PRIMATES, 37(1): 87–90, January 1996

SHORT COMMUNICATION

Seed Predation of *Cariniana estrellensis* (Lecythidaceae) by Black Howler Monkeys, *Alouatta caraya*

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ABSTRACT. Seed predation by howler monkeys is poorly documented. Here we report the seed predation on *Cariniana estrellensis* (Lecythidaceae) fruits by the black howler monkey *Alouatta caraya* in south-east Brazil during an intense dry season. This observation suggests that even non-specialized seed predators such as howlers can use seeds in critical periods of dry season.

Key Words: Atlantic forest; *Alouatta caraya*; Howler monkeys; Lecythidaceae; Seed predation; Semi-deciduous forest.

OBSERVATIONS

Fleshy fruits comprise an important food source for monkeys in the Neotropics but they are usually scarce during the dry season (TERBORGH, 1986). In the semi-deciduous forests of south-east Brazil the severe dry season corresponds to a critical period for resident frugivores, which are usually forced to shift their diet to other food sources, such as seeds, flowers, or leaves (GALETTI & PEDRONI, 1994; GALETTI et al., 1994).

Seed predation by Neotropical primates is well known in Pitheciinae species (AYRES, 1989; KINZEY & NORCONK, 1993) and more recently in other Cebinae species such as *Cebus* monkeys (PERES, 1991; GALETTI & PEDRONI, 1994).

Howler monkeys (genus *Alouatta*) are mainly folivores, but they also eat fruits and flowers when available (NEVILLE et al., 1988). Here we report the seed predation of a dry non-fleshy fruit by black howler monkeys *Alouatta caraya* during a severe dry season in 1994 in south-east Brazil.

Observations of seed predation of *Cariniana estrellensis* (Lecythidaceae) by howler monkeys were made during a forest survey carried out in the Mata dos Dourados (19°59′08″S, 47°36′42″W, about 515 m a.s.l.) a 160-ha forest fragment in the Fazenda Mandioca, Conquista, Minas Gerais, Brazil (Fig. 1). The forest tract includes periodically-flooded sites, close to the water courses, as well as upland sites on gentle slopes.

Observations were made during two field expeditions, from July 11 to 16 and September 6 to 9, 1994. These periods fell within the dry season, which extends in the region from May to September and was particularly severe in 1994. The average rainfall for May – September is 245 mm, but there was no rain at all during the same term in 1994 (Compania Energética de Minas Gerais, unpubl. data).

During the dry season most trees were completely leafless or with their foliar mass highly

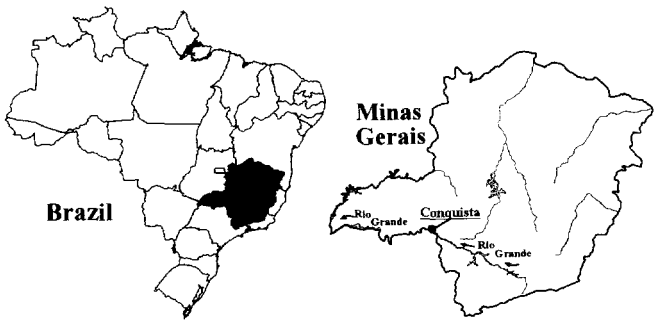

Fig. 1. Geographic location of the study site in southeastern Brazil.

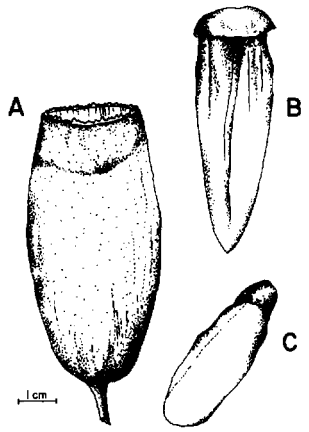

Fig. 2. Fruit of *Cariniana estrellensis*. **A:** Open pixidia; **B:** operculum; **C:** winged-seed.

depleted. We observed the howler monkeys on the first expedition when only 8 out of 161 shrubs and tree species surveyed were fruiting. These were *Cariniana estrellensis* (with dry, non-zoochoric fruits, Fig. 2). *Apeiba tibourbou* (non-fleshy, dehiscent fruits; a few trees of the population bore unripe fruits), *Guarea guidonea* (zoochoric fruits; a few trees of the population bore unripe fruits), and five fig species: *Ficus enormis*, *F. guaranitica*, *F. malacocarpa*, *F. obtusiuscula*, and *F. tomentella* (all fig trees either bore unripe syconia or were fruitless, regardless of the species). Emergent trees of *Cariniana estrellensis* had a density of 8.9 trees/ha and the density of fig species (all species together) was 9.9 trees/ha.

We observed a strange amount of both unopened and opened pixidia lying on the ground just below the crowns of *Cariniana* trees. As all of the pixidia looked fresh, they were certainly from the current fruiting season (older fruits were much more degraded by termites and fungi). We inspected the pixidia still hanging from the trees and verified that they were all still closed by that time.

We observed up to ten howler monkeys in the trees each day, but we could not determine how many groups we had been observing. The feeding behaviour of howlers was recorded for several individuals (at least five in each different day) and the behavioural sequence was very much the same.

The howler monkeys detached the fruit and held it between the finger and the hand palm with the operculum upwards and in such a way that one side could be struck against the

branch tree. Some individuals occasionally held the fruits with both hands. The monkeys started the strikes, each being produced by raising the arm with the fruit higher than the head and lowering it very quickly. After each single strike the monkey inspected briefly the operculum and repeated the sequence if the fruit remained closed (unlike PERES, 1991 description for capuchins feeding on the seeds of *Cariniana micrantha*, we did not observe strikes becoming gentler as the fruit started cracking). When eventually the operculum opened, the howler immediately pulled it out and took the fruit to the mouth and poured its content into it (not the seeds individually as observed by PERES, 1991). If the fruit remained sealed after a number of strikes, it was discarded.

For two individual howlers observed continuously for 15 min each, the number of strikes ranged from 12 to 27 ($n=13$) for successful cases, and from 19 to 30 ($n=10$) for the unsuccessful. The resulting average time of manipulation for each fruit ($n=26$ fruits for each 2 howlers over 15 min) was 1.15 min does not differ substantially from that found for capuchins manipulating *C. micrantha* (ca. 1.4 min: PERES, 1991).

We found below the *Cariniana* crowns 737 pixidia, of which 493 had their operculum removed (66.9%). An interesting fact is that a large amount of seeds still remained inside the opened pixidia (particularly the most internal ones). This suggests that howlers were not as efficient seed predator as capuchin monkeys (see PERES, 1991), which removed the seeds individually and discarded the fruits virtually empty. We also observed that, when the monkeys poured the seeds into the mouth, some were lost and "flew" away. Such seed escape was not observed by PERES (1991) for capuchins. It is difficult to say, however, if such escape is relevant to the plant, since we did not find any *Cariniana* seedling or juvenile in the area. Besides, we cannot tell whether this difference is merely behavioural between the two monkey species, or caused by morphological differences between the *Cariniana* species.

In three occasions we observed agonistic interactions between howlers in the fruiting trees. The "resident" monkey approached the intruder calling, but the latter only left the tree after direct fighting. *Cariniana* seeds were certainly the only fruit resource available for howlers at that time in the year, and food shortage probably incited fighting behaviour.

When we returned to the area in September, we did not see the howlers and noticed that the *Cariniana* trees were highly depleted of their fruits. Only a few were hanging from the twigs (which were still leafless), all of which opened ($0-33$, $n=10$ trees), while many were lying on the ground below the trees crowns, as already observed in the first trip. None of these were still sealed, as the operculum invariably opens with drying, and many showed signs of having been broken by rodents.

Although fruit hardness is an important characteristic in fruit choice by monkeys (KINZEY & NORCONK, 1993) our observations showed that even a non-specialized seed predator, such as howler monkeys, can breach the mechanical defence of some hard fruits in periods of fruit scarcity.

In south-east Brazil, specially in semi-deciduous forests, seeds of dry fruits are important to fullfil the energetic requirements of frugivores in an area, as has also been observed for *Cebus apella* (GALETTI & PEDRONI, 1994). During the dry season brown howlers *Alouatta fusca* shift their diet to less energetic food sources such as liana leaves, but seeds are rarely eaten (CHIARELLO, 1994; GALETTI et al., 1994). Because of the severe dry season in 1994, black howlers did not have anything but *Cariniana* seeds to consume since many trees were leafless and figs were unripe. The black howler monkey (*A. caraya*) is the only howler species that can thrive in small riverine vegetation in very dry xeromorphic habitats in Brazil, and more cases of seed predation during periods of leaf or fruit shortage may be expected.

These observations also suggest that black howler monkeys do not need necessarily the so-called "keystone fruiting trees" such as figs or palm fruits (see TERBORGH, 1986; GALETTI & PERES, 1993) to survive in the dry season.

Acknowledgments. We are grateful to ROGÉRIO R. DA SILVA and NEWTON P. SCHMIDT PRADO for help in the field, to DAVID J. CHIVERS and ALFREDO D. CUARÓN for comments on the manuscript. M. GALETTI receives a doctoral fellowship from CNPq. This paper is dedicated to the memory of WARREN G. KINZEY.

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—— Received: *May 26, 1995*; Accepted: *September 9, 1995*

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