

# Capítulo 2

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## Floristic and life-form composition of woody plants in the ZF2 area, an amazonian terra-firme forest

### *Composição florística e formas de vida de espécies arbóreas em uma floresta amazônica de terra-firme na área da ZF-2*

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**ABSTRACT:** To obtain basic information for identifying regeneration characteristics of tree species, characteristics of floristic composition of woody plants were studied in a Brazilian Amazon terra-firme forest. This study was carried out at ZF-2 Tropical Forestry Experimental Station of the National Institute for Research in the Amazon (INPA). Inventories of woody plants were conducted on three size classes: canopy trees (diameter at breast height (dbh)  $\geq 10$  cm), sub-canopy trees (dbh  $< 10$  cm, height  $\geq 1.5$  m) and seedlings (height  $< 1.5$  m). A total of 393 tree species were recorded; this diversity is much higher than in any other neo-tropical rainforests. In the canopy, the following botanical families are dominant: Sapotaceae, Lauraceae and three Leguminosae (Mimosaceae, Fabaceae and Caesalpiniaceae), with individual-rich families being Lecythidaceae and Sapotaceae. Individual-rich families differed between two topographically different areas ("Plateau" and depression called "Baixio"). The Plateau had higher individual-richness of Lecythidaceae and Burseraceae, whereas the Baixio had higher individual-richness of Euphorbiaceae and Myristicaceae. Individual-rich families in the sub-canopy and seedling classes were different from those in the canopy. In the sub-canopy, Rubiaceae and Dichapetalaceae in the Plateau and Monimiaceae and Violaceae in the Baixio were the richest families although they showed low individual-richness in the canopy. Violaceae in the Plateau and Elaeocarpaceae in the Baixio showed high individual-richness among the seedlings. Analysis of the sub-canopy indicated different life-form composition between the Plateau and the Baixio. Lianas showed high individual ratio in

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the Plateau, whereas palms showed high individual ratio in the Baixo. These difference of floristic and life-form composition suggest the diversified regeneration characteristics of tree species and complex environment in an Amazonian terra-firme forest.

**Key-words:** botanical families, life-form of woody plants, plateau, baixo

**RESUMO:** Para obter informações básicas para a identificação da regeneração natural de espécies arbóreas de florestas tropicais de terra-firme, foram estudadas as características da composição florística em uma floresta da região de Manaus, Amazonas. Este estudo foi executado na Estação Experimental ZF-2 do Instituto Nacional de Pesquisas da Amazônia (INPA). O inventário da regeneração natural foi executado usando três classes de tamanho: (1) árvores de dossel (diâmetro à altura do peito, DAP, maior ou igual a 10 cm), (2) árvores do dossel intermediário (DAP < 10 cm e altura  $\geq$  1,5 m) e (3) mudas (altura < 1,5 m). Um total de 393 espécies arbóreas foi encontrado; esta diversidade é muito maior do que em qualquer outra floresta neotropical. No dossel, as seguintes famílias botânicas são dominantes: Sapotaceae, Lauraceae e as três Leguminosae (Mimosaceae, Fabaceae e Caesalpiniaceae). Na área de estudo, as famílias mais ricas em termos de indivíduos são Lecythydaceae e Sapotaceae. Considerando os estratos platô e baixo, as famílias mais ricas em termos de indivíduos são, respectivamente, Lecythydaceae e Burseraceae e Euphorbiaceae e Myristicaceae. No dossel intermediário, Rubiaceae e Dichapetalaceae no platô e Monimiaceae e Violaceae foram as famílias mais ricas apesar de apresentarem baixa riqueza no dossel superior. Violaceae no platô e Elaeocarpaceae no baixo foram as famílias mais ricas na classe de mudas. A análise do dossel intermediário indicou uma composição diferente de forma de vida entre o platô e o baixo. As líanas apresentaram alta abundância no platô, enquanto que as palmeiras foram as mais abundantes no baixo. Essa diferença na composição florística e da forma de vida indica que as características da regeneração natural em florestas de terra-firme são diversificadas e complexas.

**Palavras-chave:** forma de vida de espécies arbóreas, platô, baixo.

## INTRODUCTION

Increasing deforestation in the Brazilian Amazon has become a serious problem as the economy develops in this region. Biological and ecological information should be accumulated to conserve the Amazonian forest. Several studies have been conducted in the Amazon region. Prance (1989) categorized American tropical forests into several types from floristic traits. Prance (1990) reported the floristic composition of the forest in central Amazon. Some studies have attempted to estimate forest biomass in the Amazon (e.g. Higuchi et al. 1994, Carvalho Jr et al. 1995), and forest dynamics in the Amazon were reported by Rankin-de-Merona et al. (1990) and Vieira (1996). However, the tremendous richness of species and the complexity of the ecosystem hinder the progress of studies and there is not enough biological and ecological information on the Amazon forest tree community.

The Brazil Amazonian Forest Research Project (Jacaranda Project) started in 1995 by the National Institute for Research in the Amazon (INPA) and the Japan International Cooperation Agency (JICA) to develop basic research on biology, ecology and forestry for forest conservation in the Amazon region. In the first phase of the project, permanent plots were established and the relationships between vegetation, soil characteristics and topography were determined (Higuchi et al. 1998, Ferraz et al. 1998). The Jacaranda project has been progressing as the second phase with five research themes: 1) distribution patterns of forest types, 2) natural forest dynamics, 3) site characteristics, 4) ecophysiology of seeds and 5) site adaptability. Clarifying regeneration characteristics of main tree species is one of the goals of

the natural forest dynamics of the project. Forest structure can be an effective key for estimating regeneration characteristics of tree species.

This chapter reports on the composition of botanical families of trees and life form composition at different topographic sites to provide basic information on regeneration characteristics in the Amazonian terra-firme forest.

## STUDY SITE AND METHOD

The study site is located in the ZF-2 Tropical Forestry Experimental Station (2°37'-38'S, 60°11'W), approximately 60 km north-northwest of Manaus. Monthly mean temperature ranges from 25.4 to 26.2°C and annual precipitation is about 2545 mm. The main soil type is a B Alic Yellow Latosol (Brazilian classification) with an organic layer of about 19 cm that is poor in nutrients and acidic (Vieira 1996). The topography of the land consists of a typical "Plateau" and lowland areas near small streams called "Baixio" with slopes as transition zones. The Plateau is flat and has relatively dry and clayey soil (Ferraz et al. 1998). Baixio is also flat and approximately 30-40 m lower in relative height than the Plateau. The Baixio includes streams called "Igarapé" and its soils are wet and sandy (Ferraz et al. 1998). In 1995, two perpendicular transect (N-W and E-W orientation), that are 20 m wide and 2500 m long including both Plateau and the Baixio, were established to investigate changes in vegetation structure in relation to topography classes (Higuchi et al. 1998). Along transects, woody plants of the following size classes were recorded: 1) forest canopy trees, 2) forest sub-canopy trees and 3) seedlings. In the inventory of the canopy trees, all stems with diameter at breast height = 10 cm, except lianas and palms, were tagged with numbers and identified mainly by local name. Tree identification was done by Francisco Q. Reis, field assistant, who has been working for 23 years in the area with many different plant ecologists and botanists. Four sub-plots (two on the Plateau and two on the Baixio), 20 m by 100 m each, were established in transects for the inventory of the sub-canopy vegetation. All woody plants, including lianas and palms, with dbh < 10 cm and height (H) = 1.5 m were numbered and identified. Fifty-two quadrates, 1 m by 4 m each, were set up for the inventory of seedlings: 32 were placed on the Plateau and the rest on the Baixio. All seedlings of trees with H < 1.5 m were numbered and identified by local name in the quadrates. Botanical families of trees are referred to in Higuchi et al. (1985) and Jardim e Hosokawa (1986-87). Data on lianas and palms in the sub-canopy were used only for the analysis of life form.

## RESULTS

The numbers of tree species were 317, 238 and 193 in the inventories of canopy, sub-canopy (excluding lianas and palms) and seedling classes, respectively. A total of 393 tree species appeared in the three classes (Fig. 1). In the forest canopy, the dominant botanical families were Sapotaceae, Lauraceae and three Leguminosae (Mimosaceae, Fabaceae and Caesalpinaceae), with individual-rich families being Lecythidaceae, Sapotaceae, Burseraceae and Chrysobalanaceae (Fig. 2).

Individual-rich families were different between the Plateau and the Baixio although Sapotaceae and Chrysobalanaceae showed higher individual-richness in the both area (Fig. 3). The Plateau had higher individual-richness of Lecythidaceae, Burseraceae and Lauraceae. The Baixio had higher individual-richness of Euphorbiaceae, Myristicaceae, Meliaceae and Bombacaceae. In addition, individual-rich families in the sub-canopy were different from those in the canopy (Figs. 3 and 4). In the sub-canopy, Rubiaceae and Dichapetalaceae for the Plateau and Monimiaceae and Violaceae for the Baixio showed high density although they

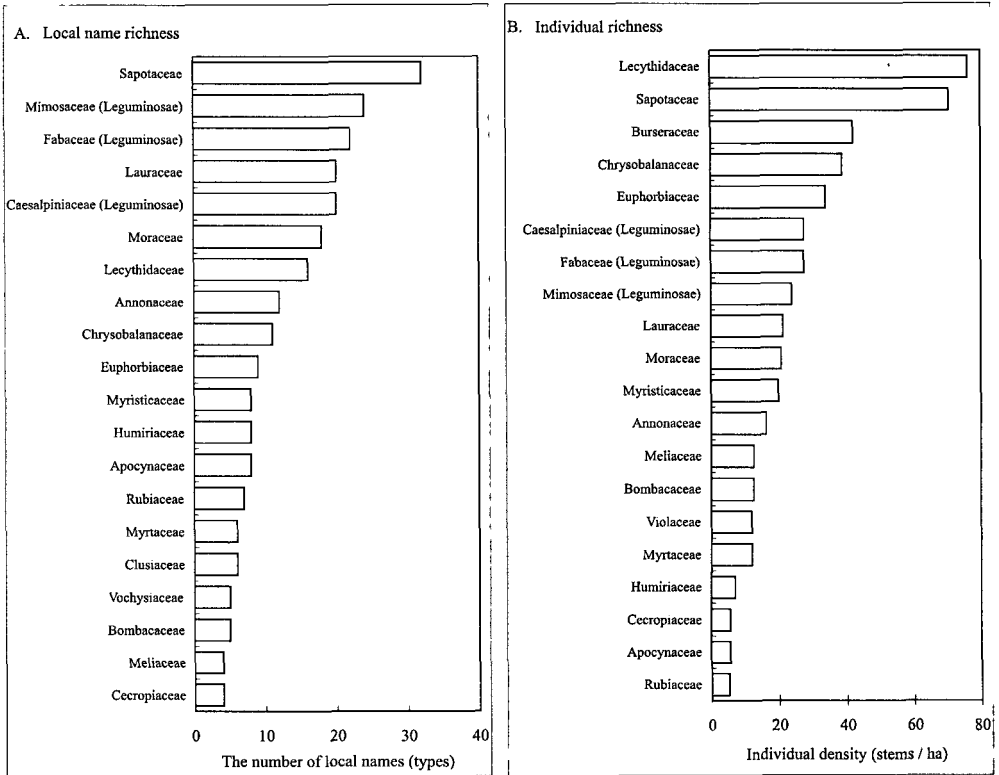


Figure 2 - Local names - and individual-rich families (top twenty families) in the canopy class.

distribution patterns for several tree species and classified three types of population structures. Tanouchi and Yamamoto (1995) estimated regeneration characteristics of tree species from population structure in an evergreen broad-leaved forest in Japan. Although this study analyzed floristic composition at the family level, analysis at the species level will be needed in further study to identify the regeneration characteristics.

Differences in forest structure (floristic and life-form composition) between the Plateau and the Baixio (Figs. 3-6) are mainly attributed to soil characteristics (Ferraz et al. 1998). Sandy and moisture-saturated soils would prevent some tree species from regenerating on the Baixio. In addition, many palms (Fig. 6) would also affect the environment for trees to regenerate on the Baixio. Bussu (*Manicalia saccifera*), which is one of the common palms on the Baixio, sometimes spread their leaves over 5m long (Henderson et al. 1995) and cover the forest floor. Kominami et al. (2000) pointed out that palms were one of the causes of decrease of light in a Dipterocarp forest in Malaysia. The Baixio did not have a much better light environment on the forest floor than the Plateau although the Baixio had lower individual density than the plateau (Fig. 6). Difference of canopy openness between the Plateau and the Baixio was not found under closed canopy (approximately 6% by analysis of hemispherical photographs).

This study showed richness of tree species and different floristic and life-form composition among size classes and/or topography. These suggest that abundant tree species are regenerating with diversified strategies under the complex environment in an Amazonian terra-firme forest.

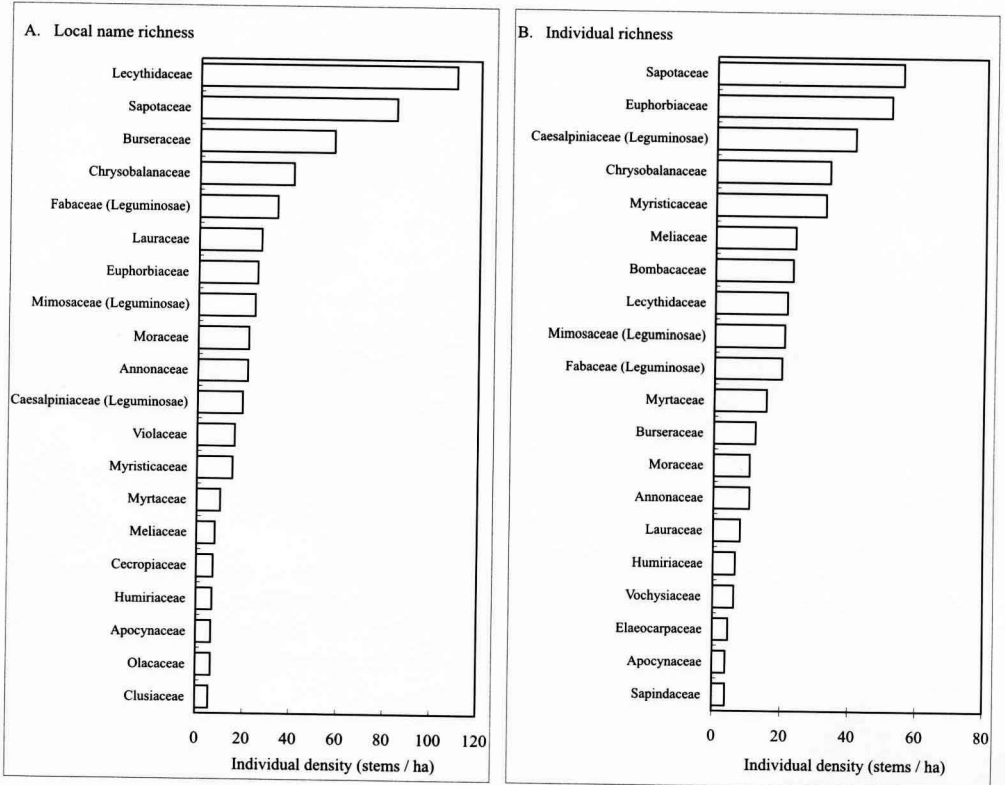


Figure 3 - Individual-rich families (top twenty families) on the plateau (A) and baixo (B) in the canopy class.

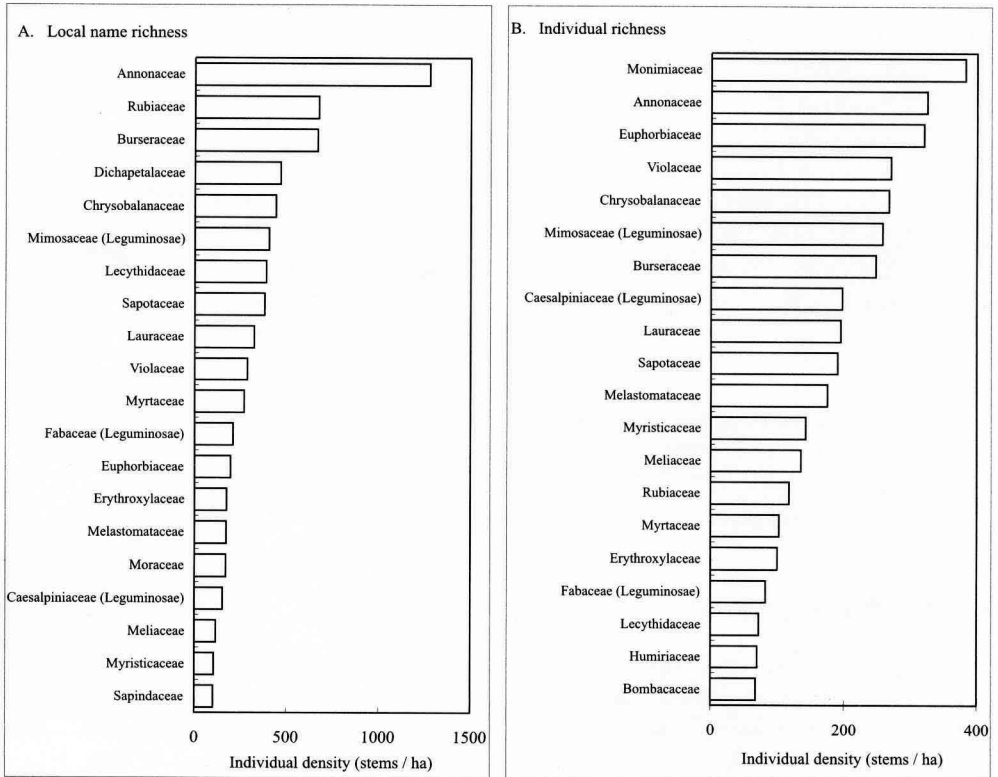


Figure 4 - Individual-rich families (top twenty families) on the plateau (A) and baixio (B) in the sub-canopy class (B).

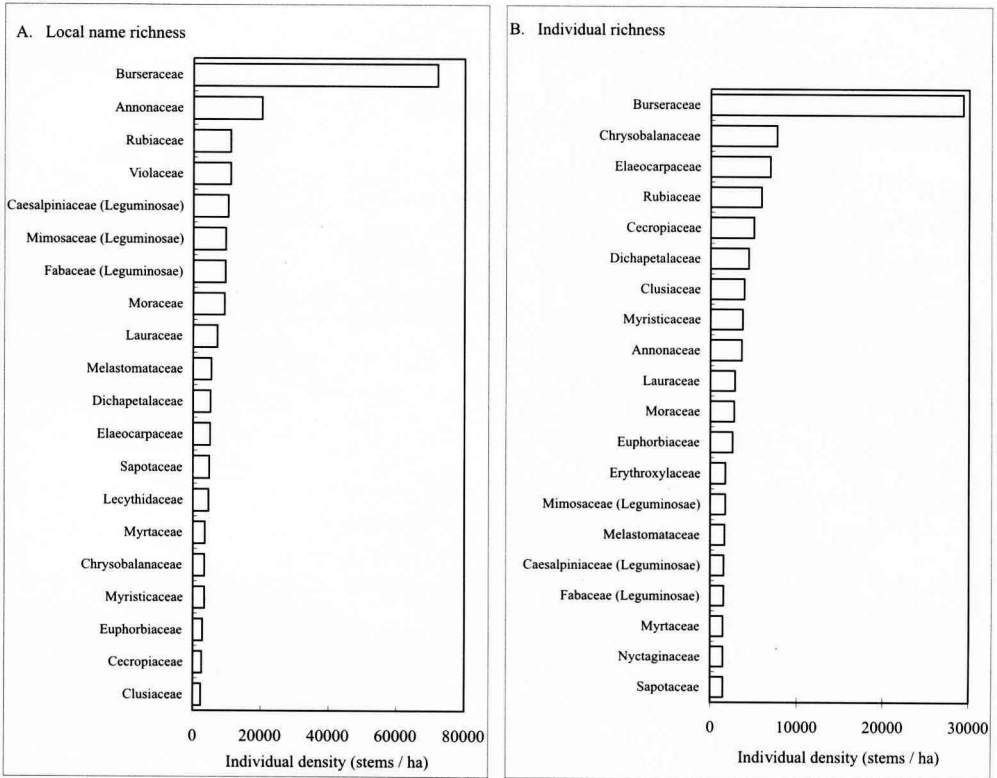


Figure 5 - Individual-rich families (top twenty families) on the plateau (A) and baixo in the seedling class.

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