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THE AGOUTI *Dasyprocta leporina* (RODENTIA: DASYPROCTIDAE) AS SEED DISPERSER OF THE PALM *Astrocaryum aculeatissimum*

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**ABSTRACT:** Some large-seeded plants depend heavily on agoutis for seedling recruitment. The importance of *Dasyprocta leporina* as seed disperser of the Atlantic Forest palm *Astrocaryum aculeatissimum* was evaluated using camera-traps and seed removal experiments. Agoutis were registered at 67% of the records obtained through the monitoring of mature fruits; palms were visited from 07:00 to 18:45 h. Dispersal distances ranged from 0.5 to 48.7 m (mean ± sd = 6.8 ± 9.1 m) and most of the removed seeds were buried (57.8%). These results corroborate the importance of agoutis for the seed dispersal of *Astrocaryum* palms.

**RESUMO:** A cutia *Dasyprocta leporina* (RODENTIA: DASYPROCTIDAE) como dispersora de sementes da palmeira *Astrocaryum aculeatissimum*. Algumas plantas de sementes grandes são fortemente dependentes de cutias para o recrutamento de suas plântulas. A importância de *Dasyprocta leporina* como dispersora de sementes da palmeira da Mata Atlântica *Astrocaryum aculeatissimum* foi avaliado com o uso de armadilhas fotográficas e experimentos de remoção de sementes. Cutias foram observadas em 67% dos registros obtidos durante o monitoramento de frutos maduros; as palmeiras foram visitadas entre 07:00 e 18:45 h. As distâncias de dispersão variaram de 0.5 a 48.7 m (média ± dp = 6.8 ± 9.1 m) e a maioria das sementes removidas foram enterradas (57.8%). Estes resultados confirmam a importância de cutias para a dispersão de sementes de palmeiras do gênero *Astrocaryum*.

**Key words.** Activity patterns. Atlantic Forest. Rodents. Seed dispersal. Seed predation.


Agoutis (*Dasyprocta* spp.) are known to eat a variety of fruits and seeds in Neotropical forests and savannas (Henry, 1999; Silvius and Fragoso, 2003; Dubost and Henry, 2006). Due to its use of large seeds and its habit of hoarding food to later consumption—a behavior found in a small group of mammals like acouchies (Forget, 1991; Jansen et al., 2006), squirrels (Glanz, 1984; Paschoal and Galetti, 1995; Bordignon and Monteiro-Filho, 1999), some small rodents (Breuer and Rejmánek, 1999; Yasuda et al., 2000; Theimer, 2001; Cheng et al., 2005; Grenha et al., 2010) and a few Australian marsupials (Dennis, 2003; Murphy et al., 2005)—agoutis act as important seed disperses (Smythe, 1978, 1989; Asquith et al., 1999; Silvius and Fragoso, 2003; Galetti et al., 2006; Donatti et al., 2009). Some large-
seeded plant species may depend entirely on agoutis’ scatter-hoarding behavior for seedling recruitment (Smythe, 1989; Vander Wall, 1990). Seeds from the families Arecaceae, Chrysobalanaceae, Fabaceae, Lecythidaceae, Meliaceae, Myristicaceae, Moraceae and Sapotaceae are among the most consumed and dispersed by agoutis (Forget and Milleron, 1991; Peres and Baider, 1997; Brewer and Rejmánek, 1999; Silvius and Fragoso, 2003; Gorchov et al., 2004; Andreazzi et al., 2009).

Specifically on palm species, seed dispersal by *Dasyprocta* spp. was observed in the genus *Acrocomia* (Scariot, 1998), *Astrocaryum* (Smythe, 1989; Brewer and Rejmánek, 1999; Galetti et al., 2006; Donatti et al., 2009; Jorge and Howe, 2009), *Attalea* (Silvius, 2002; Pimentel and Tabarelli, 2004; Almeida and Galetti, 2007), *Bactris* (Silva and Tabarelli, 2001), *Phytelephas* (Dalling et al., 1996) and *Syagrus* (Guimarães et al., 2005). Despite the variety of studies reporting palm seed dispersal and predation by *Dasyprocta* spp., little is known about seed dispersal distances, especially in the Atlantic Forest. In this study we described the importance of the red-rumped agouti *Dasyprocta leporina* Linnaeus, 1758 in the seed dispersal of the palm *Astrocaryum aculeatissimum* (Schott) Burret, 1934 (Arecales) in the lowland forests of Rio de Janeiro state, southeastern Brazil. More specifically, we assessed fruit removal, seed fate following removal and dispersal distances. Besides that, the activity patterns of *D. leporina* while feeding on *A. aculeatissimum* seeds were also described.

The palm *A. aculetassimum*, locally known as iri or brejávia, is endemic to the Brazilian Atlantic Forest, occurring from Bahia to Santa Catarina (Henderson et al., 1995). Stems are solitary or aggregated, spiny, and four to eight meters tall. Infructescences may have from 23 to 116 (n = 9, unpublished data) single-seeded spiny fruits with a tiny mesocarp and a hard endocarp. Fruit length and diameter are 4.5 ± 0.6 and 3.2 ± 0.2 mm, respectively (data are mean ± sd, n = 242, unpublished data). Such dimensions limit the range of vertebrates that can handle and consume *Astrocaryum* fruits, which are considered typical megafauna dispersed-fruits, whose primary seed dispersers were extinct in the end of the Pleistocene (Guimarães et al., 2008). Nowadays, besides rodents—which are the main seed dispersers (Kiltie, 1981; Smythe, 1989; Forget, 1991; Brewer and Rejmánek, 1999; Brewer, 2001; Donatti et al., 2009)—primates, peccaries and tapirs have also been reported as consumers of *Astrocaryum* fruits (Hladik and Hadlik, 1969; Terborgh, 1986; Henry et al., 2000; Beck, 2006; Andreazzi et al., 2009). Non dispersed seeds of *Astrocaryum* usually suffer high levels of predation by scolytid and bruchid beetles, reducing seedling recruitment near parents (Smythe, 1989; Delobel et al., 1995; Galetti et al., 2006; Draxler et al., 2011).

*Dasyprocta leporina* occurs from Central Amazon to Southeast Brazil. Animals weight from 3.0 to 6.0 kg, are territorial and their home ranges varied from 3.0 to 8.5 ha (Emmons and Feer, 1990; Silvius and Fragoso, 2003; Jorge and Peres, 2005). The species is categorized as Vulnerable in the red list of the threatened fauna of Rio de Janeiro municipality (Vera y Conde et al., 2000) due to the small size of remaining forest fragments and illegal hunting.

This study was carried out in the main forest tracts of the two largest remnants (3500 and 6300 ha) of the threatened lowland Atlantic Forest at the state of Rio de Janeiro, respectively the União (22°27’S, 42°02’15’’ W; UN-3500) and Poço das Antas (22°32’S, 42°18’ W; PA-6300) Biological Reserves. The climate of the region is tropical warm and humid with average annual temperatures about 24 °C and average annual precipitation of c. 2100 mm (Programa Mata Atlântica, unpublished data). These areas differ in the abundance of *A. aculeatissimum* palms which is almost four times higher at União (94 versus 24 reproductive stems/ha; Pires, 2006).

During the fruiting seasons of 2003 and 2004 (from August to December) eight fruit individuals were monitored using camera-traps (DeerCam® and Trapacâmera®) aiming to identify the main consumers of *A. aculetassimum* fruits. Cameras worked all day long until the end of film or batteries, when
they were replaced, resulting in a sampling effort of 1950 h. The selected time interval from one photographic record to another was one minute. For each picture obtained, the species and the day and hour of the visit were recorded.

Fruit removal experiments were carried out from November to December 2003, during the period of the natural falling of ripe fruits. Fruits were collected in the field, taken to the laboratory for marking and placed in the field in the following morning. To be able to follow fruit fate, every seed was marked as follows: on each fruit a five millimeters metal ring was passed through a small hole made in the endocarp in each fruit. A 50 m thread was tied to the metal ring and a spool was placed inside a small container attached to a tree. Groups of five threaded endocarps were placed in 20 experimental stations spaced every 50 m, along pre-existing trails within each site. Marked fruits were left in the field for 30 consecutive days and after this time the fate of every fruit was recorded. Fruit fate was then categorized as: intact (not removed from experimental station), preyed upon by rodents or dispersed. Dispersed fruits were classified as moved away (dispersed but not buried) or scatter-hoarded (dispersed and buried) and had their distances to experimental stations measured. As adult palm density differed between areas, which could result in differences in the amount of available fruits and a consequently reduction in fruit removal at experiments, analyses were performed separately for each site.

The agouti was the main visitor of *A. aculeatissimum* fruits, appearing at 67% of the photographic records (n=42). The other species detected were the nine-banded armadillo *Dasypus novemcinctus* Linnaeus, 1758, which was registered nine times, the paca *Cuniculus paca* Linnaeus, 1766, the crab-eating fox *Cerdocyon thous* Linnaeus, 1766, the common opossum *Didelphis aurita* Wied-Neuwied, 1826, the brown four eyed opossum *Metachirus nudicaudatus* É. Geoffroy Saint-Hilaire, 1803 and the teiu lizard *Tupinambis meriane* Dumeril e Bibron, 1839—all registered only once. Besides *D. leporina*, possibly only the paca consumes *A. aculeatissimum* fruits as the amount of pulp is almost insignificant and endocarp hardness makes access to seeds difficult.

The visits of *D. leporina* to fruiting palms occurred during the day, from 07:00 h to 18:45 h, with a peak around noon time (Fig. 1). This result contrasts with the bimodal pattern of activity generally found by other authors (e.g. Smythe, 1978; Lambert et al., 2009; Norris et al., 2010), with peaks shortly after sunrise and before sunset. Nonetheless, foraging activity of agoutis can vary in response to food availability, daytime temperatures and moon phases (Smythe, 1978; Jorge and Peres, 2005; Lambert et al., 2009). For palms visited more than once by agoutis in the same day, the interval among subsequent visits was relatively short (mean ± sd = 16.9 ± 30.6 min, n = 18), suggesting that the same individual visited the palm repeatedly. Agoutis were seen interacting directly with fruits (Fig. 2).

The number of removed fruits at experimental stations was higher at PA-6300ha (Fig. 3),

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**Fig. 1.** Activity patterns of *Dasyprocta leporina* while feeding on fruits of the palm *Astrocaryum aculeatissimum* at two Atlantic Forest Biological Reserves (União and Poço das Antas), Rio de Janeiro state, Brasil.
non-buried seeds were removed up to 10 m from experimental stations (Fig. 4a). Scatter-
hoarded seeds follow the same pattern at UN-3500ha, while at PA-6300ha 60% of them
were dispersed for more than 10 m (Fig. 4b). Removal distances are in accordance with
those found by Donatti (2004) in São Paulo state, where it was found that agoutis were
the only species responsible for long-distance events (> 15 m) of A. aculeatissimum seed
dispersal. The author, however, did not found differences in the removal distances between
buried or non-buried seeds.

Differences between sites in the removal rates and dispersal distances could be due to
the higher density of A. aculeatissimum at UN-3500ha (Pires, 2006). Removal rates were
cia. 50% lower in this area, which could be a result of the competition between experimental
threaded fruits and those naturally available on the ground. This result can also reflect predator
satiation, as found in other studies involving seed rodents (e.g. Theimer, 2001; Romo et al.,
2004; Briani and Guimarães, 2007; Vieira et al., 2011). Considering removal distances, it
is expected that more valuable seeds be hidden further from parent trees to difficult their
encounter by predators and other competitors (Forget et al., 1998, Jansen et al., 2002). So,
the higher distances of buried seeds at PA-6300ha could be a result of the lower abundance
of reproductive palms in this area (Pires, 2006). In fact, negative relationships between
fruit abundance and seed removal distances have already been reported by other authors

Fig. 2. Dasyprocta leporina interacting with Astrocaryum aculeatissimum fruits at Poço das Antas Biological Reserve, Rio de Janeiro state, Brasil.

Fig. 3. Fate of Astrocaryum aculeatissimum seeds in controlled experiments carried out at two Atlantic Forest Biological Reserves (União and Poço das Antas), Rio de Janeiro state, Brasil.

corresponding to a removal rate of 1.47 seeds/day in this site against 0.67 seeds/day at UN-
3500ha. At both sites most of the removed seeds were dispersed (Fig. 3). Just nine seeds
at PA-6300ha were preyed upon; one at the experimental station and the others at distances
varying from 10 up to 47 m from the initial place where they were set (26.75 ± 25.47 m).
The majority of dispersed seeds was scatter-
hoarded in both sites (Fig. 3). Buried seeds
were usually cached alone and near landmarks,
such as roots or fallen logs, an agouti behav-
ior already reported by other authors (Kiltie,
1981; Smythe, 1989). Scatter-hoarded seeds
had the exocarp previously removed and were
buried 1-4 cm deep, with the germinative pore
turned down.

Seed dispersal distances ranged from
0.5 to 48.7 m and differed among scatter-
hoarded and non-buried seeds. At both sites
Nonetheless, the influence of other factors not evaluated in this study, such as agouti density or abundance of other food resources in each area, cannot be discarded.

As mentioned above, the seeds remaining below parent palms usually suffer high predation by scolytid and bruchid beetles, and the same was observed in the areas studied here (see Galetti et al., 2006). Therefore, D. leporina should play a fundamental role in the recruitment of A. aculeatissimum seedlings as observed in other studies involving agoutis and Astrocaryum palms (e.g. Smythe, 1989). In fact, in fragmented or defaunated forests where agoutis are rare or absent, A. aculeatissimum seedling recruitment was greatly reduced (Galetti et al., 2006, Donatti et al., 2009; Jorge and Howe, 2009). Considering this, management options should be planned to enhance the recruitment of Astrocaryum palms and other plant species dispersed by agoutis in areas where these animals are absent or scarce due to habitat loss or hunting. Considering the costs and failure risks associated with the manual addition of seeds and seedlings, the reintroduction or translocation of agoutis seems to be a better option.

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