NAT CONSERVACAO. 2014; **12(1)**:24-29

Natureza & Conservação
Brazilian Journal of Nature Conservation
Supported by O Boticário Foundation for Nature Protection

Research Letters

Comparing diversity and dispersal traits of tree communities in plantations and native forests in Southern Brazil

*André de Mendonça-Lima, Leandro da Silva Duarte, Sandra Maria Hartz**

Programa de Pós-graduação em Ecologia, Universidade Federal do Rio Grande do Sul – UFRGS, Porto Alegre, RS, Brazil

ARTICLE INFO

Article history:
Received August 2013
Accepted April 2014

Keywords:
Araucaria forest
Nestedness
Silviculture
Species richness

ABSTRACT

We investigated the richness, density, and composition of woody-tree species, and which traits of colonizing species are selected in commercial stands of *Pinus elliottii* and *Araucaria angustifolia* in southern Brazil. Analyses of variance with permutation tests were performed to assess differences among stand types in relation to density and rarefied richness. Multivariate analyses of variance with permutation tests were performed to compare stand types in relation to species composition and reproductive traits. Native forests presented higher stem density when compared to the plantations, while species richness did not vary among stand types. Species composition differed between the native forest and the plantations. Species’ reproductive traits differed between the two types of plantations. The higher frequency of zoochorous diaspores in *P. elliottii* plantations when compared to the other stand types suggests the importance of the fauna in creating and sustaining the understory structure in this type of plantation. Plantations show a high potential as colonization sites by native woody species, despite their structural differences in relation to native forests. If properly managed, plantations might be catalysts for the recovery of degraded areas.

Introduction

Human alteration of tropical-forest habitats is one of the main causes of biodiversity loss at local and regional scales. However, monocultures of exotic species can be used as catalysts for the recovery of degraded areas (Senbeta *et al.* 2002; Barbosa *et al.* 2009). Dispersal of propagules is fundamental to biodiversity restoration, and can be potentially accelerated by forestry practices on degraded land (Wunderle 1997). The disturbance associated with monocultures of exotic trees can affect the structure of the vegetation, which may benefit from the presence of species with particular dispersal traits (Decocq *et al.* 2004).

**Corresponding author at:* Departamento de Ecologia, Instituto de Biociências, Universidade Federal do Rio Grande do Sul, Av. Bento Gonçalves, 9500, Caixa Postal 15007, 91501-970, Porto Alegre, RS, Brazil.
E-mail address: sandra.hartz@ufrgs.br (S.M. Hartz).
1679-0073/$ - see front matter. © Associação Brasileira de Ciência Ecológica e Conservação. Published by Elsevier Editora Ltda.
DOI: 10.4322/natcon.2014.005

The seed dispersal syndrome (Barbosa *et al*. 2009) and the physical characteristics of the diaspore (Neri *et al*. 2005), among other traits, can favor the colonization of particular tree species in commercial plantations. The enhancement of habitat structural complexity is associated with an increase in plant diversity, which by its turn might attract different propagule dispersers. The abundance, diversity, and food preferences of frugivorous animals can affect the forest structure (Clark *et al*. 2001).

The Atlantic Forest is one of the largest humid tropical forests of the Americas. It once covered approximately 150 million hectares of highly heterogeneous environments (Ribeiro *et al*. 2009). The Mixed Ombrophilous Forest (MOF) is situated in the southern part of the Atlantic Forest, and is characterized by the presence of the Paraná pine (*Araucaria angustifolia*). Over the last centuries, this forest has been largely devastated, and presently occupies approximately 12% of its original extent (Ribeiro *et al*. 2009). *Pinus elliottii* has replaced *A. angustifolia* in the timber industry by the 1950s and since then the landscape has been changed by the insertion of the exotic tree plantations. Thus, it is important to evaluate the dispersal traits of tree species colonizing plantations for successful management and restoration practices.

In the present study, our aim was to evaluate the colonization of different kinds of plantation stands by tree species in relation to diversity patterns and plant dispersal traits. We examined three hypotheses: 1. commercial plantation stands with exotic trees show lower species richness and density of native trees than stands with native tree plantations and native forests; 2. tree species occurring in the plantations represent a subset of the species present in the native forests; and 3. native forests present more variable dispersal traits than plantation stands.

Material and methods

Study area

The study was conducted in stands of commercial plantations of *P. elliottii* and *A. angustifolia*, both with presence of understory, as well as in areas of native forests in a commercial tree farm located in the municipality of Campo Belo do Sul (27°59' S and 50°53' W), southern Brazil (1,000 m asl). The area has 17,000 ha; half of it is used for *Pinus* plantations and only 500 ha are used for the *Araucaria* plantations. The climate is typical of the southern Brazilian highlands, with cool summers, no dry season, and frequent severe frosts (Köppen Cfb classification). The mean annual temperature is 16° C.

The characteristic feature of the region is the *Araucaria* forests, which occur mainly between 400 and 1,000 m asl along watercourses, valleys, hillsides, and grasslands on the plateau (IBGE 1992). The presence of *A. angustifolia* determines the vegetation physiognomy; these trees occur in continuous forest habitats, as well as in patches embedded in the plateau grasslands. The forest on the hillsides and valleys of the study area can be considered a disturbed forest, but with a high level of biotic integrity, since it was only selectively logged a few decades ago. At the time of the study, the *Pinus elliottii* plantation was 27 years old and the *A. angustifolia* plantation areas were *circa* 30 years old. Both plantations were surrounded by native forests. Thus, any species colonizing the plantations were likely dispersed from a neighbor native forest.

Sampling design

Four areas were located within each of three different vegetation types: native forest (NF), *P. elliottii* plantations (PP), and *A. angustifolia* plantations (AP). The mean distance between the areas was 8 km, and between each area in the vegetation type, 2 km. In each sampling site, six transects (at least 100 m from the edge) were delimited 100 m distant from each other. Perpendicular 50 m-long lines were established from each of the six marked transects. Within each line, five secondary points (10 m from each other) were marked. In each secondary point, a point-centered quarter (Cottam & Curtis 1956) was established, and the closest individual tree with a diameter at breast height (DBH) ≥ 47 mm was sampled in each of the four quadrants, totaling 150 points for each vegetation type. Subsequently, the individuals were identified to species level and the density of these was calculated. Field data was obtained from January to April of 2009. In the plantations, individuals that were conspecific with the planted trees were disregarded in the analysis. This precaution was needed because our main goal was to analyze the arrival of propagules from outside the stands.

Plants were characterized by traits related to dispersal and attractiveness for animals: dispersal syndrome (zoochorous or not), color (brown, red, yellow, black, orange, purple, green, or white), type (legume, drupe, pine, capsule, cypsela, berry, achene, samara, craspedium, syncarp, follicle), and size of diaspore, based on the literature and field data (Table S1, supplementary material online). We then computed the frequency of occurrence (for categorical variables) or the community weighted mean (for diaspore size) of each trait in each area, which rendered a multivariate trait matrix describing each area by frequency/mean values of traits (Pillar *et al*. 2009).

Statistical analyses

Richness values computed in each sampling site were rarefied to remove the effect of sample size according to the individuals that were disregarded (Gotelli & Colwell 2001) using the software PAST (Hammer *et al*. 2001). Next, the rarefied richness values computed for the different stand types were compared by analyses of variance (ANOVA) with permutation tests (Pillar & Orlóci 1996) The test criterion was the sum of square Euclidian distances between groups of sampling units. The same test was used to check for differences in the density of native plants and frequency of zoochorous diaspores between the plantations and the native forest.

We tested whether local assemblages in plantations were a subgroup of species present in native forest with the nestedness metric based on Overlap and Decreasing Fill – NODF (Almeida-Neto *et al*. 2008). The values range from 0 to 100, where the maximum value represents a perfectly nested assemblage. For this, a matrix of presence/absence of species for each area was generated, and from this matrix the nesting index was calculated. These values were tested by *t*-test against values created by null models, generated from