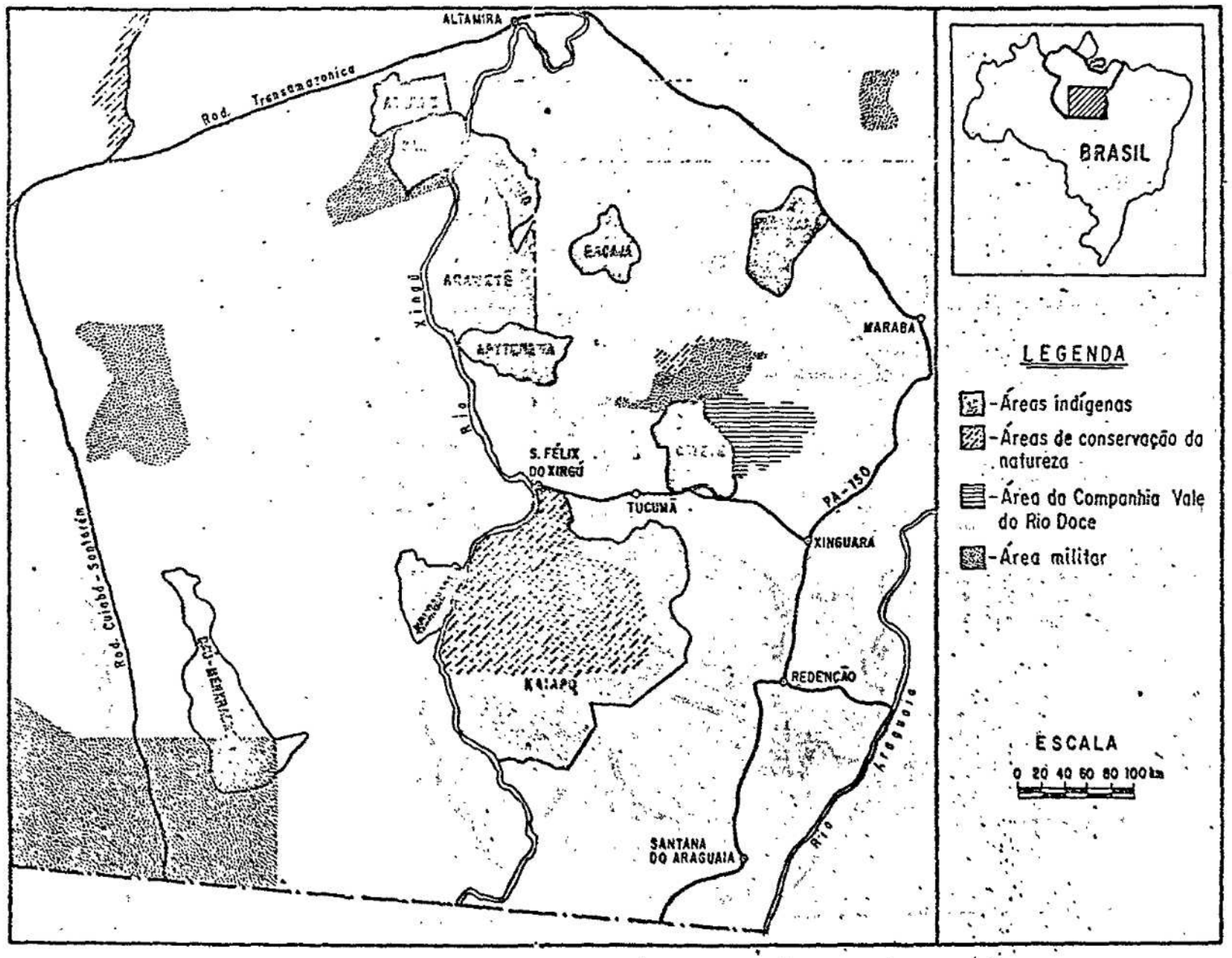
The mahogany tree has drawn loggers into the region. And the roads that the loggers build open up access to the land. Because the forests in this region have few trees that are valued for their wood, and because the prospects for a future mahogany harvest appear to be dim, loggers and colonists seem to accord little value to logged stands. Meanwhile, there is a growing trend, both among small and large landholders, to convert logged forest to cattle pasture.

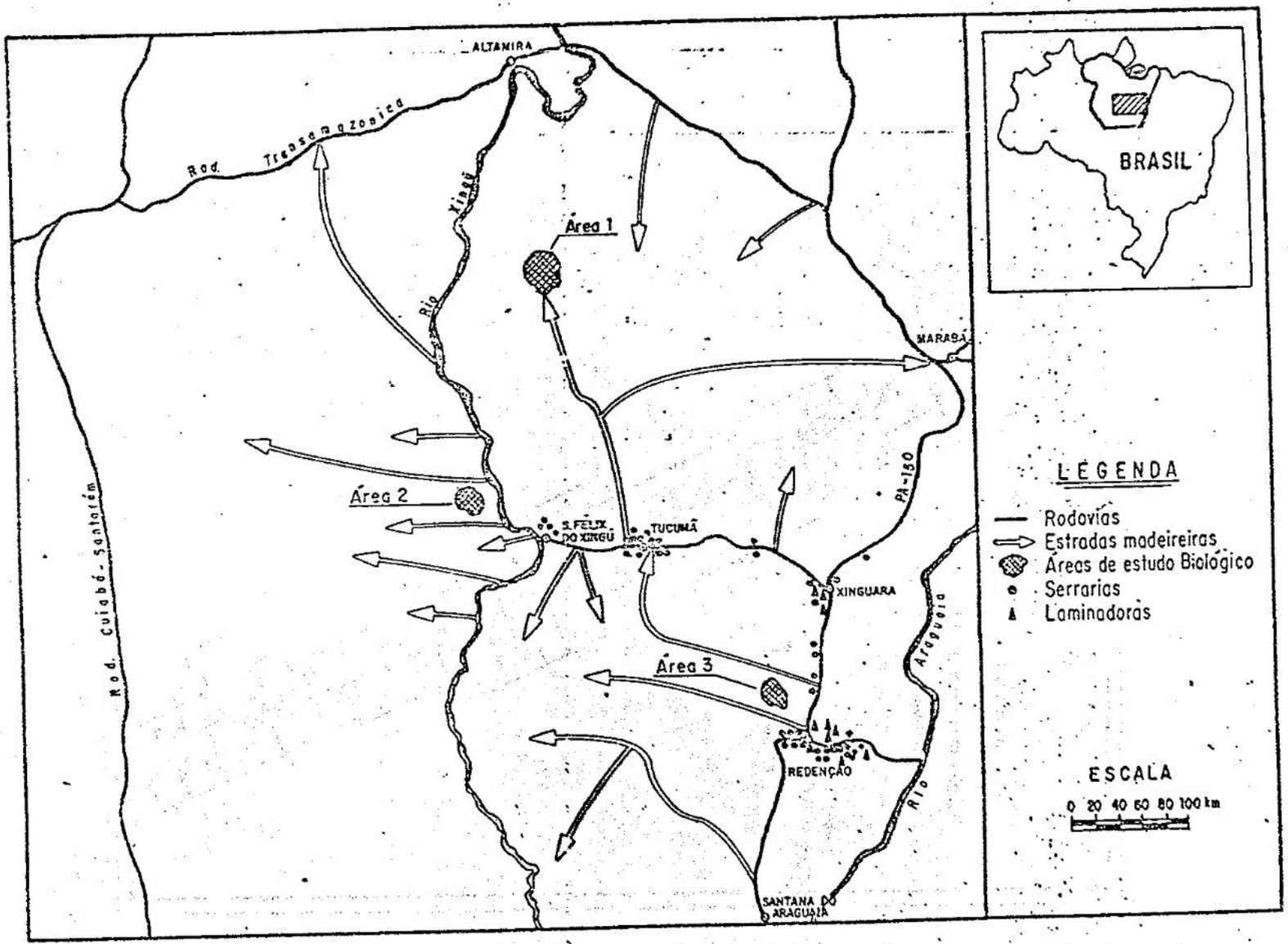
If current trends continue, is seems, at least possible, that much of the region bounded by Pará Higway 150 to the east, the Transamazon Highway

to the north and the Xingu river to the west will be deforested over the next several decades.

While logging roads-pasture dynamic may be pinpointed as the proximate cause of deforestation, it appears clear that it is the foreign demand for mahogany that drives the whole process.


VENEZUELA
GUIANA
GUIANA FRANCESA
SURINAME
COLÔMBIA
EQUADOR
AMAZÔNIA
PERU
BOLÍVIA
BRASIL
PARAGUAI
CHILE
ARGENTINA
URUGUAI
LEGENDA
– Áreas de ocorrencia de Mogno no Brasil.
CONTINENTES
1-AMÉRICA DO NORTE
2-AMÉRICA DO SUL
3-ÁFRICA
4-EUROPA
5-ÁSIA
6-AUSTRÁLIA
ESCALA
0 500 km


ALTAMIRA
Rod. Transamazonica
ESCAIA
ARAGUATÉ
Rio Xingu
MARABÁ
S. FÉLIX DO XINGÚ
TUCUMÃ
PA-150
XINGUARA
Rod. Cuiabá-Santarém
REDENÇÃO
Rio Araguaia
SANTANA DO ARAGUAIA
BRASIL
LEGENDA
- Áreas indígenas
- Áreas de conservação da natureza
- Área da Companhia Vale do Rio Doce
- Área militar
ESCALA
0 20 40 60 80 100 km


ALTAMIRA
Rod. Transamazonica
Rio Xingú
Área 1
MARABÁ
Área 2
S. FELIX DO XINGÚ
TUCUMÃ
PA-150
XINGUARA
Rio Araguaia
Área 3
REDENÇÃO
SANTANA DO ARAGUAIA
Rod. Cuiabá-Santarém
BRASIL
LEGENDA
Rodovias
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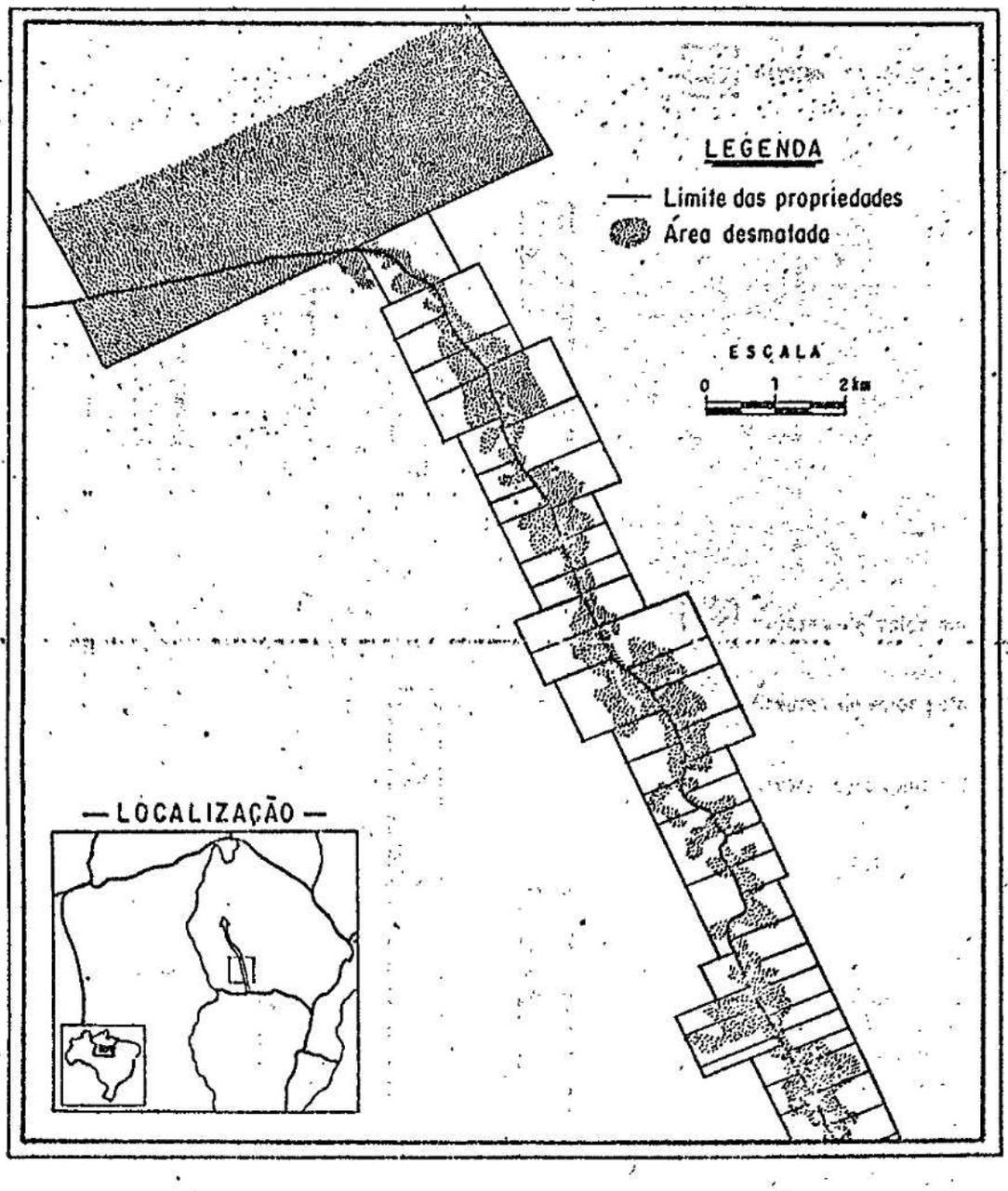
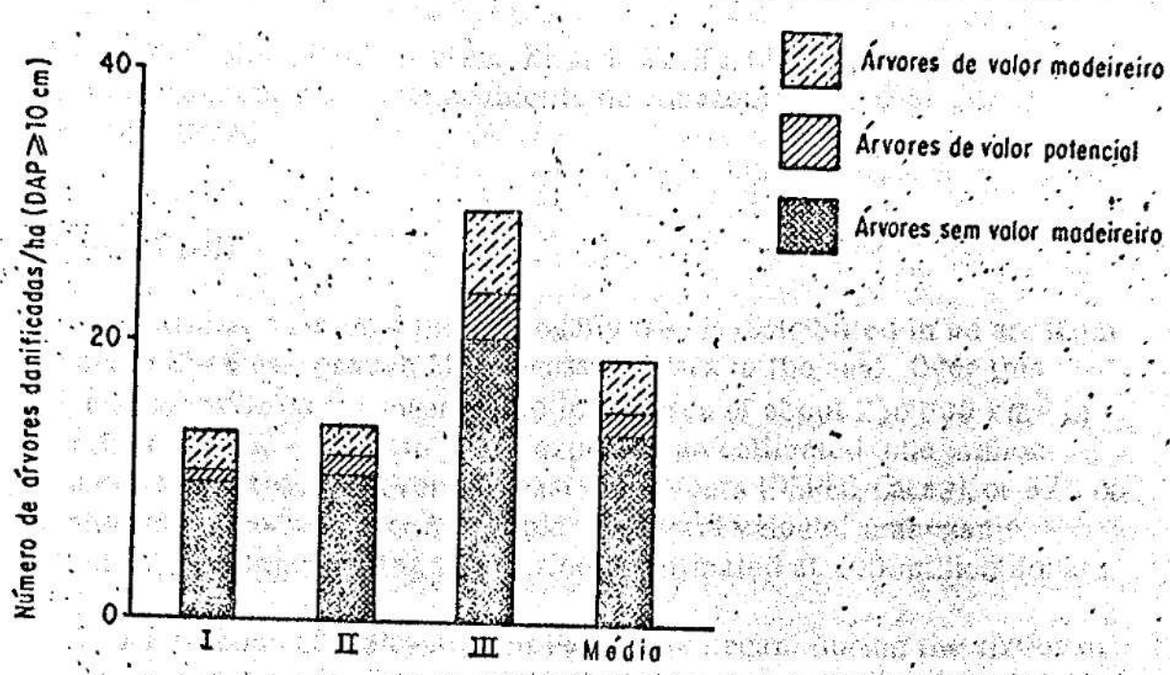
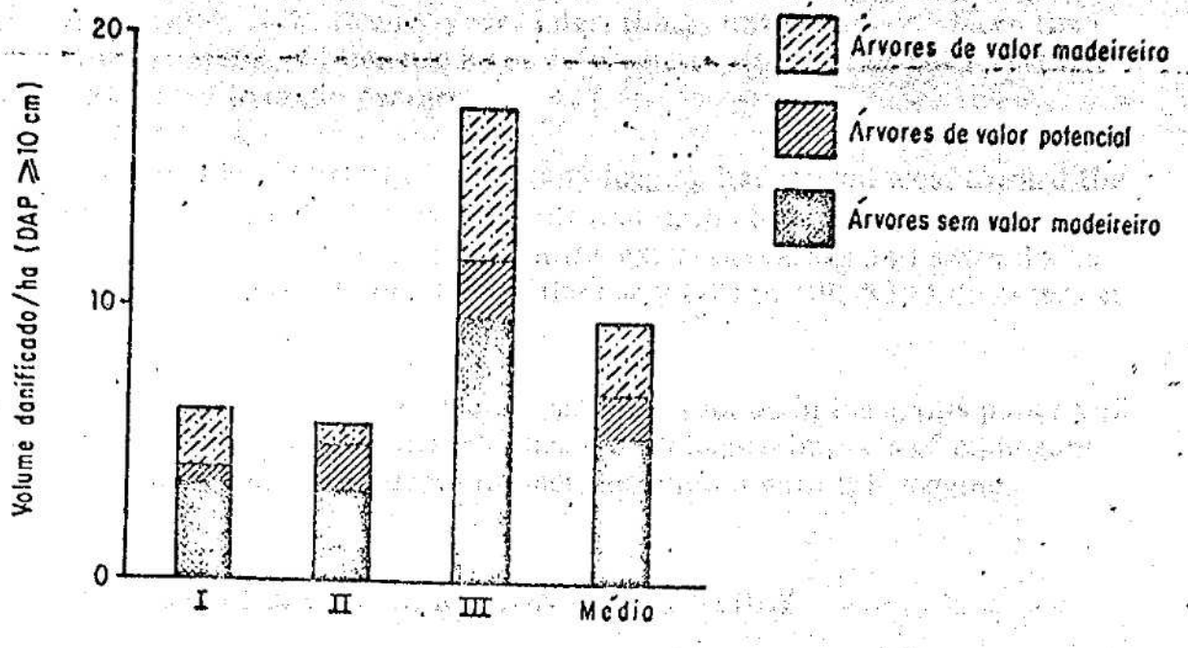
Áreas de estudo Biológico
Serrarias
Laminadoras
ESCALA
0 20 40 60 80 100 km


LEGENDA
Limite das propriedades
Área desmatada
ESCALA
0 1 2km
—LOCALIZAÇÃO—


Árvores de valor madeireiro
Árvores de valor potencial
Árvores sem valor madeireiro
Número de árvores danificadas/ha (DAP ≥ 10 cm)
40
20
0
I
II
III
Média


Árvores de valor madeireiro
Árvores de valor potencial
Árvores sem valor madeireiro
Volume danificado/ha (DAP ≥ 10 cm)
20
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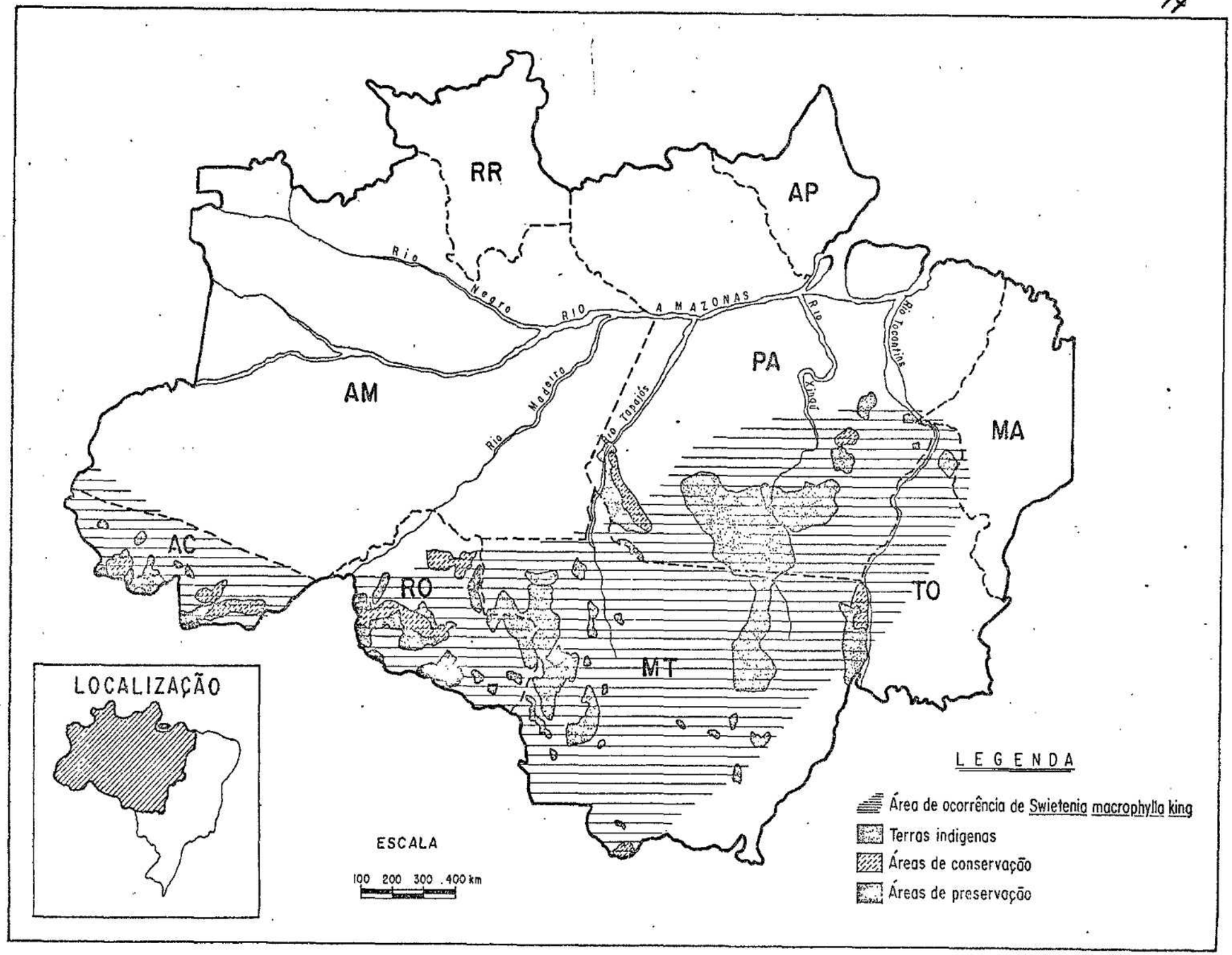
RR
AP
PA
AM
MA
AC
RO
TO
MT
Rio Negro
RIO AMAZONAS
Rio Madeira
Rio Tapajós
Rio Xingú
Rio Tocantins
LOCALIZAÇÃO
ESCALA
100 200 300 400 km
LEGENDA
Área de ocorrência de Swietenia macrophylla king
Terras indigenas
Áreas de conservação
Áreas de preservação