

**THE ASSESSMENT OF FLORISTIC COMPOSITION, SIZE, HEALTH AND CURRENT TREE  
CONSERVATION OF THE INTERNATIONAL PARK IN SANT'ANA DO LIVRAMENTO BRAZIL AND  
RIVERA URUGUAY**

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**ABSTRACT**

This study aimed to evaluate quantitatively and qualitatively the vertical composition of the International Park at Sant'ana do Livramento/BR and Rivera/UY, to identify, classify and present a list of species with their families and occurrences, and to evaluate plant health and tree management procedures required. All existing individuals with BHD greater than or equal to 15.7 cm were inventoried. At this stage, we recorded data for the individuals regarding BHD, height, origin, plant health and the need for light or heavy pruning. In the Park, 300 trees belonging to 24 families were identified, with a small rate of native species (31%) and a high percentage of exotic trees (69%). Regarding the number of individuals, Cupressaceae was the most important family, followed by Moraceae, Bignoniaceae, Oleaceae, Pinaceae and Fabaceae families. The most occurrences were found for individuals of the species *Ligustrum japonicum* followed by *Ficus microcarpa*, *Chamaecyparis lawsoniana* and *Handroanthus heptaphyllus*. A poor phytosanitary condition was observed in 18.27% of the individuals and 81.73% was in good health condition. Regarding the individuals in the worst phytosanitary condition, *Magnolia grandiflora*, *Ligustrum japonicum* and *Handroanthus heptaphyllus* were the most infested by mistletoe.

**Keywords:** urban forestry, floristic composition, landscaping.

**AVALIAÇÃO DA FLORÍSTICA, DO PORTE E DA FITOSSANIDADE ATUAL DA ARBORIZAÇÃO DO  
PARQUE INTERNACIONAL EM SANT'ANA DO LIVRAMENTO/RIVERA, BRASIL/URUGUAI**

**RESUMO**

O presente estudo teve como objetivo a avaliação quantitativa e qualitativa da composição vertical do Parque Internacional localizado no município de Sant'Ana do Livramento/BR e Rivera/UY, visando identificar, classificar e apresentar uma listagem das espécies arbóreas encontradas com suas respectivas famílias e número de ocorrência, além de avaliar o estado fitossanitário e a necessidade de manejo das árvores. Foram inventariados todos os indivíduos existentes com circunferência à altura do peito (CAP) maior ou igual a 15,7cm. Nessa etapa foram anotados e medidos dados referentes ao indivíduo como: CAP, altura total, origem, estado fitossanitário e necessidade de poda leve ou pesada. Foram inventariadas 300 árvores pertencentes a 24 famílias. Verificaram-se um baixo índice de espécies nativas existentes no Parque, 31%, e um alto percentual de árvores exóticas, 69%. Quanto ao número de indivíduos, destacam-se a família Cupressaceae, seguida pela Moraceae, Bignoniaceae, Oleaceae, Pinaceae e Fabaceae. Dentre os indivíduos encontrados as espécies *Ligustrum japonicum* seguida por *Ficus microcarpa*, *Chamaecyparis lawsoniana* e *Handroanthus heptaphyllus* foram as mais abundantes. Foram encontrados 18,27% indivíduos com o estado fitossanitário ruim e 81,73% indivíduos em bom estado. Dos indivíduos em mau estado fitossanitário destacam-se *Magnolia grandiflora*, *Ligustrum japonicum* e *Handroanthus heptaphyllus* que se encontram infestadas por erva-de-passarinho.

**Palavras-chave:** silvicultura urbana, composição florística, paisagismo.

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## INTRODUCTION

Along history, we have observed different perceptions towards trees and their functions in the environment. From the disordered extraction in recent centuries to the significant scarcity for green areas as currently observed not only in urban environments, but in rural areas as well (BRUN; BRUN, 2006). The authors emphasize that the disordered growth of cities has caused serious problems such as the concentration of air pollutants, formation of heat islands, visual and sonic pollutions due to the lack of planning for urban growth.

Thus, vegetation offers proved benefits such as the welfare provided to the population, better aesthetic effect, shades for pedestrians and vehicles, sound barrier, reduction of rain impact to the soil and rainwater runoff and preservation of local fauna (PIVETTA; SILVA FILHO, 2002). According to Paiva and Gonçalves (2002), urban afforestation contributes to the harmony of landscapes breaking the sharp lines of the concrete constructions and creating smooth and natural lines.

Places with intense movement of pedestrians, when well afforested, ensure a more pleasant environment with more ecological, social and economical benefits (MELO, 2005).

For Demattê (1997), urban afforestation always maintains a little of the original flora of cities on their squares, parks and preservation sites. Squares are meeting places whose main function is the promote community life. They are green areas with dimensions, in general, between 100 m<sup>2</sup> and 10 ha. However, it is not possible to standardize squares, in terms of area, without knowing the areas surrounding them.

Nevertheless, urban afforestation is not planned and is carried out by unqualified personnel that can cause direct negative consequences to some elements of urban

organization such as the electric and telephone wiring as well as water and sewage systems (MENESES et al., 2003). Thus, in order to introduce trees to urban spaces that do not inflict future problems, an adequate planning must be adopted considering the cultural and historic aspects of the local population, as well as their needs and aspirations taking into account the physical space available (PRASS, 2004).

Dantas et al. (2004) highlight that planning urban afforestation is a sine qua non condition for urban growth as a means to prevent damages to the environment. Urban afforestation is essential for a healthy environment, once it directly affects the welfare of the population because of the numerous benefits that urban trees provide.

The International Park, belonging to the municipality of Sant'Ana do Livramento/Brazil and Rivera/Uruguay was created on February 26, 1943, and consists of green area harmoniously enjoyed by the local population and from neighboring cities, constituting a unique case in the world. This park is part of the urbanistic-architectonic complex of both municipalities, becoming a place of high ecological, scientific, historic, cultural and patrimonial interests.

In this context, studies to assess the current floristic condition of the park present basis for the implementation of preservation and development management procedures.

Therefore, the current study aimed to assess quantitatively and qualitatively the vertical composition of the International Park to identify, classify and present a list of tree species with their respective families number of occurrences in the park, in addition to an evaluation of the phytosanitary conditions and management procedures required for the trees.



## MATERIALS AND METHODS

### Study area

The study was carried out at the International Park situated between the municipalities of Sant'Ana do Livramento, in Brazil (latitude 30° 48' 31" S and longitude 55° 22' 33"O) and Rivera, in Uruguay (latitude 30 54' 20" S and longitude 55 33' 02"O).

The park covers circa 3 hectares and the municipalities are approximately 208 meters above sea level. The climate in the region is classified as humid temperate in the summer, with the annual temperature ranging from 12.1°C and 18°C and the annual precipitation of around 1,388 mm (MALUF, 2000). According to Streck et al. (2008), this region is characterized as Ultisols Bruno-Gray Alytic abrupt.

### Vegetation sampling

We inventoried all trees existing in the International Park in the municipalities of Sant'Ana do Livramento/BR and Rivera/UY with BHD greater or equal to 15.7 cm. At this stage, we recorded and measured data regarding: BHD, total height using the hypsometer electronic Vertex III,

origin, phytosanitary condition and need for light or heavy pruning.

The tree origin was classified as native or exotic. The height was classified as follows: small ( $H \leq 6m$ ), medium ( $6.1m \leq H \leq 10m$ ) and large ( $H > 10m$ ). The need for management was evaluated individually and we analyzed the need for the following actions: light pruning, (removal of branches that affect the natural conformity of the tree); heavy pruning (removal of a large part of the crown due to some damage the trees may cause to other species or to park-goers); phytosanitary control (presence of visible pests or diseases through damages caused to several parts of the trees) and vegetation removal (dead individuals or with irrecoverable condition).

The most common species were identified *in loco* and the others were, then, identified in the Herbarium of the Department of Forest Science (HDCF) of the Universidade Federal de Santa Maria/Rio Gande do Sul state - Brazil. The botanical families were classified in accordance to Angiosperm Phylogeny Group (APG II).

## RESULTS AND DISCUSSIONS

### Floristic analysis

We surveyed 300 trees in the International Park, including one dead tree and one unidentified. The species belong to 24 families of Fabaceae, with five genera and five species and Pinaceae, with five genera and five species, followed by Arecaceae, with 4 genera and five species; Moraceae, with two genera and four species; Bignoniaceae, with two genera and three species and Cupressaceae, with two genera and three species (Table 1). These are the most important families in the floristic composition of the park and are represented by 20 genera and 25 species.

We observed a few occurrences of native species in the park (25%) and many occurrences of exotic species (69%).

The high percentage of occurrence of exotic species found in the park is not ideal, because according to Sanchotene (1985), Blum et al. (2008) and Guia et al. (2008), we should prioritize the use of species native to the region because, besides the preservation of species, this procedure also provides a better physical-graphic balance, incorporating elements that integrate the urban landscape to the landscape in the region.

The improvement of green urban areas with the use of native species of landscape features shows an expressive

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gain of valuation and can contribute, in part, to species conservation.

The native species present resistance to stress factors of the urban environment, climatic adaptability, survival capacity and development in urban sites, in addition to resistance to pests and diseases (GUIA et al., 2008).

Among the individuals found in the park, the *Ligustrum japonicum* stands out with 29 individuals, occurring in all areas of the park, followed by *Ficus microcarpa*, with 27 individuals, *Chamaecyparis lawsoniana*, with 23 individuals and *Handroanthus heptaphyllus* with 21 individuals. Among the exotic species, *Ligustrum japonicum*, *Ficus microcarpa* and *Chamaecyparis lawsoniana* stand out and among the native ones, *Handroanthus heptaphyllus*, *Caesalpinia peltophoroides* and *Vitex megapotamica* stand out (Table 1).

The total basal area found in the site was 32.7618 m<sup>2</sup>/ha and the species *Cunninghamia lanceolata* had more occurrences, followed by *Chamaecyparis lawsoniana*, *Handroanthus heptaphyllus* and *Cupressus sempervirens* (Table 1). These results show that large-sized individuals represent these species in the park.

Santamour Júnior (2002) recommends that the same species should not exceed 10% of the total, 20% of a genus and 39% of a botanical family, because diversity of trees in urban landscape is required to ensure maximum protection against pests and diseases. We observed that in the International Park, no species had occurrences above 10% (Table 1), likewise no family exceeded 30% of the total individuals in the site (Figure 1).

**Table 1. Tree species found in International Park in Sant'Ana do Livramento/BR and Rivera/UY with their families, scientific and popular names, frequency of occurrence, basal area and origin.**

Family/Scientific name	Popular name	N	F (%)	Basal area (m <sup>2</sup> /ha)	Origin
<b>Anacardiaceae</b>					
<i>Schinus molle</i>	aroeira-salvo	5	1.7	0.363	Native
<b>Araucariaceae</b>					
<i>Araucaria heterophylla</i>	araucária-heterophylla	1	0.3	0.137	Exotic
<i>Araucaria angustifolia</i>	pinheiro-brasileiro	3	1	0.809	Native
<b>Arecaceae</b>					
<i>Butia capitata</i>	butiá	4	1.3	0.813	Native
<i>Phoenix canariensis</i>	palmeira-das-canarias	4	1.3	0.921	Exotic
<i>Siagrus romanzoffiana</i>	jerivá	1	0.3	0.204	Native
<i>Washingtonia filifera</i>	palmeira-de-saia	3	1	0.953	Exotic
<i>Washingtonia robusta</i>	washingtônia	1	0.3	0.081	Exotic
<b>Apocynaceae</b>					
<i>Nerium oleander</i>	espirradeira	3	1	0.048	Exotic
<i>Thevetia peruviana</i>	chapéu-de-napoleão	3	1	0.202	Exotic
<b>Bignoniaceae</b>					
<i>Jacaranda mimosifolia</i>	jacarandá-mimoso	12	4	1.004	Exotic
<i>Handroanthus heptaphyllus</i>	ipê-roxo	21	7	2.557	Native
<i>Handroanthus chrysotrichus</i>	ipê-amarelo	4	1.3	0.052	Native
<b>Cupressaceae</b>					
<i>Cupressus macrocarpa</i>	cipreste-de-montereii	7	2.3	1.949	Exotic

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<i>Chamaecyparis lawsoniana</i>	cipreste-escaravelho	23	7.6	3.077	Exotic
<i>Cupressus sempervirens</i>	cipreste-mediterrâneo	17	5.6	2.104	Exotic
<b>Fabaceae</b>					
<i>Caesalpinia peltophoroides</i>	sibipiruna	11	3.7	0.549	Native
<i>Inga vera</i>	inga-feijão	8	2.7	0.570	Native
<i>Robinia</i> sp.		1	0.3	0.033	Exotic
<i>Schizolobium parahyba</i>	guapuruvu	2	0.7	0.233	Native
<i>Tipuana tipu</i>	tipuana	2	0.7	0.250	Exotic
<b>Hamamelidaceae</b>					
<i>Liquidambar styraciflua</i>	liquidambar	6	2	0.493	Exotic
<b>Lithraceae</b>					
<i>Lagerstroemia speciosa</i>	resedá-gigante	3	1	0.434	Exotic
<b>Malvaceae</b>					
<i>Ceiba speciosa</i>	paineira	1	0.3	0.217	Native
<b>Magnoliaceae</b>					
<i>Magnolia grandiflora</i>	magnólia	6	2	0.309	Exotic
<b>Meliaceae</b>					
<i>Cedrela fissilis</i>	cedro	3	1	0.040	Native
<b>Myrtaceae</b>					
<i>Psidium cattleianum</i>	araça	1	0.3	0.014	Native
<b>Moraceae</b>					
<i>Ficus microcarpa</i>	figueira-lacerdinha	27	9	0.703	Exotic
<i>Morus nigra</i>	amora	9	3	0.428	Exotic
<i>Ficus elastica</i>	seringueira-de-jardim	3	1	0.578	Exotic
<i>Ficus luschnathiana</i>	figueira	2	0.7	0.038	Exotic
<b>Oleaceae</b>					
<i>Fraxinus</i> sp.		4	1.3	0.240	Exotic
<i>Ligustrum japonicum</i>	ligustro	29	9.6	0.871	Exotic
<b>Pinaceae</b>					
<i>Cunninghamia lanceolata</i>	pinheiro-chinês	11	3.7	4.365	Exotic
<i>Pinus taeda</i>	pinus	3	1	1.336	Exotic
<i>Cedrus</i> sp.		1	0.3	0.147	Exotic
<i>Thuja</i> sp.		10	3.3	0.137	Exotic
<i>Juniperus chinensis</i>	junípero-chinês	8	2.7	0.299	Exotic
<b>Phytolacaceae</b>					
<i>Phytolacca dioica</i>	umbu	1	0.3	0.318	Native
<b>Rhamnaceae</b>					
<i>Hovenia dulcis</i>	uva-do-japão	3	1	0.193	Exotic
<b>Rosaceae</b>					
<i>Pirus</i> sp.		1	0.3	1.254	Exotic
<i>Eriobotrya japonica</i>	ameixa	1	0.3	0.027	Exotic
<b>Salicaceae</b>					

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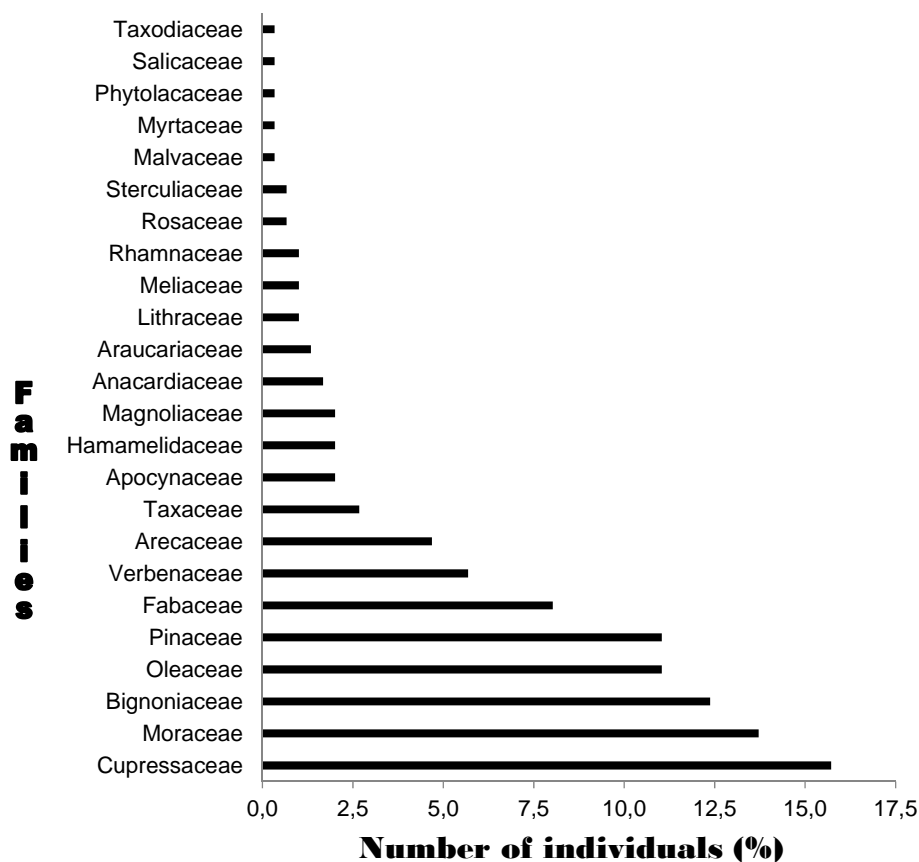


<i>Salix viminalis</i>	vime	1	0.3	0.410	Exotic
<b>Sterculiaceae</b>					
<i>Brachychiton populneus</i>	brachichita	2	0.7	0.446	Exotic
<b>Taxodiaceae</b>					
<i>Cryptomeria japonica</i>	pinheiro-japonês	1	0.3	0.103	Exotic
<b>Verbenaceae</b>					
<i>Citharexylum montevidense</i>	Tarumã-de-espinho	3	1	0.034	Native
<i>Vitex megapotamica</i>	tarumã	14	4.7	1.098	Native
<b>Taxaceae</b>					
<i>Taxus baccata</i> L.	tejo	8	2.7	0.434	Exotic
<b>Dead</b>		1	0.3	0.021	
<b>Unidentified</b>		1	0.3	0.866	
<b>TOTAL</b>		-	<b>300</b>	<b>100</b>	<b>32,7618</b>

Regarding the number of individuals, Cupressaceae stands out with 15.7% of the total, followed by Moraceae with 13.7%, Bignoniaceae with 12.4%, Oleaceae and Pinaceae with 11% of individuals each, Fabaceae with

8%, Verbenaceae with 5.7%, Arecaceae with 4.7%, which account altogether for 82.3% of the total of individuals surveyed in the site (Figure 1).

**Figure 1. Percentage of species in each family observed in the International Park of Sant'Ana do Livramento/BR and Rivera/UY, 2011**



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## Analyses of trees

### Tree sizes

The assessment on the tree sizes was carried out to allow inferences on tree chronology, given that there are no reliable data available on the tree ages or time of planting.

After evaluation of the entire area, we observed that 32.9% of the individuals were considered of large size (height above 10 meters), 50.2% had average height (6.1 to 10 m) and 16.9% of the trees were classified as small size. Among the large-sized species, we highlight the occurrence of *Cupressus macrocarpa*, *Araucaria angustifolia*, *Handroanthus heptaphyllus*, *Thevetia peruviana*, *Cunninghamia lanceolata*, *Pinus taeda*, *Brachychiton populneus*, *Chamaecyparis lawsoniana*, *Ficus microcarpa*, *Jacaranda mimosifolia*, *Liquidambar styraciflua*, *Cryptomeria japonica*, *Phoenix canariensis*, *Washingtonia robusta*, *Chamaecyparis lawsoniana*, *Phoenix canariensis*, *Tipuana tipu*, *Schizolobium parahyba* and *Taxus baccata*.

### Need of maintenance actions

Urban trees, in general, are more subjected to occurrences of pests and diseases because urban areas are artificial habitats for the trees.

The qualitative analyses performed in the site allowed to observe that 1.99% of the total number of trees require heavy pruning, and this procedure should be carried out during the fallow period of trees. According to Guia et al. (2008), if the pruning were not heavy, it could be performed at any period of the year. Evergreen species should be pruned in the period from the end of fruiting and the beginning of new branching. Deciduous species can be pruned after they lose their leaves at the end of the

fallow period, which may or may not coincide with the winter.

In the park, we found 18.27% of individuals in poor phytosanitary condition and 81.73% in good health condition. The individuals in poor health condition were *Magnolia grandiflora*, *Ligustrum japonicum*, *Cupressus sempervirens*, *Liquidambar styraciflua*, *Ficus microcarpa*, *Handroanthus heptaphyllus*, *Schinus molle*, *Jacaranda mimosifolia*, *Hovenia dulcis*, *Tipuana tipu* and *Butia capitata* (Figure 2) which were infested by mistletoe (*Sthruanthus flexicaulis* (Mart. ex Shult. F.).

The *H. heptaphyllus* stands out because from the 21 individuals in the park, 18 were infested by mistletoe and from the 29 individuals of *L. japonicum*, 12 were also infested by mistletoe. However, the most critical case was observed for the species *M. grandiflora* and *Cedrus* sp. because all individuals surveyed were infested by mistletoe.

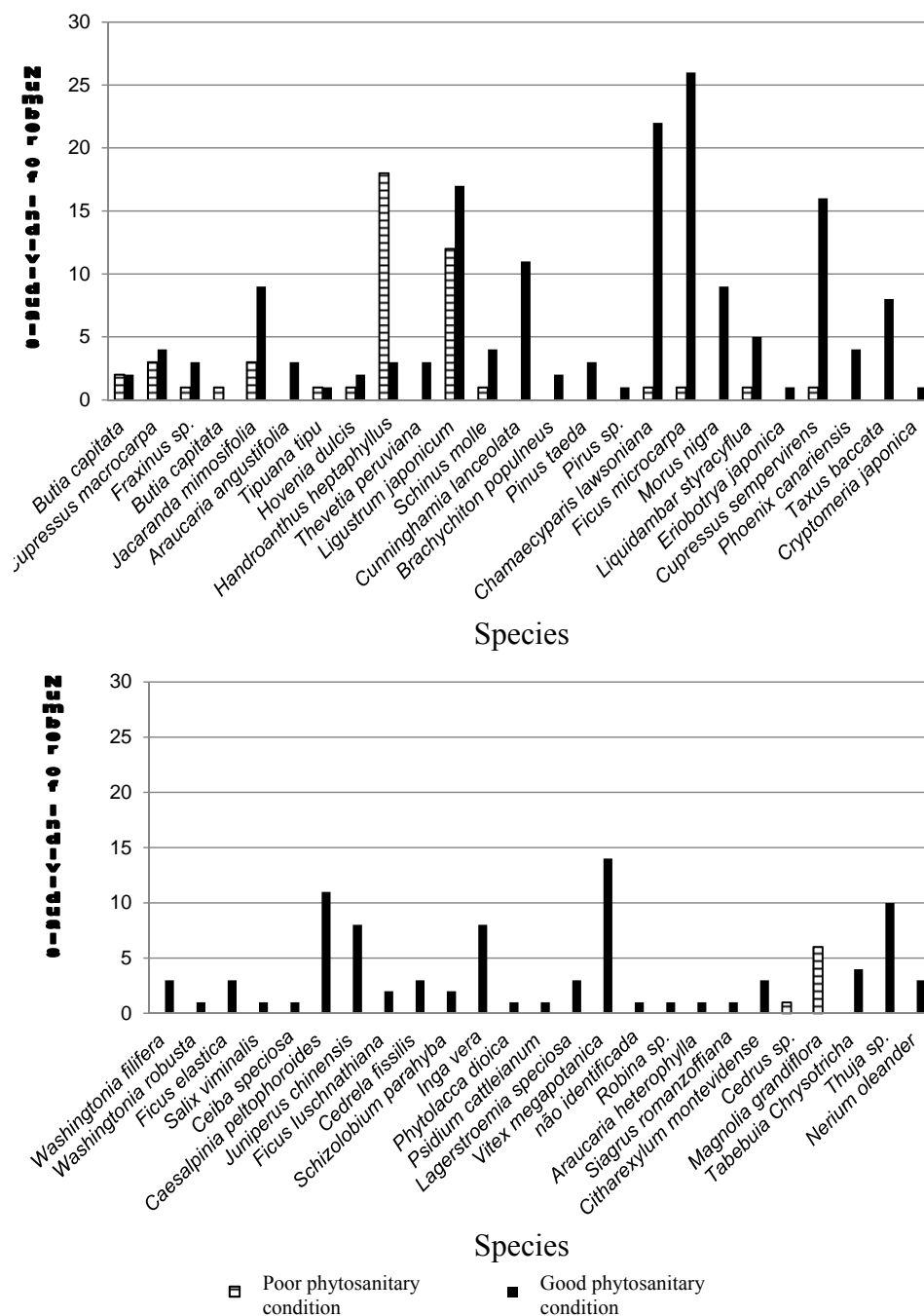
Guia et al. (2008) evaluated quantitatively the vertical composition of the Antônio Pires de Campos Park in the municipality of Cuiabá – Mato Grosso state – Brazil –, and found that 34.82% of the tree cover of the park was infested by termites, being that the species farinha (*Albizia hasslerii*), pitombeira (*Talisia esculenta*) and jatobá (*Hymenaea stigonocarpa*) showed the most occurrences. The author also observed that in 24.03% of the individuals showed infestation of mistletoe in their branches. The author states that some damages to trees are started by inadequate pruning, which leaves the area of cut exposed as an entry path for diseases. Over time, these diseases spread across to other parts of the tree leading them, in many cases, to premature death.

In the International Park, we found only one dead individual still standing, though, in the entire area of the park, which represents 0.33% of the total number of individuals surveyed.

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**Figure 2. Phytosanitary condition of individuals in the International Park of Sant'Ana do Livramento/BR and Rivera/UY, 2011.**



**CONCLUSIONS**

The afforestation of the International Park shows satisfactory distribution of genera and families, besides adequate diversity of species, which were, in general terms, in satisfactory phytosanitary condition. However, the species *Handroanthus heptaphyllus*, *Ligustrum japonicum*, *Magnolia grandiflora* and *Cedrus sp* require

special attention for their phytosanitary condition once they are infested by mistletoe which may lead the species to premature death, a regrettable loss for the park flora. Therefore, management procedures are required, such as the cut of infested branches at an initial stage, before heavy pruning is needed.

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