EVALUATING THE SUCCESS OF FOREST RESTORATION PROJECTS: EVIDENCE OF BIRD AND NATURAL REGENERATION IN TREE PLANTATION ON ABANDONED PASTURE IN SOUTHEASTERN BRAZIL.

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INTRODUÇÃO

Abandoned cattle pasture usually presents soil degradation and compaction, decrease of seed banks, and exotic grass dominance, factors that may represent barriers for establishment of native species and natural regeneration (Guariguata *et al.*, 1995; Lee *et al.*, 2005). In contrast, tree plantations (including exotic tree) are able to establish on degraded land, reducing soil degradation and catalyzing native plant colonization, what can consequently attract seed disperses, as birds (Lee *et al.*, 2005; Schlaepfer *et al.*, 2011).This is the main reason for the use of fast - growing trees in restoration programs of degraded areas (Lamb *et al.*, 2005).

OBJETIVOS

In order to evaluate the success of a restoration program, we compared the richness and abundance of bird species in a tree plantation and in a natural forest fragment, and evaluated the natural regeneration of understory in the tree plantation, compared to the natural forest.

MATERIAL E MÉTODOS

Our study areas was located at Instituto Terra (676 ha), Aimorés, MG, Southeast Brazil. We conducted this study in a secondary Semideciduous Forest remnant (25 ha; designed NF) and two exotic tree plantations, with different ages: Acacia plantation I (25 ha; designed PL1) established in 2000 in an area with few remnants of native tall tree (*Paratecoma peroba*) and dominated by exotic grass (*Setaria vulpiseta*); and Acacia plantation II (41 ha; designed PL2) established in 2002 in an area dominated by exotic grass (*S. vulpiseta*).
In each sampling site fifty 2x2m plots were established, separated by 10m. The height and diameter at soil height (DSH) of all regenerating trees (DSH $\leq$ 5cm and height between 10cm and 2m) were measured in each plot between March and April 2009. In each plot, we also estimated the percentage covering of non - woody species (including grass and herbaceous).
Bird censuses were recorded in each sampling site using fixed 50 - m radius point - counts. According to this method, we plotted six points, each 200m apart. Points were sampled in the early morning when vocal activities of diurnal birds began. Six points were sampled each morning. Bird surveys were conducted three times from September to November 2010.
We used ANOVA test (LSD post hoc test) to compared measured natural regeneration and bird species richness between sites. G test (p¡0.05) with a correction factor was used to test for differences between bird abundances (calculated by dividing its contact number of single species by the total sampling points performed in each site) of each species recorded in more than one site.

RESULTADOS

Considering the obtained data from all sites, we observed 37 regenerated tree species and 18 non - woody species. NF and plantation shared only four species in plots sampled. 23 (41.8% all species) species were recorded only in NF, six (10.9%) species were recorded only in PL1, and 19 (34.5%) species were recorded only in PL2. Plantations shared only three species. Number of all species, number of regenerated trees, and number of native species showed lower values in tree plantations when compared to the NF (Anova test p¡0.05 in all cases), except for grass cover in the tree plantation ($F_{(2,147)}$=26.8, p¡0.05; LSD p¡0.05). Individual height and DSG of regenerated trees did not show differences between NF and PL2 (p¿0.05). Herbaceous cover (excluding grass) was similar in all sampling sites (p ¿0.05). More than 50% of individual trees showed $\leq$ 0.75m tall in NF and PL2; more than 70% of individual showed $\leq$ 1cm DSH in NF and PL2, and more than 90% of individual trees showed $\leq$ 2cm DSH in PL1. Pioneers species were more abundant in PL2 (mean value of 0.7 ±1.5), whereas initials stages of secondary succession species were more abundant in NF (1.1 ±1.9) (p¡0.05). Zoochoric species were more abundant in NF (0.7 ±1.2), and Anemochoric species were more abundant in NF (1.1 ±1.5) and PL2 (0.7 ±1.7) (p¡0.05).

We observed 55 bird species: 46 in NF, being 19 (41.3%) exclusive in this site; 26 in PL1, being 5 (19.2%) exclusive; and 30 in PL2, being 3 (10%) exclusive. Bird species richness differed significantly between sampling sites ($F_{(2,51)}$=15,6; p¡0.05). Decrease in bird species richness in tree plantation was evident (LSD p¡0.05). Of the 28 bird species shared between sites, 17 showed significant differences in abundance among sampling sites (G - test, p¡0.05 for all cases): 7 species were significantly more abundant in NF, two in PL1, three in PL2 and five in both tree plantations.

CONCLUSÃO

Our results detected differences in understory regeneration among exotic tree plantations and secondary forest: secondary forest was characterized by a richness of species, including initial stages of secondary succession and zhoochoric species. However, our results also showed that tree plantation can favor the establishment of some tree seedling (higher individuals of plants ¡ 0.75cm tall), even with grass abundance. In these planted areas, the canopy shade probably was enough to improve the micro - climate for understory establishment (Guariguata *et al.*, 1995).

Bird community in the natural forest was different when compared to the tree plantations, but our study also showed that some bird species can be beneficial in the restoration planting. Most of bird community (53%) found in tree plantations presented similar abundance or were more abundant than in the secondary forest. Tree plantations can provide habitat for a diversity of avifauna when compared to pasture land, and may indicate the importance of tree plantations for forest restoration program (Schlaepfer *et al.*, 2011).

The use of fast - growing tree species in forest restoration is a widespread practice in conservation and restoration projects (Lamb *et al.*, 2005; Viani *et al.*, 2010). Our results showed the value of tree plantations for facilitation of forest restoration in degraded pasture land (Lee *et al.*, 2005). Moreover, lower numbers of tree individuals ¡ 1 m tall in 10 years - old tree plantations can suggest that future management activities will be necessary, such as removing of grass and enrichment of shade - tolerant native trees (Lee *et al.*, 2005). Further investigations are required to evaluate if management techniques can improve success of long - time forest restoration program, once it is necessary long time to increase the structural complexity of plantation (more than 20 - 30 years - old, according Munro *et al.*, 2011) and additional bird species colonization. (Thanks to Instituto Terra for logistical support and permissions to conduct research in the RPPN Faz. Bulcão, Aimorés, MG. Research grants for the first author from FAPEMIG (CRA 00236/09) and for the third author from CNPq were received during the study period.)

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