Instituto Estadual de Florestas. 2008. Cobertura vegetal de Minas Gerais. Website: http://www.ief.meioambiente.mg.gov.br. Acessada em 07 de novembro de 2008.

Johns, A. D. and Skorupa, J. P. 1987. Responses of rain--forest primates to habitat disturbance: a review. *Int. J. Primatol.* 8 (2): 157–191.

Lemos de Sá, R. M. 1991. A população de *Brachyteles arachnoides* (Primates: Cebidae) da Fazenda Esmeralda, Rio Casca, Minas Gerais. Em: Rylands, AB. e Bernardes, AT, editores. *A primatologia no Brasil – 3*. Fundação Biodiversitas para a Conservação da Diversidade Biológica, Belo Horizonte, Minas Gerais. pp. 235–238.

Machado, A., Drummond, G. M. and Paglia, A. P. 2008. *Livro Vermelho da Fauna Brasileira Ameaçada de Extinção.* 1a. Ed. 2 vols. Brasília, DF, Belo Horizonte, MG: MMA e Fundação Biodiversitas. 1420pp.

Melo, F. R, Nogueira, D. F. and Rylands, A. B. 2002. Primatas do vale Jequitinhonha, Minas Gerais. Em: *Livro de Resumos. X Congresso Brasileiro de Primatologia, Sociedade Brasileira de Primatologia*. Universidade Federal do Pará, Belém, Pará p.56.

Melo, F. R., Moreira, L. S. and Ferraz, D. S. 2004. *Inventário da população de muriquis-do-norte (Brachyteles hypoxanthus) da Reserva do Ibitipoca, Lima Duarte – MG.* [Relatório Técnico não publicado]. U&M, Santa Rita do Ibitipoca, MG.

Mendes, S. L., Coutinho, B. R. and Moreira, D. O. 2003. Efetividade das unidades de conservação da Mata Atlântica para a proteção dos primatas ameaçados de extinção. Em: *VI Congresso de Ecologia do Brasil – Anais de Trabalhos Completos*, Editora da UFCE, Fortaleza. pp.286–287.

Mendes, S. L., Melo, F. R., Boubli, J. P., Dias, L. G., Strier, K. B., Pinto, L. P. S., Fagundes, V., Cosenza, B. A. P. and De Marco Jr., P. 2005. Directives for the consertavation of the northern muriqui *Brachyteles hypoxanthus* (Primates, Atelidae). *Neotrop. Primates* 13:7–18.

Mittermeier, R. A., Valle, C. M. C., Alves, M. C., Santos, I. B., Pinto, C. A. M., Strier, K. B., Young, A. L., Veado, E. M., Constable, I. D., Paccagnella, S. G. and Lemos de Sá, R. M. 1987. Current distribution of the muriqui in the Atlantic forest region of Eastern Brazil. *Primate Cons.* 8:143–149.

Mittermeier, R. A., Myers, N., Thomsen, J. B., Fonseca, G. A. B. and Olivieri, S. 1998. Biodiversity hotspots and major tropical wilderness areas: approaches to setting conservation priorities. *Conserv. Biol.* 12 (3): 516–520.

Myers, N., Mittermeier, R. A., Mittermeier, C. G., Fonseca, G. A. B. & Kent, J. 2000. Biodiversity hotspots for conservation priorities. *Nature* 403: 853–858.

Printes, R. C. and Strier, K. B. 1999. Behavioral correlates of dispersal in female muriquis (*Brachyteles arachnoides*). *Int. J. Primatol.* 20: 941–960.

Oliveira, E. G. R. 2003. Ocorrência de muriqui (*Brachyteles hypoxanthus*) no entorno do Parque Estadual do Ibitipoca, MG. Em: *Sociedade Brasileira de Mastozoologia. II Congresso Brasileiro de Mastozoologia*. PUC-Minas, Belo Horizonte. p.228.

Oliveira, E. G. R. 2004. Levantamento de mamíferos de médio e grande porte e estimativa de tamanho populacional de duas espécies de primatas no Parque Estadual do Ibitipoca, MG. [Dissertação de Mestrado]. Programa de Pós Graduação em Ecologia da Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brasil. 84 p.

Rodela, L. G. 1998. *Mapa de Vegetação e Uso do Solo – Parque Estadual do Ibitipoca – MG.* [Relatório Técnico não publicado]. IEF/DPB, Belo Horizonte, MG.

Rylands, A. B., Fonseca, G. A. B., Leite, Y. L. and Mittermeier, R. A. 1996. Primates of the Atlantic Forest, origin, distributions, endemism, and communities. Em: Norconk, P., editor. *Adaptive Radiations of Neotropical Primates*. Plenum Press, New York. pp. 21–51.

Strier, K. B. 1992. Faces in the forest: *The endangered Muriqui monkey of Brazil.* Oxford University Press, Oxford. 138 p.

Strier, K. B. 2000. Population viabilities and conservation implications for Muriquis (*Brachyteles aracnoides*) in Brazil's Atlantic Forest. *Biotropica* 32: 903–913.

PREDATION OF ADULT PALMS BY BLACK-CAPUCHIN MONKEYS (*CEBUS NIGRITUS*) IN THE BRAZILIAN ATLANTIC FOREST

Carlos Rodrigo Brocardo
Henrique Santos Gonçalves
Valesca Bononi Zipparro
Mauro Galetti

Introduction

Neotropical primates affect plant population through mutualistic interactions, such as seed dispersal, and antagonist interactions such as seed predation and herbivory (Peres, 1993; Russo and Augspurger, 2004; Mourthé *et al.*, 2008). Primates killing trees through herbivory is rarely documented (Rocha, 2000; Santos *et al.*, 2007). The genus *Cebus* (Erxleben, 1777) is considered as having the widest diet plasticity among neotropical primates, eating leaves, seeds, fruits, invertebrates and even vertebrates (Fedigan, 1990; Galetti and Pedroni, 1994; Susan and Rose, 1994; Rose, 1996; Ludwig *et al.*, 2005; Carretero-Pinzón *et al.*, 2008; Freitas *et al.*, 2008). In this paper, we documented the predation of two palm species through the consumption of palm heart (apical meristem) by black-capuchin monkey (*Cebus nigritus* Goldfuss, 1809).

Materials and methods

Our observations were carried out between June 2009 and June 2010 in "Carlos Botelho" State Park (CBSP) (24°06' and 24°14'S; 47°47' and 48°07'W), in São Paulo State, Brazil. The CBSP has an area of 37,644 ha of Atlantic Forest, and it is located in the Forest *Continuum* of Paranapiacaba massif. The annual average temperature varied from 15 to 19 °C, and the annual precipitation varied from 1700 to 2400 mm (Instituto Florestal, 2008). The density of black-capuchin monkeys in this site is estimated at 10.5 (± 2.4 SE) individuals/km², and the average group size is 5.16 (± 0.55 SE) individuals (Galetti *et al.*, unpub. data).

The records of palm heart predation (directly and indirectly) were taken during line transects of mammal survey (430 km, approach 500 hours) and during the displacements to line transects in the forest (about 200 field hours). Despite that the *C. nigritus* groups were not accompanied directly, the animals are relatively habituated to observers. The line transects surveys were carried monthly (10–15 days per month), when we encounter predation events, *ad libitum* observations were made (with binoculars or naked eye), each predation event was recorded by a single observer. We sampled adult trees through randomized 15 0.04-ha plots, and juvenile trees through 15 0.01-ha plots to estimate the capuchin-monkey palm predation (sampling tree adapted from Durigan, 2003). Chi-square analysis was used to estimate differences in predation intensity between seasons.

Results

We observed capuchin-monkeys preying upon palm hearts of *Euterpe edulis* Mart. in 14 occasions, being 12 times in the Winter (May–August), once in the Summer (November–February), and once in the Autumn (February–May). We recorded from one to four capuchin-monkeys (sub-adult and adult) feeding simultaneously on apical meristem, but each animal on a different palm. The group size in these events varied from 3 to 12 black-capuchin monkeys. Capuchin monkeys spend between 10 to 40 minutes (mean 25 ± 4 SE) to open the palm heart, varying principally with palm diameter. Initially, the monkeys bite the outer leaves, forcing them down using both hands, remaining supported with tail and posterior members on the palm stipe, then they repeat this process until liberate the apex of most leaves. After that, the animals bite the apex basis, to release it from the stipe, and consumed the apical meristem on other tree.

We found other 44 *E. edulis* killed by capuchins along the forest trails, of which 38 palms were killed in the Winter, four in the Summer, and two in the Autumn. The presence of recently signals permitted the identification of predation period (recently withdrawn leaves on the ground, recently destroyed apices and remains of consumed meristems; Fig. 1A and 1B). Other 12 palms were too old to determine the season of the predation (resting only the old destroyed apices). Considering direct and indirect observations of palms predation (only events where was possible determining the period of predation), the consumption of *E. edulis* differed significantly between seasons ($\chi^2 = 73.0$, $df = 2$, $p < 0.001$), being 10 times higher in the Winter than Summer, and 18 times greater than in the Autumn. The *E. edulis* palms killed had diameter at breast height from 8.6 to 15.4 cm (mean 12.8 ± 0.55 SE) and height from 7 to 20 m (mean 12.2 ± 0.94 SE). *E. edulis* is the most abundant arboreal plant in the study area, with a mean density of 93.3 (± 22.8 SE) adults/ha and 706.6 (± 90.7 SE) juveniles/ha. We estimated *E. edulis* adult mortality by capuchin monkeys at 1.7 (± 1.6 SE) individuals/ha per year (1.8 % of adult population).

Moreover, for the first time, we observed the predation of palm heart of *Geonoma gamiova* Barb. Rodr., an understory palm species, with height up to 4 m. Two adults *G. gamiova* were upon preyed by two adult capuchin monkeys (in the Winter). The process is similar to *E. edulis*, but beyond the animals supported on the palm, they supported in near lianas, taking for predation 8 minutes for a palm and 9 minutes for other.

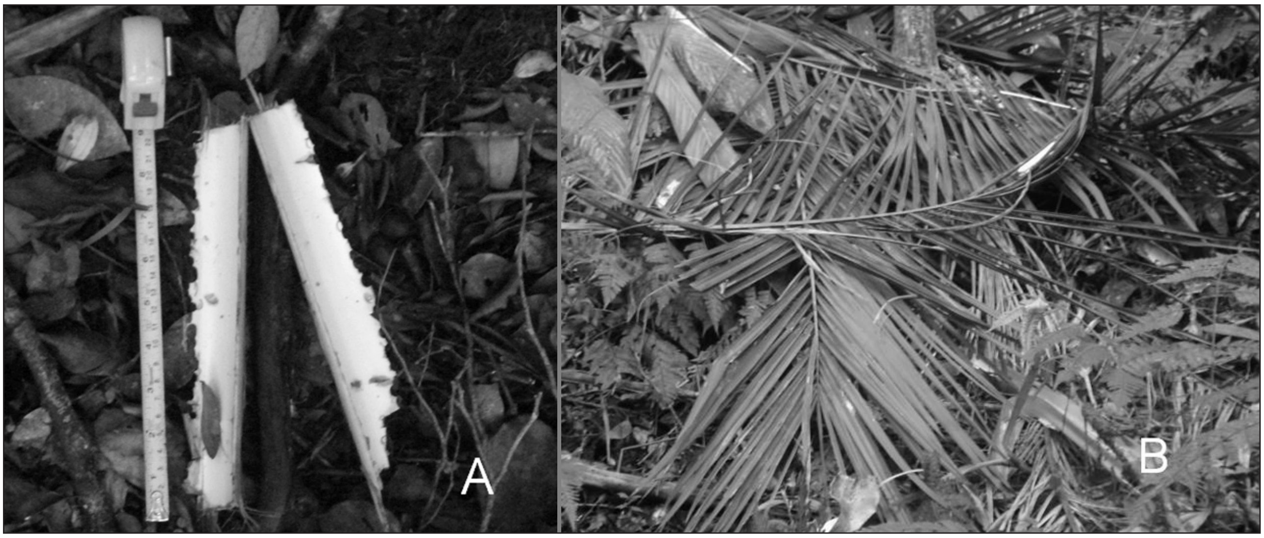

Figure 1. A) Remains of consumed apical meristem by *C. nigritus* in CBSP. B) Recently withdrawn leaves of *E. edulis* on the ground.

Discussion

The distribution of *E. edulis* and *C. nigritus* overlaps in most part of their occurrence in the Brazilian Atlantic Forest (Vilanova *et al.*, 2005; Herderson, 2000) (Fig. 2A). But, the palm heart predation by capuchin monkeys has been reported in a few places (Fig. 2B). In others areas we have worked, as the Iguaçu National Park (Araucaria Forest and Semidecidual Atlantic Forest, 185,262 ha continuous area, Paraná state, Brazil) and Semidecidual Atlantic Forest fragments in São Paulo state ("Mata São José" and "Mata Santa Genebra", both approximately 250 ha), this behavior or predation signals were never recorded. It is possible that the use of this resource may be related to the group cultural inheritance, such as tool use and food-processing (Antinucci and Visalberghi, 1986; Rocha *et al.*, 1998; Fragaszy *et al.*, 2004; O'Malley and Fedigan, 2005; Canale *et al.*, 2009). The group cultural inheritance in *Cebus* species, as well as other primate species, involves social learning, when the animals observe and interact with other group members, acquiring behaviors (Panger *et al.*, 2002; Dindo *et al.*, 2008; Dindo *et al.*, 2009). The removal of the apical meristem demands dexterity and physical effort, being not accomplished by all members of a group, commonly this is done by some adults and sub-adults, and is observed for young animals.

Except humans, *C. nigritus* seems to be one of the only vertebrate able to prey upon apical meristem of adults *E. edulis*, since white-lipped peccaries (*Tayassu pecari* Link, 1795) prey upon apical meristem of saplings (F. Rocha-Mendes unp. data), and one of the few primates killing an arboreal plant (see Santos *et al.*, 2007; Rocha, 2000). *E. edulis* is a palm with single stipe (differently of *Euterpe oleracea*), and removal of apical meristem leads to the death of individual. In forest fragments the main cause of mortality of *E. edulis* and *Geonoma brevispetha* (adult and juvenile palms) is the impact of meristem predation by black-capuchin monkeys (Souza and Martins, 2006; Santos *et al.*, 2007; Portela, 2008; Portela *et al.*, 2010). In areas where this behavior occurs, the capuchin monkeys may be helping to modeling the forest structure, similar to observed for ungulates (Silman *et al.*, 2003; Wyatt and Silman, 2004; Beck, 2007). The palm heart predation by capuchins may have consequences for other species, especially birds, rodents and ungulates that depend on *E. edulis* fruits during the Winter (Galetti *et al.*, 1999; Mikich, 2002). Nevertheless, this impact is much smaller than the one caused by human extraction, which may extirpate locally entire adult populations, being the higher threat to conservation of *E. edulis* (Galetti and Aleixo, 1998; Galetti and Fernadez, 1998; Pizo and Vieira, 2004).

Taira (2007) suggests that the consumption of palm heart in the Winter is an alternative source to insect scarcity, but not to fruit scarcity, which also occurs in the Winter at CBSP (Nakai, 2007). On the other hand, several papers concerning the diet of *C. nigritus* and congeners reported the use of alternative food resource in period of scarcity of fruits which normally constitute the main part of *Cebus* diet (Galetti and Pedroni, 1994; Peres, 1994; Freitas *et al.*, 2008). Therefore, we suggest that palm heart of *E. edulis* and, at a lesser extent, of *G. gamiova*, might be considered as a fallback food of *C. nigritus.* Indeed, fallback foods are defined as "foods consumed during seasons when preferred foods are unavailable" (Altman, 1998) or as "foods

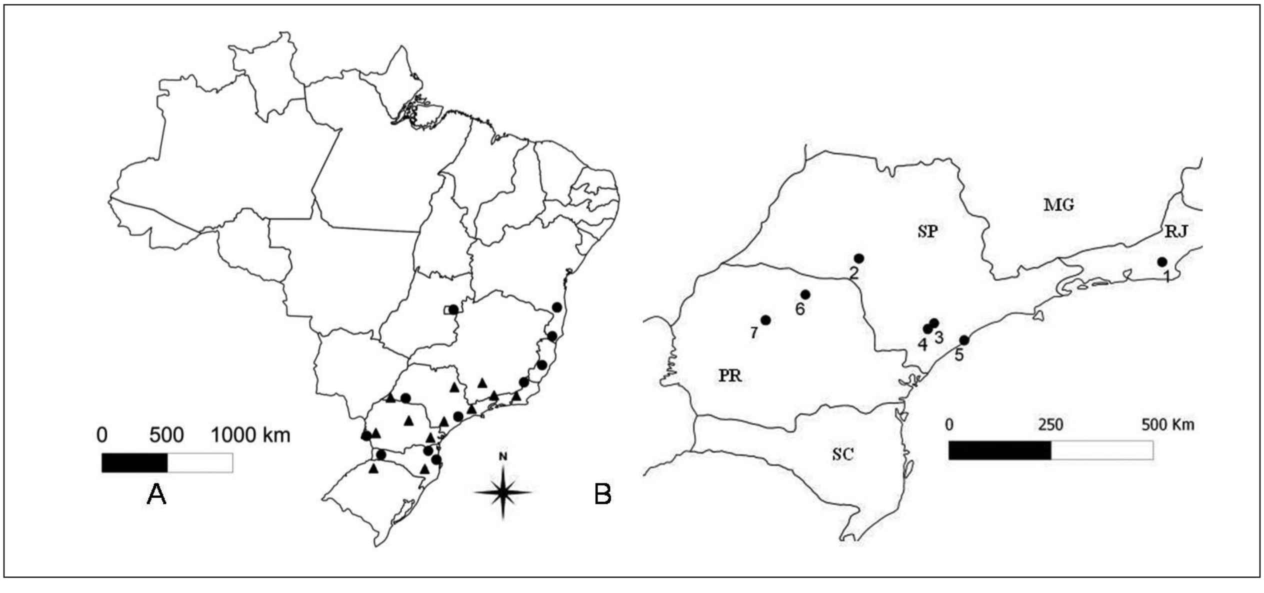

Figure 2. A) Distribution of *Cebus nigritus* (triangles) and *Euterpe edulis* (circles) in Brazil (adapted from Vilanova *et al.*, 2005 and Herderson, 2000); B) Areas with records of apical meristem predation of *E. edulis* by *C. nigritus*: 1 –Poços das Antas Biological Reserve, fragment (Portela, 2008; Portela *et al.*, 2010); 2 - Caetetus Ecological Station, fragment (R. Lázara pers. com.); 3 – CBSP, continuous (this paper, Taira, 2007); 4 –Intervales State Park, continuous (Zipparro and Galetti pers. ob.); 5 –Juréia-Itatins Ecological Station , continuous (P. Rubim pers. com.); 6 – "Mata" Doralice, fragment (Ludwig *et al.*, 2005); 7 –Vila Rica do Espírito Santo State Park, fragment (Santos *et al.*, 2007).

whose use is negatively correlated with the availability of preferred foods" (Marshall and Wrangham, 2007; reviewed in Lambert, 2009). *E. edulis* is known as a keystone-species, providing fruits and seeds for several animal species during the time of greatest shortage (Galetti *et al.*, 1999; Mikich, 2002). The consumption of meristem apical by *C. nigritus*, especially in the Winter, highlights another aspect of importance of this palm.

Acknowledgements

We thank the direction of CBSP and Fundação Florestal do Estado de São Paulo for allowing to carry out this study. We thank F. Rocha-Mendes, P. Rubim and R. Lázara for sharing their data with us. This work was supported by Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP) through the process BIOTA – FAPESP 2007/03392-6. C. R. B. and M. G. receives a CNPq fellowship (Conselho Nacional para o Desenvolvimento Científico e Tecnológico). V. B. Z. and H. S. G. received a FAPESP fellowship. We thank L. Culot and R. S. B. Gavira for improving the revision of manuscript. We thank referees for their comments and suggestions.

Carlos Rodrigo Brocardo*, **Valesca Bononi Zipparro** and **Mauro Galetti,** Laboratório de Biologia da Conservação, Universidade Estadual Paulista (UNESP), CEP 13.506-900. Av. 24 A, nº 1515, Rio Claro, São Paulo, Brazil, Henrique Santos Gonçalves, Laboratório de Biologia da Conservação, Universidade Estadual Paulista (UNESP) and Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio) – RESEX Médio Purus, Lábrea, Amazonas, Brazil. *Author for correspondence. E-mail: <carlosbrocardo@hotmail.com>

References

Altmann, S. A. 1998. *Foraging for survival*: yearling baboons in Africa. Chicago: University of Chicago Press.

Antinucci, F. and Visalberghi, E. 1986. Tool use in *Cebus apella:* A case study. *Int. J. Primatol.* 7 (4): 351–363.

Beck, H. 2006. A review of peccary–palm interactions and their ecological ramifications across the Neotropics. *J. Mammal.* 87 (3): 519–530.

Canale, G. R., Guidorizzi, C. E.,. Kierulff, M. C. M. and Gatto, C. A. F. R. 2009. First record of tool use by wild populations of the yellow-breasted capuchin monkey (*Cebus xanthosternos*) and new records for the bearded capuchin (*Cebus libidinosus*). *Am. J. Primatol.* 71:366–372.

Carretero-Pinzón, X.; Defler, T. R. and Ferrari, S. F. 2008. Observation of black-capped capuchins (*Cebus apella*) feeding on an owl monkey (*Aotus brumbacki*) in the colombian llanos. *Neotrop. Primates*, 15 (2): 62–63.

Dindo, M.; Thierry, B. and Whiten, A. 2008. Social diffusion of novel foraging methods in brown capuchin monkeys (*Cebus apella*). *P. R. Soc. B.* 275: 187–193.

Dindo, M., Whiten, A. and de Waal, F. B. M. 2009. In-group conformity sustains different foraging traditions in capuchin monkeys (*Cebus apella*). *PLoS ONE*, 4 (11): e7858. doi:10.1371/journal.pone.0007858.

Durigan, G. 2003. Métodos para análise da vegetação arbórea. In: *Métodos de estudo em biologia da conservação e manejo da vida silvestre*. Cullen, L.; Valladares-Paduá, C.; Rudran, R. (Eds.). Curitiba: Universidade Federal do Paraná; Fundação O Boticário de Proteção à Natureza, p.455–479.

Fedigan, L. M. 1990. Vertebrate predation in *Cebus capucinus*: meat eating in a neotropical monkey. *Folia Primatol.* 54: 196–205.

Fragaszy, D., Izar, P., Visalberghi, E. Ottoni, E.B. and Oliveira, M. G. 2004. Wild capuchin monkeys (*Cebus libidinosus*) use anvils and stone pounding tools. *Am. J. Primatol.* 64:359–366.

Freitas, C. H., Setz E. Z. F., Araújo, A. R. B. and Gobbi, N. 2008. Agricultural crops in the diet of bearded capuchin monkeys, *Cebus libidinosus* Spix (Primates: Cebidae), in forest fragments in southeast Brazil. *Rev. Bras. Zool.* 25 (1): 32–39.

Galetti, M. and Pedroni, F. 1994. Seasonal diet of capuchin monkeys (*Cebus apella*) in a semideciduous forest in south-east Brazil. *J. Trop. Ecol.* 10: 27–39.

Galetti, M. and Aleixo, A. 1998. Effects of palm heart harvesting on avian frugivores in Atlantic rain forest of Brazil. *J. Appl. Ecol.* 35: 286–293.

Galetti, M. and Fernadez, J. C. 1998. Palm heart harvesting in the Brazilian Atlantic Forest: Changes in industry struture and the ilegal trade. *J. Appl. Ecol.* 35: 294–301.

Galetti, M., Zipparro, V. B. and Morellato, P. C. 1999, Fruiting phenology and frugivory on the palm *Euterpe edulis* in a lowland Atlantic forest of Brazil. *Ecotropica*, 5: 115–122.

Henderson, A. 2000. The Genus *Euterpe* in Brazil. Itajaí. In: *Euterpe edulis Martius* (*Palmiteiro*): biologia, conservação e manejo. Reis, M.S. and Reis, A. (Eds.). Itajaí: Herbário Barbosa Rodrigues, p.1–22.

Instituto Florestal. 2008. *Parque Estadual Carlos Botelho:* plano de manejo. São Paulo: Instituto Florestal.

Lambert, J. E. 2009. Summary to the symposium issue: primate fallback strategies as adaptive phenotypic plasticity – scale, pattern and process. *Am. J. Phys. Anthropol.* 140:759–766.

Ludwig, G., Aguiar, L. M. and Rocha, V. J. 2005. Uma avaliação da dieta, da área de vida e das estimativas populacionais de C*ebus nigritus* (Goldfuss, 1809) em um fragmento florestal no norte do estado do Paraná. *Neotrop. Primates* 13 (3): 12–18.

Marshall, A. J and Wrangham, R. W. 2007. Evolutionary consequences of fallback foods. *Int. J. Primatol.* 28: 1219–1236.

Mikich, S. B. 2002. A dieta frugívora de *Penelope superciliaris* (Cracidae) em remanescentes de Floresta Estacional Semidecidual no Centro-Oeste do Paraná, Brasil e sua relação com *Euterpe edulis* (Arecacae). *Ararajuba* 10 (2): 207–217.

Mourthé, I. M. C.; Strier, K. B. and Boulbi, J. P. 2008. Seed predation of *Mabea fistulifera* (Euphorbiaceae) by northern muriquis (*Brachyteles hypoxanthus*). *Neotrop. Primates* 15 (2): 40–45.

Nakai, É. S. 2007. Fissão-fusão em *Cebus nigritus*: Flexibilidade social como estratégia de ocupação de ambientes limitantes. MSc thesis. Instituto de Psicologia. Universidade de São Paulo, São Paulo.

O'Malley, R. C. and Fedigan, L. 2005. Variability in food-processing behavior among white-faced capuchins (*Cebus capucinus*) in Santa Rosa National Park, Costa Rica. *Am. J. Phys. Anthropol.* 128: 63–73.

Panger, M. A.; Perry, S.; Rose, L.; Gros-Louis, J.; Vogel, E.; Mackinnon, K. C. and Baker, M. 2002. Cross-site differences in foraging behavior of white- faced capuchins (*Cebus capucinus*). *Am. J. Phys. Anthropol.* 119:52–66.

Peres, C. A. 1994. Primates responses to phenological changes in an Amazonian Terra Firme Forest. *Biotropica* 26 (1): 98–112.

Peres, C. A. 1993. Notes on the ecology of buffy saki monkeys *(Pithecia albicans,* Gray 1860): A canopy seed-predator. *Am. J. Primatol.* 31:129–140.

Pizo, M. A. and Vieira, E. M. 2004. Palm harvesting affects seed predation of *Euterpe edulis*, a threatened palm of the Brazilian Atlantic Forest. *Braz. J. Biol.* 64(3B): 669–676.

Portela, R. C. Q. 2008. Ecologia populacional de três espécies de palmeiras em uma paisagem fragmentada no domínio Mata Atlântica, RJ. Doctoral thesis. Universidade Estadual de Campinas, Campinas.

Portela, R. C. Q., Bruna, E. M. and Santos, F. A. M. 2010. Demography of palm species in Brazil's Atlantic forest: a comparison of harvested and unharvested species using matrix models. *Biodivers. Conserv.* 19: 2389–2403.

Rocha, V. J. 2000. Macaco-prego, como controlar esta nova praga florestal? *Floresta* 30 (1/2): 95–99.

Rocha, V. J., Reis, N. R. and Sekiama, M. L. 1998. Uso de ferramentas por *Cebus apella* (Linnaeus) (Primates, Cebidae) para obtenção de larvas de Coleoptera que parasitam sementes de *Syagrus romanzoffianum* (Cham.) Glassm. (Arecaceae). *Rev. Bras. Zool.* 15 (4): 945–950.

Rose, L. M. 1997. Vertebrate predation and food-sharing in *Cebus* and *Pan*. *Int. J. Primatol.* 18 (5): 727–765.

Russo, S. E. and Augspurger, C. K. 2004. Aggregated seed dispersal by spider monkeys limits recruitment to clumped patterns in *Virola calophylla*. *Ecol. Lett.* 7: 1058–1067.

Santos, C. V., Morais Jr, M. M., Oliveira, M. M., Mikich, S. B., Ruiz-Miranda, C. R. and Moore, K. P. da L. 2007. Ecologia, comportamento e manejo de primatas invasores e populações-problema. In: *A Primatologia no Brasil.* Bicca-Marques, J. (Ed.), Vol. 10, Sociedade de Brasileira Primatologia, Porto Alegre. Pp. 101–108.

Souza, A. F. and Martins, F. R. 2006. Demography of the clonal palm *Geonoma brevispatha* in a Neotropical swamp. *Austral Ecol.*, 31: 869–881.

Silman, M. R., Terborgh, J. W. and Kiltie R. A. 2003. Population regulation of a dominant rain forest tree by a major seed predator. *Ecology* 84 (2): 431–438.

Susan, P. and Rose, L. 1994. Begging and transfer of coati meat by white-faced capuchin monkeys, *Cebus capucinus. Primates* 35(4): 409–415.

Taira, J. T. 2007. Consumo de palmito-juçara (*Euterpe edulis* Mart.) por macacos-pregos (*Cebus nigritus*): Estratégia de forrageamento ótimo ou requinte de um goumert? MSc Thesis. Instituto de Psicologia. Universidade de São Paulo, São Paulo.

Vilanova, R., Silva Júnior, J. S., Grelle, C. E. V., Marroig, G. and Cerqueira, R. 2005. Limites climáticos e vegetacionais das distribuições de C*ebus nigritus* e *Cebus robustus* (Cebinae, Platyrrhini). *Neotrop. Primates* 13 (1): 14–19.

Wyatt, J. L. and Silman, M. R. 2004. Distance-dependence in two Amazonian palms: effects of spatial and temporal variation in seed predator communities. *Oecologia* 140: 26–35.

NOTEWORTHY RECORD OF A BLACK HOWLER MONKEY (*ALOUATTA CARAYA*) FROM THE CENTRAL DRY CHACO OF PARAGUAY

Anthony J. Giordano
Warren B. Ballard

Howler monkeys (*Alouatta*) comprise a diverse genus of neotropical primates that range from southern Mexico (*A. palliata*, *A. pigra*) to northern Argentina and southeastern Brazil (*A. guariba*, *A. caraya*) (Cortés-Ortiz *et al.*, 2003). Howler monkeys are the most folivorous of the Neotropical primates (Terborgh, 1983), and thus must forage for long periods to meet their high energetic demands. The southernmost distributed of the howler species, the South American black howler (*A. caraya*) has been reported to occur at the highest densities (Zunino and Rumiz, 1986; Bicca-Marques, 1990; Rumiz, 1990; Crockett, 1998). Considered principally an inhabitant of tropical lowland deciduous and semideciduous forests, black howlers are also known to frequent the gallery forests of the Rio Paraguay and Rio Paraná, as well as the seasonally inundated Pantanal in Brazil (Redford and Eisenberg, 1992; Crockett, 1998).

In Paraguay, black howlers are mostly associated with inland Atlantic forest fragments in the east and gallery forests of high rainfall in the Chaco (Stallings, 1985; Crockett, 1998). However, they have not been reported from the more xeric regions of the Chaco Boreal far from a major drainage system. Stallings and Mittermeier (1983: 161) found that *A. caraya* was "recorded from the higher forest [of the Chaco Boreal] but seemed to be rare in the region." However, they made no specific reference to geographic location, as howlers were not the primary subject of their discussion. Furthermore, they did not reference the time of year their primate observations were made. In conducting primate transects at Chaco Defensores National Park, Stallings *et al.* (1989) failed to record an observation of