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Simpósio

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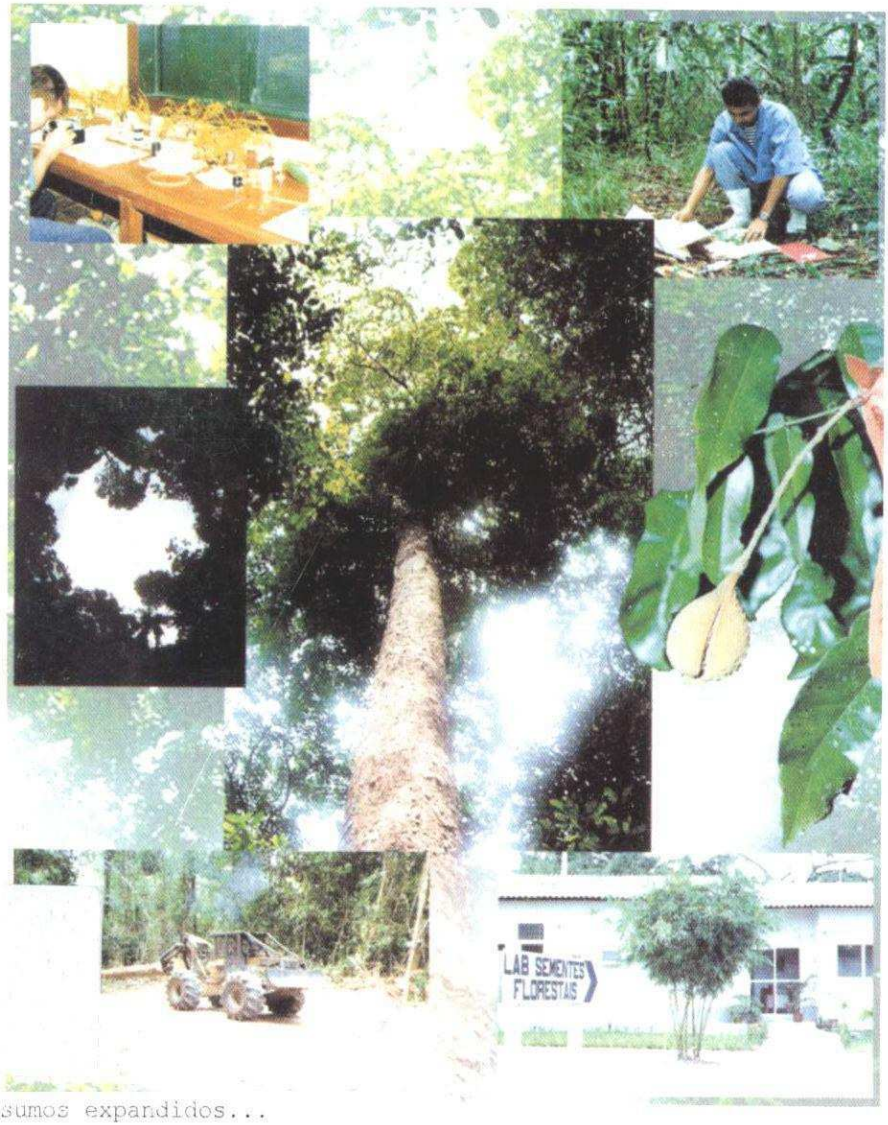

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GROWTH RATES AND DYNAMICS OF A TROPICAL SECONDARY FOREST IN AMAPÁ STATE, BRAZIL[1]

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Secondary forests, due to the large area they occupy in the Amazon region and other Brazilian ecosystems, as well due to their unique characteristics, have attracted the attention of many researchers. These researchers have emphasized their studies on comprehending the ecological process after clear-felling, the rates of recovery in species diversity and stand structure, as well their primary production and role in the environmental regulation at the local, regional and global scales. This study was carried out with the objective of analyzing the process of formation of a secondary forest, the changes in floristic composition and stand as well as the recruitment, mortality and growth rates of the trees in the forest structure during a 11-year period after clear-felling.

The area is located in Amapá State, Brazil (52°20"W and 00°55"S), where local altitude is approximately 150 m. The site is surrounded by Dense Tropical Rain Forest. The forest succession was monitored by means of continuous forest inventory. The first measurement was conducted in 1985, with remeasurements in 1986, 1988, 1990, 1994, and 1996. The species were classified in three commercial groups in accordance with their wood quality and utilization, as follows: group I: commercial species; group II: species that might become commercial in next future; group III: non-commercial species.

The mean tree density in 1985 was calculated as been 741.5 trees/ha with DBH over 5 cm. These trees belonged to 34 families, 55 genera and 76 species. The families with larger number of species were Mimosaceae, Moraceae, and Sapotaceae. In relation to the number of individuals, Moraceae was the most numerous family, mainly due to the remarkable

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presence of the pioneer Cecropia (C. obtusa, with 133 trees/ha, and C. sciadophylla, with 188 trees/ha). Regarding the commercialization groups, 13 species were classified as commercial, 28 species were potentially commercial, and 35 were considered as non-commercial species (3.44%, 92.31%, 4.25% of the number of the number of individuals, respectively). In 1985, the forest was at the beginning of the succession process, which was characterized by the predominance of pioneer species. In 1996, 2,353 individuals/ha were counted in the tree size class. These trees belonged to 41 families, 109 genera, and 174 species. During 1985 and 1996, there was an appearance of 105 new species and the disappearance of 7 species in the tree size class. The Moraceae family still continued to be that with the greatest number of individuals, especially Cecropia. In relation to the commercialization groups, there was a positive evolution in relation to 1985, with 40 species (9.38% of the individuals) classified as commercial, 66 species (18.64 %) potentially commercial, and 68 species (71.87%) as non-commercial

In 1985, the non-commercial species represented 92.31% of the total density, whereas in 1996 their participation in the stand density diminished to 71.89%. On the other hand, group I and II increased their participation, which contributed to the enrichment of the forest quality in terms of valuable woody species. In 1985, Cecropia sciadophylla and Cecropia obtusa were those species that showed the highest tree density, with 375.5 and 265.5 trees/ha, respectively, both together corresponding to 86.45% of the total tree density. In 1996, in the tree size class, the most abundant species were Cecropia sciadophylla, with 915.5 stems/ha, followed by Cecropia obtusa and Laetia procera, with 246 and 130 stems/ha, respectively. The pioneer Cecropia species corresponded, in the trees size class, to 86.40% of the total tree density in 1985 and 68.60% in 1996.

The total basal area of the forest in 1985 was 3.3 m^2/ha. Cecropia alone accounted for 2.44 m^2/ha, i.e. 73.11% of the stand basal area. During 1985 and 1996, the change in basal area was of 25.4 m^2/ha, from 3.34m^2/ha in 1985 to 28.74m^2/ha in 1996, which corresponded to 760.0% of augment of the initial basal area. This great variation in a short time (11 years) was due to the rapid growth and the great abundance of the pioneer species that found a favorable environment to their establishment and development in the beginning of the succession process. In 1996, Cecropia sciadophylla and Cecropia obtusa still continued to be the dominant species in the forest. The basal area of both summed accounted for 73,74% of the stand basal area.

In 1985 only 5 species had individuals with DBH larger than 20 cm and, therefore, participated in volume calculation. The total stem volume in 1985 was calculated to be 4.97 m^3/ha, being 96.38% of this volume belonged to the species of the non-commercial species group and the remainder 3.62% to the potentially commercial species. In 1996, the stem volume increased to 40.27 m^3/ha, which corresponded to na increase of 710% in relation to the initial volume calculated for 1985. The species that presented larger volumes were Cecropia sciadophylla, Cecropia obtusa, Inga alba, and Didymopanax morototoni, being the species of the Cecropia genus responsible for 88% volume.

The average annual periodic increment (PAI) in diameter of the trees was 0.60 cm/year, considering all individuals over 5 cm DBH. The species that composed the group II of commercialization showed the fastest diameter growth (0.63 cm/year), but for groups I and II no significant difference was noticed in terms of DBH growth. Another fact revealed by the data was the decreased in DBH growth rates with time as result of increasing plant competition. During the first period of observation (1985-1988), the average rate was 1.93 cm/year, which decreased to 0.34 cm/year within the last two years. The reduction in growth rate was more remarkable for group of commercialization III, which further indicates the progressive decline of the pioneers. The increment rate in basal area 2.33 m^2/ha.$year^{-1}$, which changed from ca.6.00m^2/ha.$year^{-1}$ in the first period to less than 1.00 m^2/ha.$year^{-1}$ in the last period of observation. This trend was similar to the individual stem diameter growth rate, i.e. this decrease reflects the canopy closure and competition for limited resources. The change in basal area growth in terms of commercialization groups was also similar to DBH growth, where group I (pioneers) showed the fastest growth rates. The average stem volume growth for 14 years was 3.53 m^3/ha.$year^{-1}$.

The mortality rate during the period 1985-1996 was calculated at 111.22 trees/ha.$year^{-1}$, which represented 5.28% of the initial number of trees (in 1985). Most of the dead stems (97.8%) belonged to group III (non-commercial species), where are included those ephemeral pioneer taxa, Cecropia and other Moraceae. The annual mortality rate varied with time, but no general trend was found. AMR was low during the first three years of succession, increased abruptly during the next two years, turned to decrease two years later, and increased considerably during the last two years. The annual recruitment rate was 263.59 trees/ha.$year^{-1}$, corresponding to 14.63%

of the initial number of trees (in 1985). Recruitment rate was greater for the group of commercialization III, which includes most of the pioneer species. Most trees were recruited immediately after the disturbance (during 1985-1988).

The findings of this study allowed to take several conclusions, which are exposed in the following paragraphs. This 14-year secondary forest showed a great variation in its floristic composition of woody species during the study period, presenting 76 species distributed in 55 genus and 34 families in 1985 and, 174 species distributed in 109 genus and 42 families, in 1996. In 1985, among the 76 species that appeared in the tree size class, 40 were the same of the surrounding primary forest, whereas in 1996 among the 174 woody species recorded, 93 occurred in the primary forest. During 14 years the forest faced a tremendous augment in terms of basal area and stem volume. It was caused by the great recruitment rates of the pioneer species during the first six years after clear-felling as well as to their very fast diameter growth rates. During 14 years, Moraceae was the dominant family in the forest, especially by the presence of pioneer species of the Cecropia genus. Cecropia and other pioneers in spite of continuing to dominate the site in the tree size class, it was noticed a progressive decline. The mortality rates were greater than recruitment rates in the trees size class within the last years, and a drastic reduction of these species in the sapling and seedling class has been observed as well. The forest became enriched in terms of wood value. It was noticed an increase in the the number of individuals of the commercial species, from 3.44% in 1985 to 9.38% in 1996. The group of potentially commercial species increase its tree density from 4.25% in 1985 to 18.64% in 1996.