Original Article

INVASION IMPACT OF *Artocarpus heterophyllus* LAM. (Moraceae) AT THE EDGE OF AN ATLANTIC FOREST FRAGMENT IN THE MUNICIPALITY OF RIO DE JANEIRO, BRAZIL

IMPACTO DA INVASÃO DE Artocarpus heterophyllus *LAM. (Moraceae) NA BORDA DE UM FRAGMENTO DE MATA ATLÂNTICA NA CIDADE DO RIO DE JANEIRO, BRASIL*

Welington Kiffer de FREITAS[1]; Luís Mauro Sampaio MAGALHÃES[2]; Alexander Silva de Resende[3]; Felipe da Costa BRASIL[1]; Lise da Rocha VIVÈS[1]; Marco Aurélio Soares PINHEIRO[2]; Pedro Lima FILHO[2]; Rômulo Vinicius LUZ[1]

1. Universidade Federal Fluminense, Volta Redonda, RJ, Brasil. wkfreitas@gmail.com; 2. Universidade Federal Rural do Rio de Janeiro, Seropédica, RJ, Brasil; 3. Empresa Brasileira de Pesquisa Agropecuária, Seropédica, RJ, Brasil.

ABSTRACT: The Atlantic Forest is reduced to less than 20 % of its original area, but it still protects an important biological heritage. Forest fragmentation makes the environment more susceptible to invasive species occupation. Jackfruit (*Artocarpus heterophyllus*) was introduced into Brazil in the seventeenth century; and in the second half of the twentieth century, its natural regeneration increased the density of individuals, compromising the recruitment of many native species. This study investigated the impact of *A. heterophyllus* invasion on the diversity and tree structure component at the edge of an Atlantic Forest fragment, in Rio de Janeiro (Brazil). Two transect-type plots were set up with 10 m x 100 m (1,000 m^2), being divided into 10 subplots of 10 m x 10 m, with a total sampling area of 2,000 m^2. Trees with a diameter at breast height (DBH) equals to or greater than 5 cm were tagged and DBH and total height measured. The following phytosociological parameters were estimated: Frequency (F), Density (D), Dominance (Do), Importance (IV) and Coverage (CV) Values. In total, 191 tree individuals were sampled. Invasive species made up more than 35% of the entire vegetation structure in the studied environment, ending in first place in terms of Importance Value (IV = 35.62%). Low floristic wealth seems to have favored the *A. heterophyllus* invasion process in the community, showing the need for an effective control of the species for the native genetic heritage protection.

KEYWORDS: Jackfruit. Phytosociology. Horizontal structure. Dominance.

INTRODUCTION

The Atlantic Forest encompasses 17 Brazilian states, with an original area of about 1,300,000 square kilometers, extending from the state of Rio Grande do Norte to the state of Rio Grande do Sul, also covering part of Argentina and Paraguay territories (LIMA; CAPOBIANCO, 1997; MAGALHÃES; FREITAS, 2013). It is currently estimated that nearly 11 to 16% of its original cover is maintained (RIBEIRO et al., 2009).

Nowadays, the diversity of the Atlantic Forest is under serious threat due to an intense human occupation, to which this biome has gone through. The state of Rio de Janeiro still keeps near 18.6% of its original forest covers, which are mainly located within Conservation Units and in areas difficult to access (SANTANA et al., 2015).

In 2000, the Atlantic Forest was considered as the second most threatened biome worldwide, and one among the 35 global ‘hotspots’ of biodiversity by the nonprofit environmental organization Conservation International, since it owns a high biodiversity with high rates of endemism in great threat (MYERS et al., 2005; WILLIANS et al., 2011). More than 15,000 plant species occur within its domain, of which about 7,000 have some degree of endemism (STEHMANN et al., 2009).

The fragility of this biome provides the occurrence of a threatening phenomenon to its biodiversity, which is the biological invasion. According to Ziller and Galvão (2002), the biological invasion is an introduction process and, consequently, an adaptation of species that are not naturally found in a certain ecosystem but naturalize themselves, and begin to cause changes in the local ecological processes.

Lake and Leishman (2003) emphasized features that are likely associated with an invasive behavior of plants, such as leaf surface area, texture and hairiness, seed mass, growth form, dispersion mode, vegetative propagation capacity, flowering time, and canopy height.

Each species ecological importance within a community is associated with its ability to promote interspecific interactions (HURLBERT, 1971). Indeed, biological contamination occurs because

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invasive species show a minimum of interactions since they have no relationship with the organisms living in the new environment.

As stated by Pysek (1995), an invasive species is an exotic whose distribution and/or abundance are in an increasing process. According to Parker et al. (1999), biological invasions can cause impacts at different levels, including effects on individuals (e.g. mortality rates and growth), genetics (e.g. hybridization), population dynamic (abundance, population growth, and extinction), community (species richness, diversity, and trophic structure), and ecosystem processes (nutrient availability, productivity, and disturbance regime). As reported by Kanashiro (2003), species known as 'invasive', are nowadays regarded as the world's second-largest threat to biodiversity.

One of the species that has shown an invasive behavior in the Atlantic Forest is *Artocarpus heterophyllus* Lam., commonly known as jackfruit or jack tree (FABRICANTE et al., 2012). This species was introduced into Brazil by the Portuguese Royalty, in the seventeenth century, due to a mercantilist policy aiming to acclimatize plants and spices from Asia (PEREIRA; KAPLAN, 2013). The jack tree has become part of a list of alien species widely used in landscaping projects by Auguste Glaziou, who was hired by D. Pedro II, in the mid-nineteenth century, to serve as director of the Rio de Janeiro's division of parks and gardens, in Boa Vista and Campo de Santana (SANTOS et al., 2008). Furthermore, at that time, the species joined the list of trees used to recover part of the massif of Tijuca (RJ), exhausted by coffee and sugarcane monoculture (DEAN, 1996). This species has easily adapted to Brazil by several factors, such as a high annual production of fruit and absence of specific predators, besides serving as a food source for several species of native animals (PEREIRA; KAPLAN, 2013). In the early twentieth century, jack trees were used in gardens, farms, country houses, and orchards of this city, wherein its fruit is commonly found in small shops (grocery stores), local markets, street vendors and in free markets (MAGALHÃES et al., 2015).

Apparently, the presence of this species in Brazil has not been a problem until the second half of the twentieth century. However, in the 1970's to 80's of the last century, some protected areas in Rio de Janeiro city, like Tijuca National Park, showed a fast natural regeneration of jack trees, expanding increasingly and hindering the richness of native species. Thenceforth jack trees began to show a typical behavior of invasive alien species (BYERS et al., 2002; ABREU; RODRIGUES, 2010; BERGALLO et al., 2016). This occupation weakens the efforts taken by the society to protect forest remnants of an ecosystem with great ecological value as fragments of the Atlantic Forest.

This study aimed to analyze aspects of the structure and diversity at the edge of a fragment invaded by *A. heterophyllus*, in the Mendanha Municipal Natural Park (MMNP), on the westside of Rio de Janeiro - RJ, Brazil.

MATERIAL AND METHODS

Study area

This study was conducted at the edge of a forest fragment invaded by *A. heterophyllus* (1 hectare). It is located in the Mendanha Municipal Natural Park (MMNP), in Bangu - westside of Rio de Janeiro (RJ), Brazil (22º 55 S and 43° 30 W), with an area of 1,323,47 ha (TOMIAZZI et al., 2006) (Figure 1).

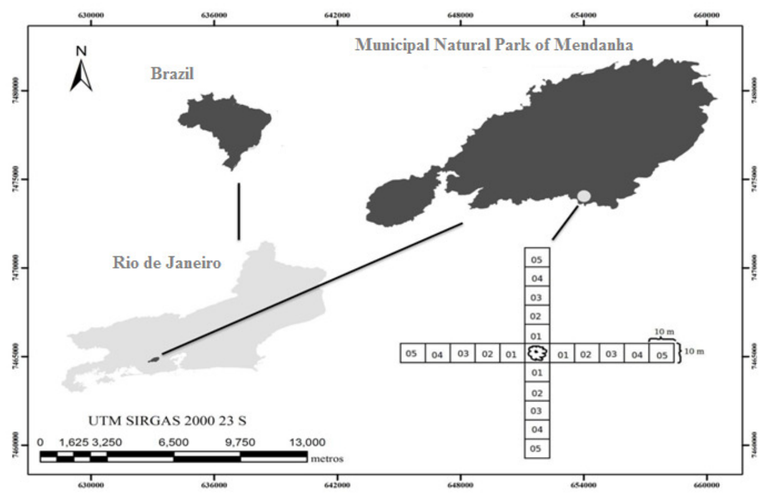

Figure 1. Location of the MMNP, Rio de Janeiro, Brazil. *Source: Landscapes Management Laboratory – DCA/IF/UFRRJ*

Methodology

In this study, the sampling was made in tracks (IBGE, 1992), using transect-type plots of 10 m x 100 m (1,000 m^2). Across the entire study area, two transects were set up perpendicularly, one in the North-South direction and the other in the East-West direction. Each one was divided into 10 subplots of 10 m x 10 m (Fig. 1).

Within the subplots (10 m x 10 m), all tree individuals with circumference at breast height (CBH), or at 1.30 m above the soil, ≥ 15.7 cm (or DBH ≥ 5 cm), including standing dead trees, were tagged with numbered aluminum tags (3 cm x 3 cm), in intaglio printing, with the aid of metal numbers.

Biometric data (total height and CBH) were obtained and registered in field records. In the case of forked trees, all stems emerging from the soil were individually measured, as well as the stem forked below the DBH, considering only those stems that met the inclusion criteria above.

For each individual tree immediately unidentified, morphological characteristics were noted, such as the rhytidome color, exudates (latex, sap, resin, and gum), odor, or other traits able to assist in identification, such as popular name.

Between March and July 2012, representative samples of morphospecies were collected for identification and deposited in an herbarium. Sampling was carried out using long-reach branch pruners.

The specimens were placed between layers of newspapers and pressed in an herbarium press, remaining preserved in alcohol during field stay. At the laboratory, all the collected botanical material was dried in an oven for further identification through comparisons of their morphological characters to those of exsiccates available in the Herbarium of the Federal Rural University of Rio de Janeiro (UFRRJ), by means of bibliographic consultation and expert support.

In addition, species and individuals found within the examined fragment were classified according to successional stages (pioneer, early secondary, late secondary, and climax) (BUDOWSKI, 1965), besides unclassified ones.

Validation of species names and standardization of botanical synonyms were ascertained by consulting the website *Flora Brasil* (2015). Taxa were classified according to the Angiosperm Phylogeny Group (APG III, 2009), except for Fabaceae family which was based on Cronquist (1981), considering the subfamilies Caesalpinioideae, Faboideae, and Mimosoideae.

Spatial distribution of *A. heterophyllus* trees was established by the use of McGinnies' index (IGA) (MC GINNIES, 1934). In this study, the following phytosociological parameters were considered: Frequency (F), Density (D), Dominance (Do), Coverage and Importance Values (CV and IV) (MULLER-DOMBOIS; ELLENBERG, 1974). All calculations were processed through Mata Nativa 3 software (CIENTEC, 2006).

RESULTS

At the edge of the examined forest fragment, 191 tree individuals were found, belonging to 20 families, 27 genera, and 28 species, also disregarding the unidentified and dead individuals (Tables 1 and 2).

Nearly 15% of the individuals were described only as morphospecies, families, or genera, given the lack of plant sources for identification during fieldworks, such as reproductive material (flowers and fruits), which is the basis for determining taxonomy.

Of the 191 sampled individuals, 114 belonged to only three botanical families. Jointly, Moraceae (67), Meliaceae (30), and Fabaceae (17) accounted for almost 60% of the total individuals. The other 77 individuals were distributed among the other families (Table 1).

Families that stood out in number of species were Fabaceae and Myrtaceae, with three species each, followed by Bignoniaceae, Caricaceae, Melastomataceae and Meliaceae, each featuring two species.

With great expressiveness in the studied environment, *A. heterophyllus* stood out by reaching a McGinnies' index (IGA) of 2.08, showing a trend to clustering. The basal area was 25.97m^2 x ha^{-1}.

The community showed greater participation, both for individuals (39%) and species (39%), of organisms belonging to the ecological group of early secondary (Figure 2).

Table 1. Floristic list of tree species from the edge of an Atlantic Forest fragment located in the MMNP, Rio de Janeiro city (RJ), Brazil. Wherein: PI = pioneer species; ES = early secondary species; LS = late secondary species; UN = unclassified species; N = native from Brazilian flora; EX = exotic species; EN = endemic to the Atlantic Forest; NE = non-endemic to the Atlantic Forest

Family	**Scientific Name**	**Ecological Group**	**Origin / Endemism**
ANACARDIACEAE	*Astronium graveolens* Jacq.	ES	N/NE
ANNONACEAE	*Guatteria candolleana* Schltdl.	ES	N/EN
APOCYNACEAE	*Tabernaemontana laeta* Mart.	LS	N/NE
BIGNONIACEAE	*Jacaranda macrantha* Cham.	ES	N/NE
	Sparattosperma leucanthum (Vell.) K. Schum.	P	N/NE
CANNABACEAE	*Trema micrantha* (L. Blumen)	P	N/NE
CARICACEAE	*Carica papaya* L.	P	EX
	Jacaratia spinosa (Aubl.) A. DC.	P	N/NE
CELASTRACEAE	*Maytenus obtusif*olia Mart.	LS	N/NE
ERYTHROXYLACEAE	*Erythroxylum pulchrum* A. St.-Hil.	ES	N/EN
FABACEAE	*Apuleia leiocarpa* (Vogel) J.F. Macbr.	LS	N/NE
	Piptadenia gonoacantha (Mart.) J.F. Macbr.	P	N/NE
	Pseudopiptadenia sp.	ES	N/EN
LAURACEAE	*Nectandra membranacea* (Sw.) Griseb.	ES	N/NE
	Ocotea sp.	LS	N
MELASTOMATACEAE	*Miconia cinnamomifolia* (DC.) Naudin	P	N/EN
	Miconia sp.	P	N
MELIACEAE	*Cabralea canjerana* (Vell.) Mart.	ES	N/NE
	Guarea guidonia (L.) Sleumer	ES	N/NE
MORACEAE	*Artocarpus heterophyllus* Lam.	UN	EX
MYRTACEAE	*Eugenia* sp.	LS	N
	Marlierea glazioviana Kiaersk. (O.Berg) Loefgr. & Everett	LS	N/EN
	Myrtaceae 2	UN	UN
NYCTAGINACEAE	*Guapira opposita* (Vell.) Reitz	ES	N/NE
PHYTOLACCACEAE	*Gallesia integrifolia* (Spreng.) Harms	ES	N/NE
RUBIACEAE	*Psychotria leiocarpa* Cham. & Schltdl.	ES	N/NE
SALICACEAE	*Casearia sylvestris* Sw.	P	N/NE
SAPINDACEAE	*Cupania vernalis* Cambess	P	N/NE
URTICACEAE	*Cecropia* sp.	P	N/NE
UNDETERMINED	-	UN	UN

Table 2. Phytosociological parameters in descending order of Importance Value (IV) for the species found at the edge of a forest fragment in the MMNP, Rio de Janeiro (RJ), Brazil.

Scientific Name	N	BA	AD	RD	AF	RF	ADo	RDo	CV	CV (%)	IV	IV (%)
Artocarpus heterophyllus Lam.	67	5.194	335	35.08	80	14.29	25.969	57.49	92.57	46.28	106.855	35.62
Guarea guidonia (L.) Sleumer	27	1.278	135	14.14	60	10.71	6.39	14.15	28.283	14.14	38.997	13
Psychotria leiocarpa Cham. & Schltdl.	11	0.149	55	5.76	55	9.82	0.744	1.65	7.405	3.7	17.227	5.74
Pseudopiptadenia sp.	8	0.223	40	4.19	35	6.25	1.113	2.46	6.652	3.33	12.902	4.3
Piptadenia gonoacantha (Mart.) J.F. Macbr.	6	0.444	30	3.14	25	4.46	2.22	4.91	8.056	4.03	12.52	4.17
Gallesia integrifolia (Spreng.) Harms	4	0.374	20	2.09	20	3.57	1.868	4.13	6.229	3.11	9.8	3.27
Guatteria candolleana Schltdl.	6	0.076	30	3.14	20	3.57	0.378	0.84	3.979	1.99	7.55	2.52
Dead	**4**	**0.165**	**20**	**2.09**	**20**	**3.57**	**0.825**	**1.83**	**3.921**	**1.96**	**7.493**	**2.5**
Erythroxylum pulchrum A.St.-Hil.	5	0.117	25	2.62	20	3.57	0.584	1.29	3.911	1.96	7.482	2.49
Ocotea sp. 2	7	0.044	35	3.66	15	2.68	0.218	0.48	4.147	2.07	6.826	2.28
Guapira opposita (Vell.) Reitz	4	0.182	20	2.09	15	2.68	0.909	2.01	4.106	2.05	6.784	2.26
Tabernaemontana laeta Mart.	4	0.126	20	2.09	15	2.68	0.632	1.4	3.493	1.75	6.171	2.06
Apuleia leiocarpa (Vogel) J.F. Macbr.	3	0.142	15	1.57	15	2.68	0.712	1.58	3.147	1.57	5.826	1.94
Miconia cinnamomifolia (DC.) Naudin	2	0.219	10	1.05	10	1.79	1.096	2.43	3.475	1.74	5.26	1.75
Cabralea canjerana (Vell.) Mart.	3	0.084	15	1.57	15	2.68	0.42	0.93	2.501	1.25	5.179	1.73
Trema micrantha (L.) Blume	4	0.011	20	2.09	15	2.68	0.054	0.12	2.213	1.11	4.891	1.63
Astronium graveolens Jacq.	3	0.014	15	1.57	15	2.68	0.072	0.16	1.731	0.87	4.409	1.47
Marlierea glazioviana Kiaersk.	3	0.009	15	1.57	15	2.68	0.044	0.1	1.669	0.83	4.348	1.45
Sparattosperma leucanthum (Vell.) K. Schum.	2	0.056	10	1.05	10	1.79	0.282	0.62	1.672	0.84	3.458	1.15
Jacaranda macrantha Cham.	2	0.022	10	1.05	10	1.79	0.112	0.25	1.296	0.65	3.081	1.03
Cupania vernalis Cambess.	2	0.02	10	1.05	10	1.79	0.1	0.22	1.269	0.63	3.055	1.02
Eugenia sp.	2	0.008	10	1.05	10	1.79	0.041	0.09	1.139	0.57	2.924	0.97
Undetermined 1	2	0.015	10	1.05	5	0.89	0.073	0.16	1.209	0.6	2.102	0.7
Undetermined 2	1	0.034	5	0.52	5	0.89	0.171	0.38	0.901	0.45	1.794	0.6
Miconia sp.	1	0.006	5	0.52	5	0.89	0.032	0.07	0.595	0.3	1.488	0.5
Nectandra membranaceae (Sw.) Griseb.	1	0.004	5	0.52	5	0.89	0.02	0.04	0.568	0.28	1.461	0.49
Casearia sylvestris Sw.	1	0.004	5	0.52	5	0.89	0.018	0.04	0.564	0.28	1.457	0.49
Undetermined 3	1	0.004	5	0.52	5	0.89	0.018	0.04	0.562	0.28	1.455	0.49
Maytenus obtusifolia Mart.	1	0.003	5	0.52	5	0.89	0.014	0.03	0.555	0.28	1.448	0.48
Cecropia sp.	1	0.002	5	0.52	5	0.89	0.01	0.02	0.546	0.27	1.439	0.48
Jacaratia spinosa (Aubl.) A. DC.	1	0.002	5	0.52	5	0.89	0.01	0.02	0.546	0.27	1.439	0.48
Myrtaceae 2	1	0.002	5	0.52	5	0.89	0.01	0.02	0.546	0.27	1.439	0.48
Carica papaya L.	1	0.002	5	0.52	5	0.89	0.01	0.02	0.545	0.27	1.438	0.48
Total	**191**	**9.034**	**955**	**100**	**560**	**100**	**45.17**	**100**	**200**	**100**	**300**	**100**

Wherein: N – the number of individuals; BA - Basal Area (ind. x ha^{-1}); RD - Relative Density; RF - Relative Frequency; RDo - Relative Dominance; CV (%) – Coverage Percentage Value; IV (%) – Importance Percentage Value.

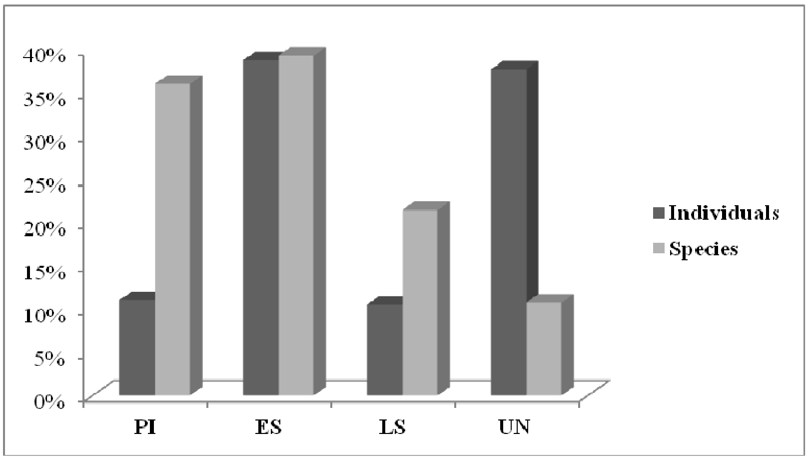

Figure 2. Frequency distribution of ecological groups of individuals and species found in the edge of a forest fragment in the MNPM, RJ, Brazil. Where: P = pioneer species; ES = early secondary species; LS = late secondary species; UN = unclassified species.

Table 2 shows that *A. heterophyllus* excelled all other species within the community, totaling 35.62% of total IV, followed by *Guarea guidonea* (IV = 13%).

Diameter distribution, illustrated in Figure 3, showed a typical pattern for uneven-aged tropical forest stands, in inverted-J-shape, indicating that tree recruitment rates tend to offset mortality over time (DURIGAN, 2009). As regards the distribution of diameter of native species (Figure 3), perhaps the competition with *A. heterophyllus* provided an imbalance, mainly for larger trees (40.0 to 44.9 cm). However, such inverted-J-shape behavior (Figure 3) suggested a great self-regeneration capacity and maintenance of density levels of *A. heterophyllus* population.

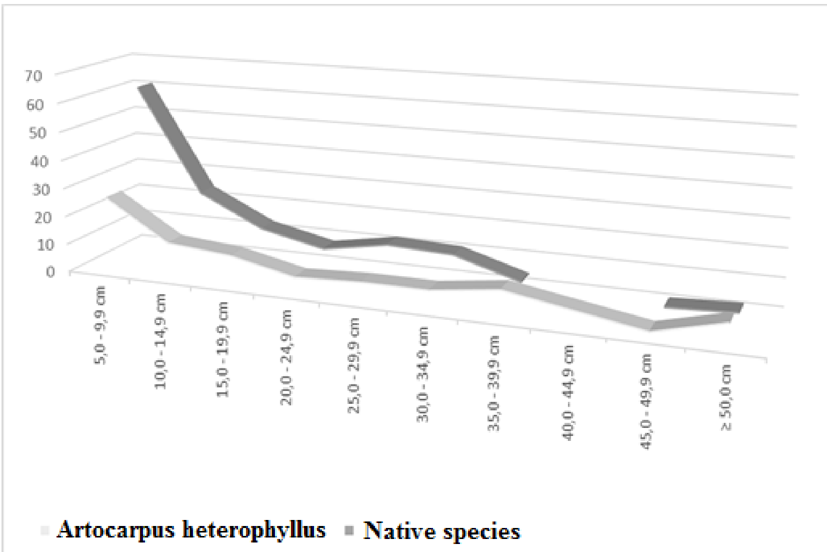

Figure 3. Frequency distribution of diameter classes of the sampled tree individuals at the edge of a forest fragment in the MMNP, Rio de Janeiro (RJ), Brazil.

DISCUSSION

This study recorded a few individuals identified only by morpho-species, families, or genera, given the lack of plant reproductive parts during fieldworks (flowers and fruits), which serve as the basis for determining taxonomy.

In the Atlantic Forest, Fabaceae and Myrtaceae families are considered the most representative in species richness (OLIVEIRA-FILHO; FONTES, 2000), as proven by this study. Nevertheless, when analyzing the number of individuals per family, Moraceae family stood out because of its high number of *A. heterophyllus* individuals.

The species *A. heterophyllus* is characterized as an introduced plant species performing aggressively as a biological invader since it had already been pointed out in different studies carried out in the Brazilian Atlantic Forest (ABREU; RODRIGUES, 2010; FABRICANTE et al., 2012; CRUZ et al., 2013; MAGALHÃES et al., 2015; BERGALLO et al., 2016).

According to Cruz et al. (2013), *A. heterophyllus* may have three to four reproductive events each year, with a single individual responsible for about 100 fruits in each reproductive phase, with seeds showing high germination rates, especially in edge environments (ABREU; RODRIGUES, 2010). These authors also highlighted the low palatability of its vegetative parts, reducing herbivory, besides the absence of predators able to regulate its populations within the ecosystem, according to the Enemy Release Hypothesis (KEANE; CRAWLEY, 2002; SAX; BROWN, 2000). Cunha et al. (2006) and Mello et al. (2015) emphasized the role of native fauna (spiny-rat, agoutis, opossums, and primates) as a potential spreader of propagules. According to these authors, a protocooperation relationship is established between *A. heterophyllus* and certain primate species, also exotic in the Atlantic Forest of the southeastern Brazil, as *Callithrix jacchus* (originally from the northeastern Atlantic Forest) and *Callithrix penicillata* (from the Cerrado biome), which also have no specific predators within this biome. Such relationship relies on the sense that these animals would facilitate dispersion of *A. heterophyllus* seeds by peeling fruit searching for pulp which surrounds the seeds. These factors reveal the high invading potential of this species, which could cause flora homogenization in important remnants of the Atlantic Forest.

Invasive plants can cause significant changes in fundamental properties that may breach ecological thresholds such as nutrient cycling, structure, dominance, density, distribution, and species functions, in addition to interfering with evolutionary processes and relationships between pollinators and plants (ZILLER, 2006).

As stated by Abreu and Rodrigues (2010), biological invasion problem has been every day more critical in Strictly Protected Conservation Units, mainly Parks, Biological Reserves, and Ecological Stations, which are legally protected areas and where human interventions are more restrictive (BRAZIL, 2000). Recent studies have pointed to problems caused by *A. heterophyllus* in some Conservation Units of the Rio de Janeiro state as the MMNP (MAGALHÃES et al., 2015), the Tijuca National Park (ABREU; RODRIGUES, 2010), the Atalaia Municipal Park, in Macae - RJ (CRUZ et al., 2013), among others.

For these reasons, Ziller (2006) warns that cases of biological invasions should not be left aside since the impacts tend to increase exponentially over time.

Another factor favoring colonization of tropical forest edges is related to the pioneering behavior of the species *A. heterophyllus*. According to Santana et al. (2015), tropical forest edges often feature differences and variations from edge to inside edge in relation to micro-environmental conditions, vegetation structure, composition, and biotic interactions. This factor can also make the process of biological invasion easier.

According to IGA, the spatial distribution pattern tending to cluster as calculated for *A. heterophyllus*, according to IGA, might have occurred due to its dispersion syndrome, barochoric in this case, besides of its high abundance in most of the sample units. As stated by Townsend et al. (2010), the simplest evolutionary explanation for a clustered distribution is because organisms aggregate when and where they find suitability of habitats for breeding and survival.

A. heterophyllus distribution tended to cluster within the dominated environment, with the youngest individuals surrounding the adults ones (mother trees). It denotes this species ability to use clustering strategies as an exploration of "safe sites" in most suitable areas, likewise pioneer species in secondary forests dynamics (CHAZDON, 2008).

It is worth mentioning that spatial pattern of species might occur at different scales simultaneously (CAIN et al., 2011). Freitas and Magalhães (2014) deemed three main scales: macro (biogeographical), meso (communities), and micro (individuals within a community). In this study, the microscale was taken into account, which was restricted to the understanding of the edge of the forest fragment invaded by *A. heterophyllus*.

As reported by Freitas and Magalhães (2014), forest fragmentation can cause changes in the microclimate, increasing the risk of fires that favors tree mortality in a range of up to 100 meters from the edge of a forest fragment, increasing edge effects with direct influence on species diversity. According to Levine (2000), diversity loss reduces a community resistance to biological invasion processes.

The degree of evenness (J) corroborated the H' value, suggesting a low uniformity between the number of individuals out of the number of examined species within the studied plant community (BROWER; ZAR, 1998).

The species showing the highest basal areas were *A. heterophyllus* (25.97 $m^2 \times ha^{-1}$) and *G.*

guidonia (6.39 m^2 x ha^{-1}). Dead trees were the eighth position (0,825 m^2 x ha^{-1}). As stated by Martini et al. (2008), the permanence of dead trees inside the forest over time suggests a lesser disturbance in the area. According to Durigan (2009), tree basal area is the best descriptor to characterize structurally a plant community and make comparisons with others because of its direct relation to vegetation biomass and, consequently, influencing microclimate, rainwater interception, as well as shelter and food availability to the fauna.

For Lamprecht (1990), the major combinations under an ecological, silvicultural, and structural aspect for density, frequency, and dominance parameters may be accounted according to the following conditions:

1) High Density, Frequency, and Dominance values stand for the most important species, that is, those species with the highest IV when only analyzed the community horizontal structure (*A. heterophyllus*).

2) High Density and Frequency represent a typical condition for species with a regular horizontal occurrence (*Psychotria leiocarpa*).

3) High Density and low Frequency highlight a typical phenomenon for species with site-specific clustering, as for *A. heterophyllus* and *G. guidonia*.

Some species found in the study area showed low forest density. This information reinforces the need to adopt effective measures for conservation of these plant populations, which are mostly susceptible to genetic erosion and local extinction (RUSCHEL et al., 2009), as the case of *Maytenus obtusifolia*.

CONCLUSIONS

This study reveals the importance of *A. heterophyllus* as an invasive species in the Atlantic Forest ecosystems, being the most important species of the studied community and showing a site-specific clustering. We showed the urge to adopt conservation measures to establish an effective control of its population.

On the other hand, complementary studies are still necessary to understanding better the mechanisms by which invasion of *A. hetereophyllus* occur in the Atlantic Forest, so that management and control actions against this species could be adopted, especially in fragments where regenerating species can be seen.

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RESUMO: A Mata Atlântica encontra-se reduzida a menos de 20% de sua cobertura original, mas ainda protege um importante patrimônio biológico. A fragmentação da floresta torna o ambiente mais favorável para a ocupação de espécies invasoras. A jaqueira (*Artocarpus heterophyllus*) foi introduzida no Brasil no século XVII e na segunda metade do século XX houve uma rápida densificação de sua regeneração natural, comprometendo o recrutamento de muitas espécies nativas. Este estudo investigou o impacto da invasão de *A. heterophyllus* na diversidade e na estrutura do componente arbóreo da borda de um remanescente de Mata Atlântica, no Rio de Janeiro. Duas parcelas do tipo transecto foram alocadas, com 10 m x 100 m (1.000 m^2), divididas em 10 subparcelas de 10 m x 10 m, com uma amostra total de 2.000 m^2. Árvores com diâmetro à altura do peito (DAP) igual ou superior a 5 cm foram marcadas e o DAP e a altura total foram medidos. Foram obtidos os seguintes parâmetros fitossociológicos: Freqüência, Densidade, Dominância, Valor de Importância (VI) e de Cobertura (VC). No total, 200 espécies de árvores foram amostradas. A invasão foi responsável por mais de 35% de toda a estrutura do ambiente estudado, obtendo o primeiro lugar em termos de Valor de Importância (VI = 35,62%). A baixa riqueza florística parece ter favorecido o processo de invasão de *A. heterophyllus* na comunidade, mostrando a necessidade de um controle eficaz das espécies para proteção da herança genética nativa.

PALAVRAS-CHAVE: Jaca. Fitossociologia. Estrutura horizontal. Dominância.

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