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Seed dispersal by bats in a disturbed area of Southeastern Brazil

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Resumen. Se recolectó semillas de heces de muerciélagos en la cuenca del río Piracicaba, Brasil, de julio de 1995 a mayo de 1996. Estos habitan un área con plantas pioneras y de sucesión secundaria tardía. Seis de las 16 especies de muerciélagos dispersan plantas de 14 especies y siete familias. La mayor diversidad de dieta correspondió a *Artibeus lituratus* y *Carollia perspicillata* y la planta más frecuente fue *Cecropia glaziovii*. Los muerciélagos actúan como dispersores de plantas de la sucesión secundaria inicial.

Key words: seed dispersal, bats, Brasil.

Frugivorous bats play an important role in the dispersal of several tropical plant species (Fleming 1986, Fleming & Williams 1990). Due to their tendency to occur in all kinds of habitats (Estrada *et al.* 1993), and ability to carry fruits long distances away from the parent tree (Heithaus *et al.* 1975) they are considered good seed dispersers. Such bat-mediated seed dispersion is very important in fragmented habitats and/or very disturbed forests (Galetti & Morellato 1994) promoting plant recolonization in these areas (Whittaker & Jones 1994).

This study was conducted in the county of Antônio Dias (19° 40'S; 42° 55'W), a region within the Piracicaba river basin, southeastern Brazil. Recent estimates indicate that 93.9 % of the original vegetation of this region has been removed, making way for urban areas, agricultural expansion, pastures and eucalyptus plantations for coke and pulp production (Machado 1995). The data were collected in an *Eucalyptus* spp. plantation abandoned for 25 years with a successional understory. This area has 50 ha approximately, and is located between the Piracicaba river and the Machado stream, where remaing traces of riparian forest and fragments of secondary forest occur. The objective of this study was to identify the plant species that make part of the diet of bats collected in that site, trying to verify which species could be or are being dispersed by these animals.

Bats were collected bimonthly with mist nets (ATX 12 m; mesh size 36 mm) from July 1995 to May 1996 totalizing a capture effort of 1 800 hours. Faeces were collected while the animals were in the nets, or during subsequent handling. Fecal samples were sealed in vegetal paper envelopes and labeled. Seeds were later separated for identification and germination in the laboratory. Seeds were identified, when possible, at the lower taxonomical level. The seeds were placed to germinate in Petri dishes

with filter paper moistened with distilled water, under both continuous light ($30\mu mol.m^{-2}\cdot s^{-1}$) and darkness, at 25°C. Repetitions were made for *Carica papaya* (4 x 20 seeds), *Cecropia glaziovii* and *Piper aduncum* (4 x 25 seeds), which were collected from the faeces in sufficient number. The germination percentage of *P. aduncum* (4 x 25 seeds) collected from the fruits were compared to those obtained from the bat faeces. The experiments were carried out for a period of 30 days and the criteria used to establish germination was the emergence of the radicle. Data were compared by analysis of variance, by the Tukey test with $p < 0.05$. After germination, the seedlings were grew in a greenhouse for later taxonomical confirmation.

Six out of sixteen bats species captured during the study were frugivorous that consumed fruits of 14 plant species from seven families (Table 1). Five of these families are of pioneers and two are of late secondary succession species. The pioneer species occur in and close to the studied area, and the late secondary succession species in the remaing riparian forest and in the fragments. The more frequent bat species, with seeds in its faeces were: *Artibeus lituratus, Carollia perspicillata* and *Sturnira lilium* (Table 1). Except for Solanaceae seeds, all other plant species were found in the faeces of *A. lituratus*, a large bat which is basically frugivorous (Marinho-Filho 1992). These data reinforce the idea that *A. lituratus* is a generalist, having a great ability to utilize a wide variety of food resources, being able to occur in many different habitats including urban forests and anthropically affected areas (Zortéa & Chiarello 1994). At the end of the dry season, *A. lituratus* fed preferentially on Moraceae fruits (*Ficus* spp). Although figs do not appear to be nutrient rich fruits and contain considerable amounts of indigestable fibre (Morrison 1980), they were the primary food resource for this bat during that period. *Carollia perspicillata* consumed fruits from various plant species, although other studies have demonstrated that it shows a preference for Piperaceae fruits (Marinho-Filho 1991, Aguiar 1994). Throughout the study period, *S. lilium* consumed Solanaceae, Myrtaceae and Piperaceae fruits, although the first family was more used (Table 1). Our observations agree with the data of Marinho-Filho (1991) and Aguiar (1994) which show that *S. lilium* has a preference for fruits from the Solanaceae family.

Cecropia glaziovii was the species used by the greatest number of bats (Table 1). This genus of pioneer plants is widely distributed in South America (Berg 1978) and its seeds are common food items in the diets of frugivorous vertebrates (Fleming & Williams 1990). The seeds of *C. glaziovii* are positive photoblastic (Válio & Joly 1979) and this behavior was not affected by the passage through the digestive tract of the bats (germination: light 90%, dark 3%; $P < 0.05$). As a consequence, dispersal of seeds to open areas, far from the parent tree, should be an important factor in the life cycle of this species. Our data show that *C. glaziovii* was an important item in the diet of chiropterans, which serve as potential dispersers of this species, contributing to the process of natural succession. Seeds of *Carica papaya*, present only in one fecal sample of *A. lituratus*, were indifferent to light (germination: light 42%, dark 37%; $P > 0.05$).

No difference was found between germination rates of *Piper aduncum* seeds taken directly from fruits and those collected from the faeces of *A. lituratus*, *C. perspicillata* and *S. lilium* (light: fruits 58%, faeces 54%; dark: fruits 0%, faeces 2%; $P > 0.05$). The absence of difference, and the fact that these seeds were ingested by three different bats, suggest that these bats are good dispersers of *P. aduncum*. Bizerril & Raw (1998), reported no significant difference between the germination rates of *P. arboreum* seeds collected from fruits and those collected from the faeces of *C. perspicillata*, *Glossophaga soricina* and *A. lituratus*, and suggested that these animals are excellent dispersers of this species.

Consumption of fruits from pioneers, like *C. glaziovii* and *P. aduncum*, indicates that the bats are acting as dispersers for plants of early secondary succession. The presence of seeds

TABLE 1

Number of individuals of bats whose faeces contained fruit seeds.

Plants	Bats					
	Carollia perspicillata	*Artibeus lituratus*	*Sturnira lilium*	*Vampyressa pussila*	*Glossophaga soricina*	*Platyrrhinus recifinus*
Caricaceae (P)						
Carica papaya	-	1	-	-	-	-
Cecropiaceae (P)						
Cecropia glaziovii	4	2	-	-	1	1
Melastomataceae (P)						
Miconia sp.	-	1	-	-	-	-
Piperaceae (P)	-					
Piper aduncum	3	1	1	-	-	-
Piper sp.	-	1	-	-	-	-
Solanaceae (P)						
sp. 1	2	-	1	-	-	-
sp. 2	1	-	-	-	-	-
sp. 3	1	-	-	-	-	-
sp. 4	5	-	2	-	-	-
Moraceae (S)						
Ficus sp. 1	-	1	-	-	-	-
Ficus sp. 2	-	1	-	-	-	-
Ficus sp. 3	-	1	-	-	-	-
Myrtaceae (S)						
Psidium sp. 1	-	2	1	-	-	-
Psidium sp. 2	-	1	-	2	-	-
TOTAL	16	12	5	2	1	1

P=pioneer; S = late secondary succession species

from plants of late secondary succession in the faeces, reinforces the idea that the dispersion of seeds by bats greatly contribute to the increase in the diversity in disturbed areas as is the case in this abandoned *Eucalyptus* plantations.

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