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Comunicação Científica

Consumption of the invasive alien species *Hovenia dulcis* Thumb. (Rhamnaceae) by *Sapajus nigritus* Kerr, 1792 in a protected area in southern Brazil.

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Resumo. Consumo da espécie invasora *Hovenia dulcis* Thumb. (Rhamnaceae) por *Sapajus nigritus* Kerr, 1972 em uma área protegida no sul do Brasil. *Hovenia dulcis* é uma espécie exótica invasora no Brasil, amplamente distribuída em algumas regiões, como no sul do país, inclusive dentro de áreas protegidas. Durante um levantamento populacional de *Sapajus nigritus* no Parque Estadual Fritz Plaumann (PEFP), localizado no município de Concórdia, oeste do estado de Santa Catarina, observamos o consumo de pseudofrutos de *H. dulcis* por essa espécie. Em áreas protegidas, comportamentos como este não podem ser negligenciados uma vez que o consumo observado pode facilitar o processo de invasão de uma espécie exótica com alto potencial de risco para a biodiversidade local.

Palavras-chave: macaco-prego, comportamento alimentar, uva-do-japão, invasão biológica.

Abstract. Consumption of the invasive alien species *Hovenia dulcis* Thumb. (Rhamnaceae) by *Sapajus nigritus* Kerr, 1792 in a protected area in southern Brazil. *Hovenia dulcis* is an exotic invasive species in Brazil, widely found in some areas, such as the southern region of the country, including in protected areas. During a population survey of *Sapajus nigritus* in the Fritz Plaumann State Park (FPST), located in the municipality of Concórdia, western Santa Catarina state, we observed the consumption of pseudofruits of *H. dulcis* by this species. In protected areas, these type of behaviors cannot be overlooked, as this can facilitate the invasion process of a exotic species with a high potential risk to the local biodiversity.

Keywords: black-horned capuchin monkey, feeding behavior, Japanese raisin tree, biological invasion.

Hovenia dulcis Thumb. (Rhamnaceae) is a tree native to China, Japan, and Korea. Their fruits are small globose capsules with diameter from 6 to 7 mm called pseudofruits (Carvalho, 1994). They have sweet taste and contain from 2 to 4 seeds that can be carried by frugivorous birds and mammals (Carvalho, 1994). It is widely found in Brazilian tropical and subtropical forests, as well as in steppes and ecotones between these plant formations, from interior forests of Bahia state, throughout Cerrado, Atlantic forest ecosystems, to Araucaria moist forests (Zenni & Ziller, 2011). According to these authors, *H. dulcis* is one of the four most pervasive species in Brazilian subtropical forests, competing with native species for space, light and nutrients, and reducing the availability of these resources. Its allelopathic potential on plant species is also known. Seedlings of *Lactuca sativa* L. (Asteraceae) were significantly affected in the presence of aqueous extracts of pseudofruits and leaves of *H. dulcis* (Wandscheer *et al.*, 2011).

In southern Brazil, *H. dulcis* is used in rural properties for timber production (Selle, 2009), shading in crops, fields and pastures, hedges, and for energy production (Inoue *et al*., 1978, Carvalho, 1994; Buono *et al*., 2008). This might have contributed for spreading the species, which is currently found in many protected areas such as the Turvo State Park in Rio Grande do Sul state (Sema, 2005), Araucarias State Park (Fatma, 2007) and Fritz Plaumann State Park, in Santa Catarina state.

Capuchin monkeys (genera *Cebus* and *Sapajus*) are omnivorous and opportunistic species, but their diet is classified as frugivore-insectivore (Bicca-Marques *et al*., 2006), making them a potential seed disperser. The propensity of capuchin monkeys to accept novel foods that are easy to obtain and to process (Fragaszy *et al*., 1997; Visalberghi *et al*., 2003) increases the probabilities of include human-provided food resources as well as non-native species into their diet. In fact, the consumption of human cultivated plants, such as mango [*Cebus capucinus* (Linnaeus, 1758); Baker & Schutt, 2005], cocoa (*Sapajus apella* Kerr, 1792; Oliveira & Fialho, 2007), corn and sugar cane (*Sapajus libidinosus* Kerr, 1792; Freitas *et al.,* 2008), and American pine (*Sapajus nigritus* Kerr, 1792; Rocha, 2000) has become more frequently observed.

The consumption of *H. dulcis* by capuchin monkeys has been reported in antropized areas of primary vegetation (Ludwig *et al*., 2005), but there are no previous records for protected areas. Documenting the consumption of invasive alien species by primates is important to evaluate the potential contribution of these animals as seed dispersers.

We observed the consumption of pseudofruits of *H. dulcis* by *S. nigritus* in the Fritz Plaumann State Park, western Santa Catarina state, in southern Brazil (27°17'36" S; 52°06'38" W; Figura 1). The park

Figura 1. Location of the Fritz Plaumann State Park, Concórdia, Santa Catarina, southern Brazil.

comprises a total area of 741 hectares and lies within the Brazilian rainforest, in a transitional region between seasonal deciduous forest and Araucaria forest (Velloso & Góes-Filho, 1982). The density of *H. dulcis* is high (340 trees per hectare) with a clustered spatial distribution in the study area (m. s. dechoum, pers. com.).

The population of the black-horned capuchin monkey in the study area was surveyed from January through December 2010 following the line transect method (Buckland *et al.,* 2010). Here we report occasional feeding records obtained with the aid of binoculars by an observer walking in four pre-existing transects in the area.

In three encounters, on 24 May, 12 June, and 11 September 2010, we observed groups of 10, 17 and 7 individuals of *S. nigritus,* respectively, feeding on pseudofruits of *H. dulcis*. The monkeys picked ripe pseudofruits from tree branches, feed on them, and then threw the branches to the ground. Some uneaten peduncles were thrown to the ground, although most of the fruits removed were immediately ingested.

The aggregated distribution of *H. dulcis* allows more individuals consume pseudofruits simultaneously, and can concentrate the activity of the groups during foraging. In fact, in the areas where *H. dulcis* occurs in high-density clusters (m. s. dechoum, pers. com.), the monkeys were sighted more frequently. Characteristics such as highly attractive display (strong odor and the high pulp to seed ratio) and abundant production of edible parts (pseudofruits) (Richardson *et al.,* 2000) also contribute to attract monkeys and promote consumption.

Additionally, some aspects of the behavior of capuchin monkeys can increase their effectiveness as seed dispersers (Schupp *et al*., 2010), indicating a possible role in the dispersal of *H. dulcis*. First, the large number of monkeys feeding simultaneously (up to 17 recorded in this study) promotes the removal of a large quantity of seeds, either individually or as a group (Wehncke *et al*., 2003). Second, its ability to disperse small seeds such as those of *H. dulcis* in a frequency higher than expected by chance (Izar *et al*., 2008). And a high germination rate of small seeds after passing through the digestive tract of some species of capuchin monkeys, such as *C. capucinus* (Wehncke & Dalling, 2005). Third, capuchin monkeys usually make long daily journeys (1605.0 ± 488.7 m; Rímoli *et al.,* 2008) and may transport seeds far from the mother plant. Seed dispersal distances recorded for other species of capuchin monkeys support this pattern: mean 390 m (SD= 215 m) for *S. apella* (Zhang & Wang, 1995), mean 235.6 m (Valenta & Fedigan, 2010) and up to 1,000 m (Rowell & Mitchell, 1991) for *C. capucinus*. Capuchin monkeys produce 8-10 defecations per day (Wehncke *et al*., 2003), usually separated by large distances (mean= 81 m, 28.3 min) (Valenta & Fedigan, 2010), swallowing seeds in a scattered pattern in the forest. Thus, *S. nigritus* may act as a facilitator of the invasion of *H. dulcis* in the study area. However, further studies are necessary to quantify their consumption and effectiveness as dispersers.

The black-tufted capuchin monkey is not the only species that feeds on *H. dulcis* in the study area. We also observed seeds of this species in feces of the crab-eating fox (*Cerdocyon thous,* Linnaeus, 1776), as described by Rocha *et al*., (2008). Fleshy-fruited invasive plants can provide important food resources for the native fauna, and new mutualistic interactions can emerge between them (Richardson *et al*., 2000; Buckley *et al*., 2006; Strayer *et al*., 2006). Such mutualisms may enhance a plant's invasive potential via increased dispersal effectiveness (Panetta & McKee, 1997; Wenny, 2001; Mandon-Dalger *et*

al., 2004), causing disruptions to previously existing interactions among native species, and affecting not only the fruit-frugivore interactions, but the entire biological community (Buckley *et al*., 2006; Strayer *et al*., 2006).

To efficiently manage a zoocoric invasive species such as *H. dulcis* in conservation units, the effective dispersers need to be known (Buckley *et al*., 2006). These questions are important and should be addressed in the management plan and in the development of strategies to control and remove alien species, such as *H. dulcis,* in the Fritz Plaumann State Park and other protected areas.

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REFERENCES

Baker, m. & Schutt, a. 2005. Managing monkeys and mangos, pp. 444- 463. *In*: Paterson, j.d. & Wallis, j. (eds.). **Commensalism and Conflict:** The Human-Primate Interface. American Society of Primatologists, Norman: Oklahoma. 249p.

Bicca-marques, j.c.; Silva, v. & Gomes, d.f. 2006. Ordem Primates, pp.101-148. *In*: Reis, n.r. Dos; Peracchi, a.l.; Pedro, w.a.; Lima, i.p. De. (eds.). **Mamíferos do Brasil**. Londrina. 437p.

Buckley, y.m.; Anderson, s.; Catterall, c.p.; Corlett, r.t.; Engel, t.; Gosper, c.r.; Natahan, r.; Richardson, d.m.; Setter, m.; Spiegel, o.; Vivian-smith, g.; Voigt, f.a.; Weir, j.e.s. & Westcott, d.a. 2006. Management of plant invasions mediated by frugivore interactions. **Journal of Applied Ecology 43** (5): 848-857.

Buckland, s.t.; Plumptre, a.j.; Thomas, l. & Rexstad, e.a. 2010. Design and Analysis of Line Transect Surveys for Primates. **International Journal of Primatology 31** (5): 833-847.

Buono, r.a.; Oliveira, a.b. & Paiva, e.a.s. 2008. Anatomy, ultrastructure and chemical composition of food bodies of *Hovenia dulcis* (Rhamnaceae). **Annals of Botany 101**: 1341-1348.

Carvalho, p.e.r. 1994. **Ecologia, silvicultura e usos da uva-do-japão (*Hovenia dulcis* Thunberg)**. Colombo: EMBRAPA-CNP Florestas. (Boletim Técnico, 23).

Fatma - Fundação do Meio Ambiente de Santa Catarina. 2007. **Plano de Manejo do Parque Estadual das Araucárias.** Estado de Santa Catarina: [s.n.], 55p. Disponível em: <http://www.fatma.sc.gov.br> Acesso em: 11. set. 2012

Fragaszy, d.m.; Visalberghi, e. & Galloway, a.t. 1997. Infant tufted capuchin monkeys behaviour with novel foods: opportunism, not selectivity. **Animal Behaviour 53** (6): 1337-1343.

Freitas, c.h.; Setz, e.z.f.; Araújo, a.r.b. & Gobbi, n. 2008. Agricultural crops and the diet of bearded capuchin monkeys *Cebus libidinosus*, Spix (Primates: Cebidae) in forests fragments in southeastern Brazil. **Revista Brasileira de Zoologia 25** (1): 32-39.

Inoue, o.; Takeda, t. & Ogihara, y. 1978. Carbohydrate structures of three new saponins from the Root Bark of *Hovenia dulcis* (Rhamnaceae). **Journal of the Chemical Society 1**:1289-1293.

Izar, p. 2008. Dispersão de sementes por *Cebus nigritus* e *Brachyteles arachnoides* em área de Mata Atlântica, Parque Estadual Intervales, SP, pp. 8-24. *In*: Ferrari, s.f & Rímoli, j. (eds.). **A Primatologia no Brasil - 9**. Sociedade Brasileira de Primatologia, Biologia Geral e Experimental – UFS, Aracaju. 201p.

Ludwig, g.; Aguiar, l.m. & Rocha, v.j. 2005. Uma avaliação da dieta, área de vida e estimativas populacionais de *Cebus nigritus* (Goldfuss, 1809) em um fragmento florestal no norte do estado do Paraná. **Neotropical Primates 13** (3): 12-18.

Mandon-Dalger, i.; Clergeau, p.; Tassin, j.; Rivière, j. n. & Gatti, S. 2004. Relationships between alien plants and an alien bird species on Reunion Island. **Journal of Tropical Ecology 20** (6): 635–642.

Oliveira, m.m. & Fialho, m.s. 2007. Instalação de cercas para evitar a predação de frutos de cacau por macaco-prego em Rondônia, Brasil. **Neotropical Primates 14** (1): 34.

Panetta, f.d. & McKee, j. 1997. Recruitment of the invasive ornamental *Schinus terebinthifolius* is dependent upon frugivores. **Australian Journal of Ecology 22** (4)**:** 432–438.

Richardson, d. m.; Allsopp, n.; D'antonio, c, m.; Milton, s. & Rejmánek, m. 2000. Plant invasions: the role of mutualisms. **Biological Review 75**: 65-93.

Rímoli, j.; Strier, k.b. & Ferrari, s.f. 2008. Seasonal and longitudinal variation in the behavior of free-ranging black tufted capuchins *Cebus nigritus* (Goldfuss, 1809) in a fragment of Atlantic Forest in Southeastern Brazil, pp.130-146. *In:* Ferrari, S.F. & Rímoli, J. (eds.). **A Primatologia no Brasil – 9**. Sociedade Brasileira de Primatologia, Biologia Geral e Experimental – UFS, Aracaju. 201p.

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

Rocha, v.j.; Aguiar, l.m.; Silva-Pereira; j.e.; Moro-Rios, r.f. & passos, f.c. 2008. Feeding habits of the crab-eating fox, *Cerdocyon thous* (Carnivora: Canidae), in a mosaic area with native and exotic vegetation in Southern Brazil. **Revista Brasileira de Zoologia [online] 25** (4): 594-600.

Rowell, t. e. & Mitchell, b. j. 1991. Comparison of seed dispersal of guenons in Kenya and capuchins in Panama. **Journal of Tropical Ecology 7**: 269-274.

Schupp, e.w.; Jordano, p. & Gómez, j.m. 2010. Seed dispersal effectiveness revisited: a conceptual review. **New Phytologist 188** (2): 333-353.

Selle, g.l. 2009. **Guias de densidade e índices de sítios para Hovenia dulcis Thunberg na região central do estado do Rio Grande do Sul, Brasil**. Tese de Doutorado. Universidade Federal de Santa Maria. 100p.

Sema – Secretaria Estadual do Meio Ambiente. 2005. Plano de Manejo do Parque Estadual do Turvo. Estado do Rio Grande do Sul: [s.n.], 348p. Disponível em: <http://www.sema.rs.gov.br/upload/Plano_manejo_PETurvo.pdf> Acesso em: 11. set. 2012.

Strayer, d.l.; Eviner, v.t.; Jeschke, j.m. & Pace, m.l. 2006. Understanding the long-term effects of species invasions. **Trends in Ecology and Evolution 21** (11): 645-651.

Valenta, k. & Fedigan, l. m. 2010. Spatial Patterns of Seed Dispersal by White-Faced Capuchins in Costa Rica: Evaluating Distant-Dependent Seed Mortality. Biotropica 42 (2): 223-228.

Velloso, h.p. & Góes-Filho, l. 1982. **Fitogeografia Brasileira:** classificação fisionômica - ecológica da vegetação neotropical. Boletim Técnico do Projeto RADAMBRASIL, Série Vegetação 1. 80p.

Visalberghi, e.; Janson, c.h. & Agostini, i. 2003. Response toward novel foods and novel objects in wild *Cebus apella*. **International Journal of Primatology 24** (3): 653-675.

Wandscheer, a.c.d.; Borella, j.; Bonatti, l.c. & Pastorini, l.h. 2011. Atividade alelopática de folhas e pseudofrutos de *Hovenia dulcis* Thunb. (Rhamnaceae) sobre a

germinação de *Lactuca sativa* L. (Asteraceae). **Acta Botânica Brasilica 25** (1): 25-30.

WEHNCKE, E.V.; HUBBELL, S.P.; FOSTER, R.B. & DALLING, J.W. 2003. Seed dispersal patterns produced by white-faced monkeys: implications for the dispersal limitation of neotropical tree species. Journal of Ecology 91 (4): 677-685.

WEHNCKE, E.V. & DALLING, J.W. 2005. Post-Dispersal seed removal and germination selected tree species dispersed by **Cebus capucinus** on Barro Colorado Island, Panama. Biotropica 37 (1): 73-80.

WENNY, D.G. 2001. Advantages of seed dispersal: a re-evaluation of directed dispersal. **Evolutionary Ecology Research 3**: 51–74.

ZENNI, R.D. & ZILLER, S.R. 2011. An overview of invasive plants in Brazil. **Revista Brasileira de Botânica 34** (3): 431-446.

ZHANG, **S.Y.** & WANG, **L.X.** 1995. Fruit consumption and seed dispersal of *Ziziphus cinnamomum* (Rhamnaceae) by two sympatric primates (*Cebus apella* and *Ateles paniscus*) in French Guiana. **Biotropica 27** (3): 397-401.

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