



## Original article

# Changes in plant community of Seasonally Semideciduous Forest after invasion by *Schizolobium parahyba* at southeastern Brazil



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## ABSTRACT

The recognition of a species as invasive is generally accepted when it comes from another continent or even from another country, but requires strong evidences of negative impacts to support control actions when the invasive species comes from another region in the same country. *Schizolobium parahyba* – the ‘guapuruvu’, is a Brazilian tree native from the evergreen type of the Atlantic Forest, which has been recorded as invader in a number of remnants of the Seasonally Semideciduous Forest – SSF. We hypothesized that this giant and fast growing invasive tree changes the structure and composition of the understorey, thus impairing the forest dynamics. We assessed the invasive population in the whole fragment, and, within the portion invaded, we sampled the regenerating plant community 1) under the largest alien trees, 2) under a native species with similar ecology (*Peltophorum dubium*), and 3) randomly in the forest. Density, basal area and richness under *S. parahyba* were remarkably lower than under the equivalent native species or in the understorey as a whole. Floristic composition of the plant community was also distinct under *S. parahyba*, possibly due to increased competition for soil water. Even though the alien species has occupied, as yet, a small proportion of the forest fragment, it dominates the overstorey and threatens the regeneration processes under its canopy. In view of our findings, we recommend extirpation of the species from SSF, as well as avoiding cultivation of the species away from its native range.

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## 1. Introduction

A clear distinction between natural range expansion and invasion is not easy (Vermeij, 2005; Valéry et al., 2008). Nevertheless, new arrivals to a community are managed typically depending on whether is an extra range natural dispersal or a human-mediated range expansion (Wilson et al., 2009). An invasive species has been defined as an alien species that sustains self-replacing populations over several life cycles, forms reproductive offspring in very large numbers at considerable distances from the parent and/or site of introduction, and has the potential to spread over

long distances (Richardson et al., 2011). The recognition of a species as invasive is generally accepted when it comes from another continent or even from another country and leads to ecological changes or economic losses (Pimentel et al., 2005). Although invasive species recorded outside their natural range within the same country can cause severe impacts on natural ecosystems, control of these species may still encounter resistance from the public and policy makers (Simberloff, 2003a). Resistance to control these invaders is greater when the species is noted for some human value (e.g. large size, fast growth, beauty). Such is the case for the guapuruvu – *Schizolobium parahyba* (Fabaceae: Caesalpinioideae) in the Brazilian Atlantic Forest.

The Atlantic Forest in the state of São Paulo has two main subdivisions, related to the climate conditions (Oliveira-Filho and Fontes, 2000): the Evergreen Forest – along the coast, where the climate is always wet (average annual precipitation about 2500 mm yr<sup>-1</sup>, Sentelhas et al., 2003), and the Seasonally Semideciduous Forest (hereafter SSF) – located farther inland and

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<sup>3</sup> <http://lattes.cnpq.br/6907261164017372>.

characterized by a dry winter average annual precipitation about 1500 mm yr<sup>-1</sup> (Sentelhas et al., 2003). Historically, guapuruvu is restricted to the evergreen type (Andrade and Vecchi, 1916; Bentham, 1876; Correa, 1926), where it was reported by Correa (1926) as “the tallest tree in the Atlantic coastal forest” (Correa, 1926). Recent evidence of the guapuruvu as invader at SSF was obtained from 232 records of herbarium specimens from the Species Link data base (<http://www.splink.org.br/>, accessed 08/12/2012). *S. parahyba* has been recorded in the Atlantic Forest region since the nineteenth century. All exsiccates and records of guapuruvu at SSF before 1985 corresponded to cultivated specimens. However, 23 exsiccates were collected from fragments of SSF after 1985, and several new occurrences were mentioned in the literature (Matthes et al., 1988; Nicolini, 1990; Souza et al., 2009; Nogueira, 2010).

The recent range expansion of guapuruvu into the SSF likely occurred as a result of human-mediated invasion. Guapuruvu is a fast growing tree (Backes and Irgang, 2002; Lorenzi, 2002), recommended and widely cultivated as ornamental or for restoration purposes, being included in almost 50% of forest restoration projects away from its native range, in the western São Paulo state (Barbosa et al., 2003). From the trees planted as ornamentals or for forest restoration, the species has easily invaded patches of SSF, and the consequences of this process have not yet been evaluated. The functional performance of *S. parahyba* in restoration plantings and possible unintended negative consequences on the restored communities were never assessed.

In spite of the evidence of recent invasion of the SSF by the guapuruvu, it has not been recognized as invasive species and a threat to the biodiversity. The potential for a catastrophic loss in biodiversity is great. The Atlantic Forest as a whole supports one of the highest degrees of species richness and rates of endemism on the planet and is among the most threatened biomes in the world (Ribeiro et al., 2009); it has been elected as one of the global biodiversity hotspots for conservation (Myers, N., et al., 2000). Of the various sub-types of the Atlantic Forest, the SSF is one of the most threatened by habitat fragmentation, since it has the most suitable soils and relief for agriculture and was the first to be deforested by the European settlers. While 11.8% of the Atlantic Forest (*sensu lato*) remains, the remaining proportion of SSF is only 7.1%, scattered among thousands of small and isolated fragments (Ribeiro et al., 2009) and susceptible to a wide range of edge effects, including biological invasions. Given the potential consequences of unchecked expansion of guapuruvu on SSF, it is crucial that we monitor effects on the plant community at early stages of its invasion.

We assessed the recent spread of the giant trees of *Schizolobium parahyba* into a SSF fragment and its impact on the invaded ecosystem by assessing the plant community regenerating under the largest alien trees, under an ecologically similar species (*Peltophorum dubium*), and at random locations in the invaded portion of the forest. We hypothesized that the fast growing invader, adapted to the evergreen rain forest, can change the native community of the semideciduous forest in its composition and structure, constraining the forest dynamics and threatening the native species populations.

## 2. Material and methods

### 2.1. Study species – the alien *Schizolobium parahyba* and the native *Peltophorum dubium*

From the species of the SSF, we choose *P. dubium* (Spreng.) Taub. (another species from the family Leguminosae – Caesalpinioideae), as the “native equivalent” to *S. parahyba*. *S. parahyba* and *P. dubium* are functionally very similar species (Carvalho, 2003). Both are fast

growing trees, classified as pioneers or early secondary, with yellow flowers pollinated by bees. Their seeds are dispersed by wind or gravity, and persist in the soil seed bank for years, since they have tegumentary dormancy. Both are emergent trees, surpassing 20 m in height, and 100 cm in d.b.h., with broadly umbelliform crowns. Reproductive processes start at 6–8 years for *S. parahyba* and 7–12 years for *P. dubium*, but young individuals are very rare in the understorey, since both species are heliophylous. In spite of being legumes, neither is N-fixing.

The main differences between *S. parahyba* and *P. dubium* are their native range within the Atlantic Forest (the evergreen forest and the SSF, respectively), as well as their growth rhythm (up to 45 and 19.6 m<sup>3</sup> ha<sup>-1</sup> yr<sup>-1</sup>, respectively), wood density (0.22–0.40 and 0.75–0.90 g cm<sup>-3</sup>, respectively), and longevity. While *S. parahyba* very rarely lives over 40 years (but can reach 70 years; Callado and Guimarães, 2010), *P. dubium* can often surpass a hundred years. *P. dubium* is reported as deciduous and *S. parahyba* as semi-deciduous in their respective native ranges (Carvalho, 2003). In the SSF, however, the guapuruvus behave as deciduous, losing all their leaves in the dry season – an indication of soil water deficiency – and recovering them after the first rains in the spring. Another relevant distinction is that *P. dubium* is resistant to wind while *S. parahyba* easily breaks with the wind and opens gaps.

### 2.2. Study area

The study site is a SSF fragment of 73 ha, located at 22°47'20" S and 50°47'20" W with altitudes ranging from 426 to 455 m (a.s.l.) – at Tarumã municipality, southwestern São Paulo State, Brazil, about 500 km west from the native range of guapuruvu (Fig. 1). Local climate is tropical, with average annual rainfall around 1400 mm and a dry season in the winter, which can last up to five months (Brando and Durigan, 2004). High fertility and clayish texture characterize the local soil, classified as Eutrudox. Soil and topography are both homogeneous, and there is no record of recent disturbances such as fires or tree cutting in any portion of the forest. The forest fragment is far from water bodies, and isolated from other forest remnants at least during the last 50 years. It has been surrounded by sugar cane plantations, with high proliferation of lianas along the edges and in natural gaps. Well-preserved remnants of the same forest type – the SSF have been studied in the region, where basal area reaches 30 m<sup>2</sup> ha<sup>-1</sup> (Durigan et al., 2000). The spread of the invasive trees over the native forest at the study site started from a stand of *S. parahyba* planted in 1965 for ornamental purposes, in a 30 × 140 m area (6 m × 6 m spaced), between the edge of the native forest and the main entrance of the farmhouse.

### 2.3. Extent of invasion and population structure

We assessed the alien population of *S. parahyba* by a census of all individuals from 1 m in height, established within the native forest and also under the planted stand. We searched for individuals of *S. parahyba* through the whole fragment, at first from the edges, since the emergent trees are easily visible, and later by transects from the planted stand towards the core area of the fragment. In the area where the adult trees were recorded and at least 50 m around them, the whole terrain was explored in search for young individuals. Each individual was labelled, mapped (coordinates taken with a GPS) and measured (d.b.h. – diameter at breast height – and canopy diameter, as its projection on the ground).

### 2.4. Invasion impacts

To evaluate the impact of the alien species on the native forest, we compared the structure and composition of the native plant

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