

**Timber tree collection of an Acre forest under community management****Acervo arbóreo madeireiro de uma floresta acreana sob manejo comunitário**

Recebimento dos originais: 20/01/2019

Aceitação para publicação: 15/03/2019

**Henrique José Borges de Araujo**

Master in Forestry Engineering by the "Luiz de Queiroz" College of Agriculture / University of São Paulo (ESALQ / USP)

Institution: Brazilian Agricultural Research Corporation / Embrapa Acre  
Address: Rodovia BR 364, km 14, CEP 69900-970, Rio Branco-AC, Brazil  
E-mail: henrique.araujo@embrapa.br

**ABSTRACT**

The evaluation of forest composition is a very important stage of forest management. This evaluation is done through forest inventories. The objective of this work is to present the results of a 100% forest inventory made in areas of forest exploitation of small farmers under logging management, located in the municipality of Senador Guimard, in the state of Acre, in the Brazilian Amazon. The inventoried area (206.8 ha), in which all the trees with DBH  $\geq$  50.0 cm were measured, revealed a total number of trees (NT) of 3,518, abundance (AB) of 17.01 trees ha<sup>-1</sup>, total volume (VT) of 21,667.41 m<sup>3</sup>, volume per hectare (V) of 104.77 m<sup>3</sup> ha<sup>-1</sup>, total basal area (ABsT) of 1,413.77 m<sup>2</sup> and basal area per hectare (ABs) of 6.84 m<sup>2</sup> ha<sup>-1</sup>. A total of 204 species belonging to 136 genera and 43 botanical families were recognized in the field. The five species of highest Index of Importance of Species (IND) were: Brazil nut (*Bertholletia excelsa* Bonpl.), Tauari (*Couratari macrosperma* A.C. Sm.), Cumarú-cetim (*Apuleia molaris* Spruce ex Benth.), Rubber tree (*Hevea brasiliensis* (Willd. ex A. Juss.) Müll. Arg.) and Cumarú-ferro (*Dipteryx odorata* (Aubl.) Willd.). The sum of the IND of these five represents a third (33.6%) of the total IND (all species). Most of the 20 species with the highest IND are loggers of commercial use and represents for about 60% of the total IND. This study showed a significant concentration of the dendrometric elements, that is, few species unit most of the adult trees and, consequently, most of the timber volume.

**Keywords:** Amazonian forest species; Dendrometry; Floristic diversity; Forest Inventory.

**RESUMO**

Entre as etapas fundamentais do manejo florestal está a avaliação da composição da floresta. Essa avaliação é feita por meio de inventários florestais. Este trabalho tem como objetivo apresentar resultados de um inventário florestal a 100% realizado em talhões de colheita de pequenas áreas sob manejo florestal madeireiro, localizadas em Senador Guimard-AC. A área inventariada, de 206,8 ha, em que foram abordadas todas as árvores com DAP  $\geq$  50,0 cm, revelou um número total de árvores (NT) de 3.518, abundância (AB) de 17,01 árvores ha<sup>-1</sup>, volume total (VT) de 21.667,41 m<sup>3</sup>, volume por hectare (V) de 104,77 m<sup>3</sup> ha<sup>-1</sup>, área basal total (ABsT) de 1.413,77 m<sup>2</sup> e área basal por hectare (ABs) de 6,84 m<sup>2</sup> ha<sup>-1</sup>. Foram reconhecidas 204 espécies, pertencentes a 136 gêneros e a 43 famílias botânicas. As cinco espécies de maior Índice de Importância da Espécie (IND) foram: Castanheira (*Bertholletia excelsa* Bonpl.), Tauari (*Couratari macrosperma* A.C. Sm.), Cumarú-cetim (*Apuleia molaris* Spruce ex Benth.), Seringueira (*Hevea brasiliensis* (Willd. ex A. Juss.) Müll. Arg.) e Cumarú-ferro (*Dipteryx odorata* (Aubl.) Willd.). Estas cinco espécies representaram um terço (33,6%) do IND total. A maioria das 20 espécies com maior IND são madeiras de uso comercial e responderam por cerca de 60% do IND total. Os resultados mostraram expressiva concentração dos elementos

dendrométricos, ou seja, poucas espécies reúnem a maior parte das árvores adultas e, conseqüentemente, a maior parte do volume madeireiro.

**Palavras-chave:** Dendrometria; Diversidade florística; Espécies florestais amazônicas; Inventário florestal.

## 1 INTRODUCTION

The forest inventories provide the subsidies for the planning of harvesting activities and management itself, such as: species to be harvested, cutting intensities and cutting cycles, silvicultural treatments to be conducted, etc. Another important aspect of the evaluation of existing forest resources is the possibility of economic projections about the commercialization, such as calculations of expected expenses and revenues, markets to be reached, etc.

The inventories can be of three types (ARAUJO, 2015): a) inventory of recognition or diagnosis: this inventory analyzes the composition and structure of the forest, covering individuals from the regeneration to adult trees, allowing to determine the potential and suitability of the forest for the management; b) 100% inventory: this inventory determines with good precision the existing wood stock and is denominated "100%" because it covers the whole area and all the trees from a minimum DBH (e.g. 50.0 cm); c) continuous or monitoring inventory: this inventory covers from regeneration to adult trees, evaluates the forest dynamics regarding inflows and mortality of individuals, diametric and volumetric growth, harvest damage, etc.

The objective of this work is to present results of a 100% forest inventory conducted in small areas of smallholder under forest management, located in the municipality of Senador Guiomard, in the state of Acre, in the Brazilian Amazon region.

## 2 METHODOLOGY

The inventoried area, located in the municipality of Senador Guiomard-AC, is inserted in the Pedro Peixoto Colonization Project, which is an Amazonian federal agrarian settlement project classified by the National Institute of Colonization and Agrarian Reform (INCRA) in the form of Directed Settlement Project - PAD, which were created from the 1970s on a family-owned basis (MEDEIROS et al., 2009). The area is composed of 12 small properties under community forestry management (Figure 1). Each property has, on mean, 72 ha, with an effective area under management of 36 ha (half the area). The total area under management of the properties totals 431 ha (ARAUJO, 2015).

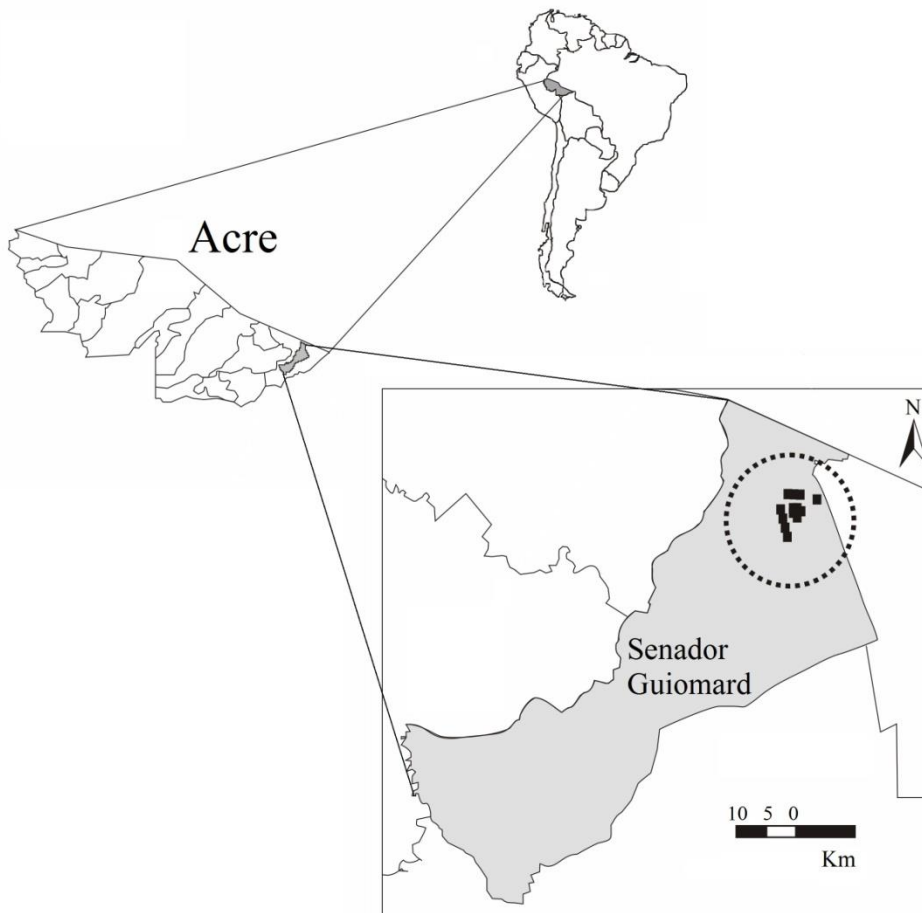


Figure 1. Location of small properties under forest management in the Pedro Peixoto Colonization Project, Municipality of Senador Guiomard-AC.

Figura 1. Localização das pequenas propriedades sob manejo florestal no Projeto de Colonização Pedro Peixoto, Município de Senador Guiomard, AC.

In the Peixoto Colonization Project is a predominance of plane topography and low fertility soils, with high clay content, but with spots with good agricultural potential. The hydrography is made up of semi-perennial streams. The climate is type Aw (Köppen), typically tropical, hot and humid, composed of dry seasons (May to October) and rain (November to April) well defined. The average maximum temperatures, recorded from August to October, are between 31 °C and 33 °C, and the minimum averages, registered in July, between 17 °C and 22 °C. The average annual precipitation is in the range of 1,950 mm. Forest cover is the typical dense Amazonian rainforest with open forest and dense forest formations (ACRE, 2006; DUARTE, 2006).

In the 100% inventory all the trees with DBH  $\geq$  50.0 cm were measured, the following information was taken for each: common name of the species (provided by experienced forest men), the measurement of DBH and the condition of utilization of the log, in addition to sketch plotting. For the 12 properties, 57 management compartments were inventoried, totaling 206.8 ha.

The 100% inventory parameters, expressed for the total area and by species, were: a) total number of trees (NT) in the inventory area; b) abundance (quantity of trees) per hectare (AB); c) total volume of standing trees (VT) in the inventory area; (d) the volume per hectare of standing trees (V); e) total basal area (ABsT) in the inventory area; f) basal area per hectare (ABs); g) Index of Importance of Species (IND) and h) condition of utilization of log: total, partial and without use.

The volume of the standing tree (V) corresponds to the potentially usable volume of the log with bark, using as calculation components the DBH and the commercial height, which is usually initiated at the base of the tree, at ground level, to the first branches or bifurcations.

The IND is a percentage value, expressed by the simple arithmetic mean of the percentages of each species for NT, VT and ABsT, in relation to the respective totals (all species) of these variables for the inventoried area. The IND index (ARAUJO, 2002) was adapted from the Index of Importance Value - IVI (MÜLLER-DOMBOIS and ELLEMBERG, 1974), that is calculated based on other parameters, that is, density (number of individuals), frequency (number of plots in which it occurs) and dominance (basal area).

The species identification was based on the work of Araujo and Silva (2000), and the scientific names were updated and verified in databases available on the web: LISTA DE ESPÉCIES DA FLORA DO BRASIL (2018), MOBOT (2018) and NYBG (2018).

### 3 RESULTS AND DISCUSSION

The 100% inventoried area (206.8 ha) revealed, for trees with DBH  $\geq$  50.0 cm: NT of 3.518; AB of 17.01 trees ha<sup>-1</sup>; VT of 21,667.41 m<sup>3</sup>; V of 104.77 m<sup>3</sup> ha<sup>-1</sup>; ABsT of 1,413.77 m<sup>2</sup>; and ABs of 6.84 m<sup>2</sup> ha<sup>-1</sup>. In relation to the condition of utilization of the log, the result was: 83.2% (2,926 trees) total, 14.0% (493 trees) partial and 2.8% (99 trees) without utilization.

A total of 204 species belonging to 136 genera and 43 botanical families were recognized by the inventory. The most important families were (in parentheses the respective number of species): Fabaceae (58); Moraceae (16); Malvaceae (12); Meliaceae (11); Sapotaceae (9); Apocynaceae and Lauraceae (8 each); Annonaceae (7); and Chrysobalanaceae, Euphorbiaceae, Lecythidaceae and Urticaceae (6 each). The most important genres were: *Inga* (6); *Brosimum* and *Ficus* (5 each); *Aspidosperma*, *Licania* and *Ocotea* (4 each); *Cariniana*, *Cecropia*, *Guarea*, *Ormosia*, *Parkia*, *Pourouma*, *Pouteria* and *Trichilia* (3 each).

According to the IND, the five species of greatest relevance were: Brazil nut (*Bertholletia excelsa* Bonpl.), Tauari (*Couratari macrosperma* A.C. Sm.), Cumaru-cetim (*Apuleia molaris* Spruce ex Benth.), Rubber tree (*Hevea brasiliensis* (Willd. ex A. Juss.) Müll. Arg.) and Cumaru-ferro (*Dipteryx odorata* (Aubl.) Willd.).

The five species with the highest IND represented one-third (33.6%) of the total IND (100%). Brazil nut was the most prominent species with an IND of 15.4%, almost triple that of the Tauari (IND = 5.5%), the second most important species, which was followed by Cumaru-cetim (IND = 4.5%), Rubber tree (IND = 4.2%) and Cumaru-ferro (IND = 3.9%).

Most of the 20 species with the highest IND (about 10% of the occurring species) are commercial timber and account for about 60% of the total IND (Figure 2).

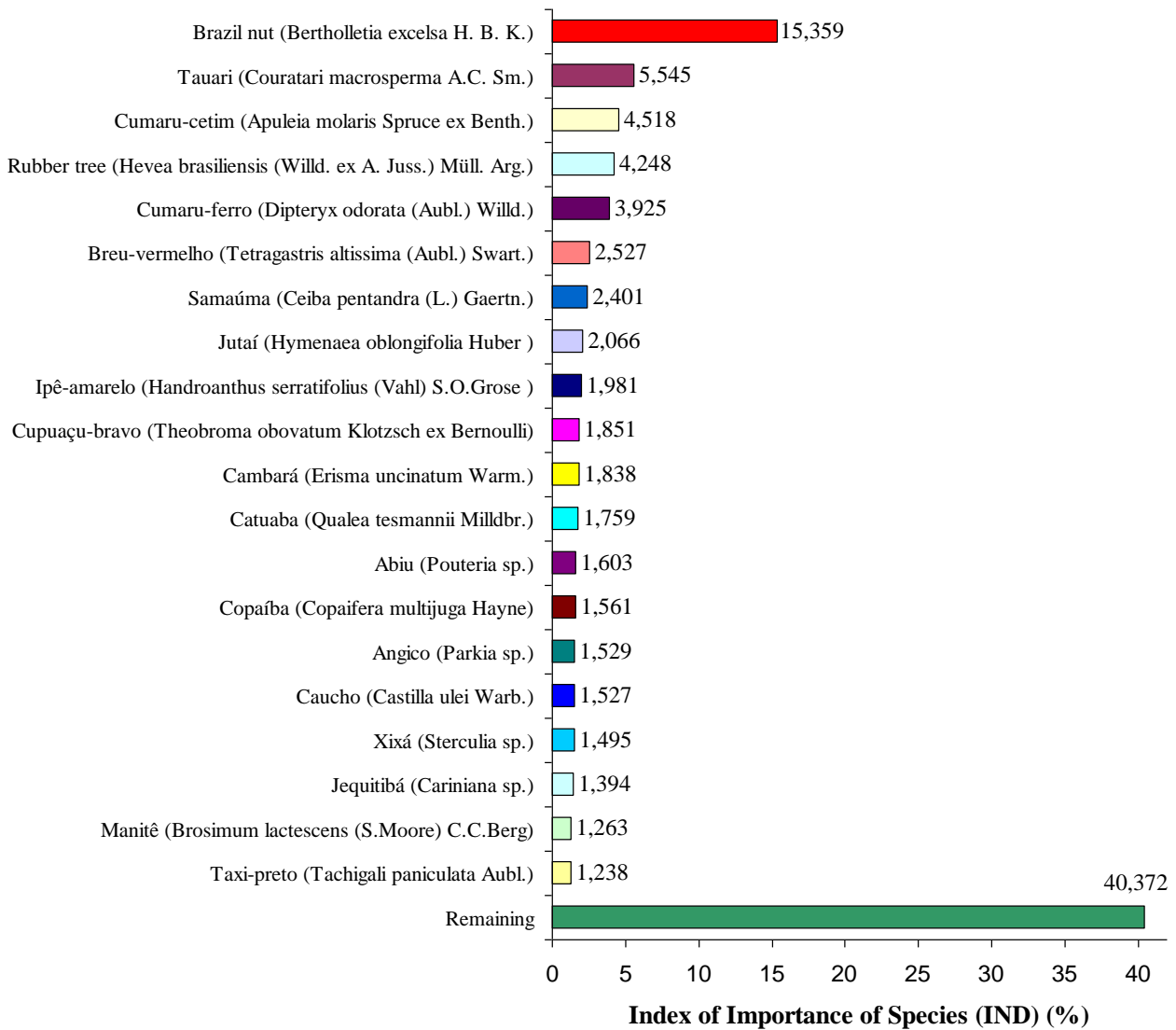


Figure 2. The top 20 species occurring in the inventory area according to the Index of importance of the species (IND).  
 Figura 2. As 20 principais espécies ocorrentes na área inventariada conforme o Índice de importância das espécies (IND).

Most species (130 species - 63.7%) were identified at species level (genus and species), about one third (67 species - 32.9%) only at the genus level, a small part (7 species - 3.4%) only at the family level. It is worth noting that 2.8% of the trees (98 of the total of 3,518) were not recognized in

the field and were considered unknown, demonstrating that the task of identifying trees, even of large size (morphologically defined), is not simple.

The Figure 3 shows some examples of timber species occurring in the inventoried area.



Figure 3. Specimens of timber species occurring in the inventoried area (left to right): Aroeira (*Astronium lecointei* Ducke), Samaúma (*Ceiba pentandra* (L.) Gaertn.) and Tauari (*Couratari macrosperma* A.C. Sm.). Senator Guiomard-AC. Photos: the author himself.

Figura 3. Exemplos de espécies madeireiras ocorrentes na área inventariada (da esquerda para a direita): Aroeira (*Astronium lecointei* Ducke), Samaúma (*Ceiba pentandra* (L.) Gaertn.) e Tauari (*Couratari macrosperma* A.C. Sm.). Senator Guiomard-AC. Fotos: próprio autor.

## 4 CONCLUSION

The imbalance of the species with respect to IND shows a significant concentration of the dendrometric elements, that is, few species concentrate most of the adult trees and, consequently, most of the timber volume. Thus, the diversity of commercial species with significant volumes of wood available for forest management is limited. An alternative for high commercial value species with low IND is to conduct silvicultural treatments, combined with artificial regeneration, to increase their participation. The inventory showed that a significant part of the existing wood stock in the areas is of wood of commercial value, indicating the economic viability of the forest management.

## REFERENCES

ACRE. Governo do Estado do Acre. Programa Estadual de Zoneamento Ecológico-Econômico. **Zoneamento Ecológico-Econômico do Acre Fase II Documento síntese – escala 1:250.000**. Rio Branco, Secretaria de Estado de Meio Ambiente. 2006. 355p.

ARAUJO, H. J. B. **Acervo arbóreo madeireiro das áreas sob manejo florestal comunitário do Projeto de Colonização Pedro Peixoto**. Rio Branco: Embrapa Acre, 2015. 49 p. (Embrapa Acre. Documentos, 139).

ARAUJO, H. J. B. **Agrupamento das espécies madeireiras ocorrentes em pequenas áreas sob manejo florestal do Projeto de Colonização Pedro Peixoto (AC) por similaridade das propriedades físicas e mecânicas**. 2002. 168 f. Dissertação (Mestrado em Ciências florestais). Escola Superior de Agricultura "Luiz de Queiroz", Universidade de São Paulo, Piracicaba.

ARAUJO, H. J. B.; SILVA, I. G. **Lista de espécies florestais do Acre (ocorrência com base em inventários florestais)**. Rio Branco: Embrapa Acre, 2000, 77p. (Embrapa Acre. Documentos, 48).

DUARTE, A. F. Aspectos da climatologia do Acre, Brasil, com base no intervalo 1971 – 2000. **Revista Brasileira de Meteorologia**, São Paulo, v. 21, n. 3b, p. 96-105, 2006.

LISTA DE ESPÉCIES DA FLORA DO BRASIL. Jardim Botânico do Rio de Janeiro. Disponível em: <<http://floradobrasil.jbrj.gov.br/>>. (Access in: May 18, 2018).

MEDEIROS, A. B.; ANDRADE NETO, R. de C.; OLIVEIRA, M. G.; COELHO, D. M. **Plano de ação qualificado para regularização ambiental em assentamentos de reforma agrária no Estado do Acre**. Rio Branco, AC: MDA: INCRA-AC, 2009. 66 p.

MOBOT, Missouri Botanical Garden. Disponível em: <<http://www.tropicos.org>>. (Access in: May 16, 2018).

MÜLLER-DOMBOIS, D.; ELLEMBERG, H. **Aims and methods for vegetation ecology**. New York: John Wiley & Sons, 1974. 547p.

NYBG. New York Botanical Garden. Disponível em: <<http://sciweb.nybg.org/Science2/vii2.asp>>. (Access in: May 16, 2018).