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SEED DISPERSAL AND GERMINATION BY THE BROWN HOWLER MONKEY (*ALOUATTA GUARIBA CLAMITANS* CABRERA, 1940) IN AN AREA OF ATLANTIC FOREST IN SOUTHERN BRAZIL

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Abstract. We investigated the role of *Alouatta guariba clamitans* as a seed dispersal agent at Itapuã State Park, at the southern limit of the Brazilian Atlantic Forest. During observations of a group of brown howlers, feces were collected whenever possible. Undamaged seeds were planted in forest soil inside a greenhouse, and control seeds were planted in the same soil. Germination rates of ten species were compared using Chi-square. The germination rates of only three species increased significantly after ingestion by howlers. In particular, 80.0% of the ingested seeds of *Syagrus romanzoffiana* (the fruit of which represented 25.4% of the group's diet) germinated, against only 3.3% of the control.

Key Words: frugivory, seed dispersal, germination, brown howler, *Alouatta guariba clamitans*, Atlantic Forest.

Resumo. Este trabalho avalia o papel de *Alouatta guariba clamitans* como dispersor de sementes no Parque Estadual de Itapuã, no limite meridional da Mata Atlântica. Durante observações de um grupo de sete bugios-ruivos, coletaram-se fezes sempre que possível. Sementes não danificadas foram plantadas em solo da floresta, em uma estufa, e sementes controle foram plantadas no mesmo solo. As taxas de germinação de dez espécies comparadas com o Qui-quadrado. As taxas de germinação de apenas três espécies aumentaram significativamente após ingestão pelos animais. Em especial, 80,0% das sementes ingeridas de *Syagrus romanzoffiana* (cujos frutos representaram 25,4% da dieta do grupo) germinaram, contra somente 3,3% do controle.

Palavras-chave: frugivoria, dispersão de sementes, germinação, bugio-ruivo, *Alouatta guariba clamitans*, Mata Atlântica.

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INTRODUCTION

The relationship between plants with fleshy fruits and seed dispersers is protocooperative – while the animal receives nutrients from the fleshy part of the fruit, it contributes to the reproductive success of the plant by dispersing its seeds (Howe, 1980). This relationship is prominent in Neotropical forests, where three-quarters of tree species produce fruits adapted for consumption by vertebrates.

Primates constitute an important group in this relationship since they represent a major part of the frugivore biomass in most tropical forests (Eisenberg & Thorington, 1973). This indicates that the maintenance of primate populations is crucial for the regeneration of tropical forests.

The main objective of this work was to describe the role of the brown howler, *Alouatta guariba clamitans*, as a seed disperser in its natural habitat in southern Brazil. Special attention was given to the plant species that are also important resources for other elements of the local frugivore community.

METHODS

Study Area

The study was carried out at the Itapuã State Park (30º20'S, 51º00'W) in the municipality of Viamão, Rio Grande do Sul. The park covers a total area of 5,566.50 hectares, and is located at the southern limit of the Atlantic forest.

The climate is humid subtropical, with no marked dry season, and annual mean temperatures of around 17.5ºC. In the summer, the temperature will often exceed 22ºC, whereas in the winter, it may fall to -3ºC. Mean annual precipitation is 1,100-1,300 mm. The vegetation is heterogeneous, with a variety of both forest and open habitats.

Data collection

Data were collected between February 1999 and March 2000, during the behavioral monitoring of a group of seven howlers (*Alouatta guariba clamitans*). The group was accompanied for three to five days each month, and feces, were collected whenever possible, during the collection of behavioral data. All undamaged seeds were separated from the feces and planted in forest soil inside a greenhouse. For each species identified, the same number of seeds was collected from uneaten ripe fruit collected from within the study

area. The seeds were planted in exactly the same way as those collected from feces, and formed the control for comparisons with the ingested seeds.

All seeds were checked for signs of germination every two days, during nine months. The proportion of seeds germinating in each group – experimental and control – was compared using Chi-square (Zar, 1999).

RESULTS

Defecation was observed 121 times during the study, and the seeds of ten different plant species were identified and collected in numbers adequate for the germination tests (Table 1). Germination rates varied considerably among species, but there was no clear overall pattern with regards to the effects of ingestion by the howlers. Of the ten species monitored, only five presented a significant difference between groups. In three of these cases – *Erythroxylum argentinum*, *Lithraea brasiliensis* and *Syagrus romanzoffiana* – the germination rate recorded for ingested seeds was significantly greater than that of the control. In the other two species (*Enterolobium contortisiliquum* and *Myrciaria cuspidata*), however, control seeds germinated at a significantly higher rate than ingested ones.

Table 1. Results of the germination tests for the ten principal species of fruit in the diet of *A.g. clamitans* in Itapuã State Park. Significant results in bold type.

		% seeds germinating:		
Taxon		Ingested	Control	χ^2 (p)
Anacardiaceae	*Lithraea brasiliensis*	55.6	20.0 (36)[1]	10.01 (<0.005)
Annonaceae	*Rollinia maritima*	38.5	61.5 (13)	1.38 (>0.05)
Arecaceae	*Syagrus romanzoffiana*	80.0	3.3 (30)	36.27 (<0.005)
Ebenaceae	*Diospyros inconstans*	61.5	61.5 (13)	0.00 (>0.05)
Erythroxylaceae	*Erythroxylum argentinum*	87.5	60. 4 (48)	9.14 (<0.005)
Fabaceae	*Enterolobium contortisiliquum*	6.7	73.3 (30)	9.14 (<0.005)
Moraceae	*Ficus organensis*	21.3	15.7 (108)	1.10 (>0.05)
Myrtaceae	*Myrciaria cuspidata*	22.2	62.2 (37)	4.65 (<0.05)
Sapotaceae	*Sideroxylum obtusifolium*	3.3	6.7 (30)	0.35 (>0.05)
Ulmaceae	*Celtis* sp.	70.0	66.7 (30)	0.08 (>0.05)

[1]Number of seeds (in each group).

The most striking result was that for *Syagrus romanzoffiana*, a common palm in the Itapuã Park, which has a distinct orange-colored fruit of approximately 1.5 cm in diameter. Whereas 80% of the ingested seeds of this species germinated, only one seed (3.3%) of the control sample did. This species represented 25.44% of the fruit ingested by howlers in the 13-month study period (Marques, 2001).

DISCUSSION

The results of this study indicate that *A.g. clamitans* is a potentially important disperser of the seeds of some of the plant species it exploits for fruit in southern Brazil. The palm *S. romanzofiana* may be especially important here, from the viewpoint of both the plant and the monkeys. The fruit is available throughout most of the year, and may represent one of the most important food resources for the local frugivore community. Howlers may be among the most important dispersers of this species, not only because of the number of seeds ingested, but also because of the quality of dispersion, as indicated by germination rates (Schupp, 1993).

For a majority of the species, however, ingestion had, at best, a neutral effect on germination rates, and in some cases, an apparent negative effect. These included the fig *F. organensis*, which represented 20.67% of the group's diet (Marques, 2001). Figs are a keystone resource for many Neotropical frugivores (Serio-Silva *et al*., 2001), but in this particular case, consumption by the howlers did not appear to contribute to the reproductive success of the plant.

Many other studies, including those of howlers (Howe, 1980; Estrada & Coates-Estrada, 1984; Chapman, 1989; Julliot, 1996) have shown that passage through the gut may have a positive effect on the germination of the seeds of a number of different plant species. These studies highlight the contribution of primate populations to the regeneration of tropical forests. Unfortunately, ongoing anthropogenic impacts on many of these populations, such as hunting and habitat destruction, are altering their ecological relationships with their food resources, thus influencing other interactions (Chapman & Oderdonk, 1998). Further studies are necessary to understand the role of primates in habitat regeneration, including long-term monitoring of post-dispersion seed development.

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