ISSN 1517-6770

Short Communication

First record of occurrence of black-tufted marmoset *Callithrix penicillata* (É. Geoffroy, 1812) (Primates, Callitrichidae) in Northern Paraná, Brazil

Gabriela Regina de Oliveira[1*], Gisele da Silva Porto[1], Diego Azevedo Zoccal Garcia[1,2], Armando César Rodrigues Casimiro[2], Ana Paula Vidotto-Magnoni[2] & Mário Luís Orsi[2]

*[1]Programa de Pós-graduação em Ciências Biológicas, Universidade Estadual de Londrina, Londrina, Paraná, Brazil. *Corresponding author: gabeoliveira@hotmail.com.*

[2]Laboratório de Ecologia de Peixes e Invasões Biológicas, Universidade Estadual de Londrina, Londrina, Paraná, Brazil.

Abstract. Invasive species always endanger biodiversity because of their competing efficiency for food resources, high reproduction, and dispersion capacity. The aim of this study is to report the first record of 10 specimens of a small-sized primate, *Callithrix penicillata*, introduced in an Atlantic Rainforest fragment, Northern Paraná, Brazil. Due to their generalist feeding habit, behavior flexibility and parental care, the species adapted itself to different habitat and types of food. The monitoring of the group should be enhanced since the characteristics of the environment which provides them with food and shelter, coupled to the forced placement of the specimens in the fragments, may establish the species in the area.

Keywords: Atlantic forest, Biological invasions, Non-native species, Propagule pressure.

Resumo. Primeiro registro de ocorrência de sagui de tufo preto *Callithrix penicillata* (É. Geoffroy, 1812) (Primates, Callitrichidae) no norte do Paraná, Brasil. Espécies invasoras ameaçam a biodiversidade por sua eficiência na competição por recursos e elevada capacidade reprodutiva e de dispersão. O trabalho reporta o primeiro registro de 10 indivíduos de *Callithrix penicillata*, primata de pequeno porte, introduzidos em um fragmento florestal de Mata Atlântica, no norte do Paraná. Devido ao hábito alimentar generalista, flexibilidade comportamental e cuidado parental, a espécie pode adaptar-se a diferentes habitat e tipos de alimentação. Assim, destaca-se a necessidade de monitorar o grupo, tendo em vista que as características do ambiente, que propiciam alimento e abrigo, e o número de indivíduos liberados como pressão de propágulo na natureza, podem permitir o estabelecimento da espécie na área.

Palavras-chave: Espécies não nativas, Invasões biológicas, Mata Atlântica, Pressão de propágulo.

Accidental or intentional transporting of organisms beyond their original distribution area causes the introduction of non-native species and the initial stage in the process of biological invasion (Casimiro *et al.*, 2010; Vitule & Prodocimo, 2012). The process ends up in the establishment of a viable population and its expansion and territorial dispersion (Blackburn *et al*., 2011). Invading species are highly efficient in the competition for resources, coupled to reproduction capacity and dispersion (Williamson & Fitter, 1996; Carter & Leonard, 2002; Deberdt & Scherer, 2007; Vitule & Prodocimo, 2012; Vale & Prezoto, 2015). They consequently prevail in the environment and endanger native species and the ecosystem, causing an ecologically inferior condition to the original species, with loss of biodiversity and ecological processes (Williamson & Fitter, 1996; Vitule *et al*., 2009; Mcgeoch *et al*., 2010; Mantoani *et al.*, 2013; Orsi & Britton, 2014). Thereby, the introduction rate of a new species increases (Ziller, 2006; Wood *et al*., 2015) with a subsequent break in the resilience of the system.

Callithrix penicillata (É. Geoffroy, 1812) (Primates, Callitrichidae), commonly known as black-tufted marmoset, is a small-sized species, weighing between 300 and 450 g (Silva *et al*., 2014). It is distinct from the other species of the genus due to its brush-like black hair tufts near the ears (Oliveira *et al*., 2015). *C. penicillata* has a diverse diet that includes arthropods, small vertebrates, fruits, nectar, flowers and exudates (Oliveira *et al*., 2015). The use of exudates as a feeding resource can explain the high reproduction rate of the genus, characterized by semi-annual breeding and birth of twins (Ah-King & Tullberg, 2000).

Like other Callitrichines, *C. penicillata* has a communal breeding system in which all or most group members help care for the offspring (Goldizen, 1987). Since parental care facilitates offspring performance traits, this communal breeding system can represent a significant benefit over offspring developmental rate. Furthermore, behaviorally flexible species as *C. penicillata* can adapt to different environments changing behaviors such as foraging, mate choice, and dispersal (Jones, 2005). They are able to survive in areas with little natural vegetation and they also can adapt to urban areas due to their use of alternative food sources (Santos *et al*., 2014).

The habitat of the species is the Brazilian savannah, which extends on the states of Bahia, Minas Gerais, Goiás, Piauí, Maranhão and the Northern region of the state of São Paulo. Although it belongs to the Brazilian fauna, it is a non-native species to the Atlantic Rainforest biome (Rylands *et al*., 1993). Since the beginning of the twentieth century individuals of *C. penicillata* have been bought as pets. However, as they tend to be aggressive and cannot be tamed, the owners end up releasing them into the wild and urban areas (Rocha *et al*., 2011). The black-tufted marmoset is a potentially invasive species due to its generalist feeding habit, behavioral flexibility and parental care, acknowledged as

synanthropic in several places (Patrocínio, 2009). It is considered a territorial species, which lives in social groups of 2-13 animals, and its home range varies between 2.5 and 18.5 ha (Oliveira, *et al*., 2015). In the state of Paraná (PR), *C. penicillata* and *Callithrix jacchus* (Linnaeus, 1758) have been introduced in certain habitats and have caused environmental imbalance and displacement of native species due to competition and predation (Primack & Rodrigues, 2001).

Ten specimens of *C. penicillata* (Figure 1) were introduced in the municipality of Londrina, PR Brazil in January 2015, precisely in a small Atlantic Forest fragment (23°22'32.9"S; 51°10'03.6"W) in the peri-urban area (Figure 2), close to urban area, small farms and forest areas with favorable conditions for the colonization of the species. The occurrence was reported by a local resident. To confirm the information, an active searching was performed at the site of release and neighboring areas. The first specimen was registered on 15th July 2015 when two of the marmosets were photographed in the urban area (Figure 2).

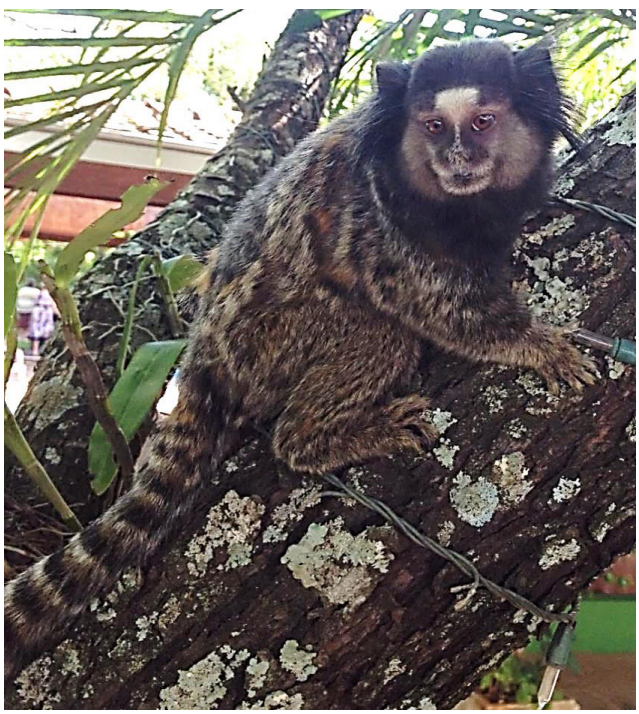

Figure 1. *Callithrix penicillata* introduced in the municipality of Londrina PR Brazil in January 2015.

The colonization process may have been facilitated by the adaptability of the species to different habitats and types of food (Vilela & Faria, 2004; Vilela & Del-Claro, 2011; Oliveira *et al*., 2015). Fruit trees on the farms on the area provide an extra source of food, associated to food provided by population. Due to its high-energy rate, extra food is relevant in anthropized areas (Zago *et al*., 2013) since it may cause behavioral and ecological changes and increase population density due to higher reproduction rates. They may consequently favor the establishment of the species in these areas beyond their natural distribution (Modesto & Bergallo, 2008; Zago, 2012; Zago *et al*., 2013). *Callithrix penicillata* and *C. jacchus* were both introduced in the Brazilian states of Rio de Janeiro, São Paulo e Minas Gerais (Malukiewicz *et al.*, 2015), areas that include ranges of three threatened species of marmosets, *Callithrix aurita* (É. Geoffroy in Humboldt, 1812), *Callithrix flaviceps* (Thomas, 1903), and *Callithrix kuhlii* (Coimbra-Filho, 1985) (IUCN, 2016). As inter-specific competition for food is expected among species with similar foraging behaviors, these two introduced species endanger the native ones since they are more morphologically specialized than other marmosets to exploit

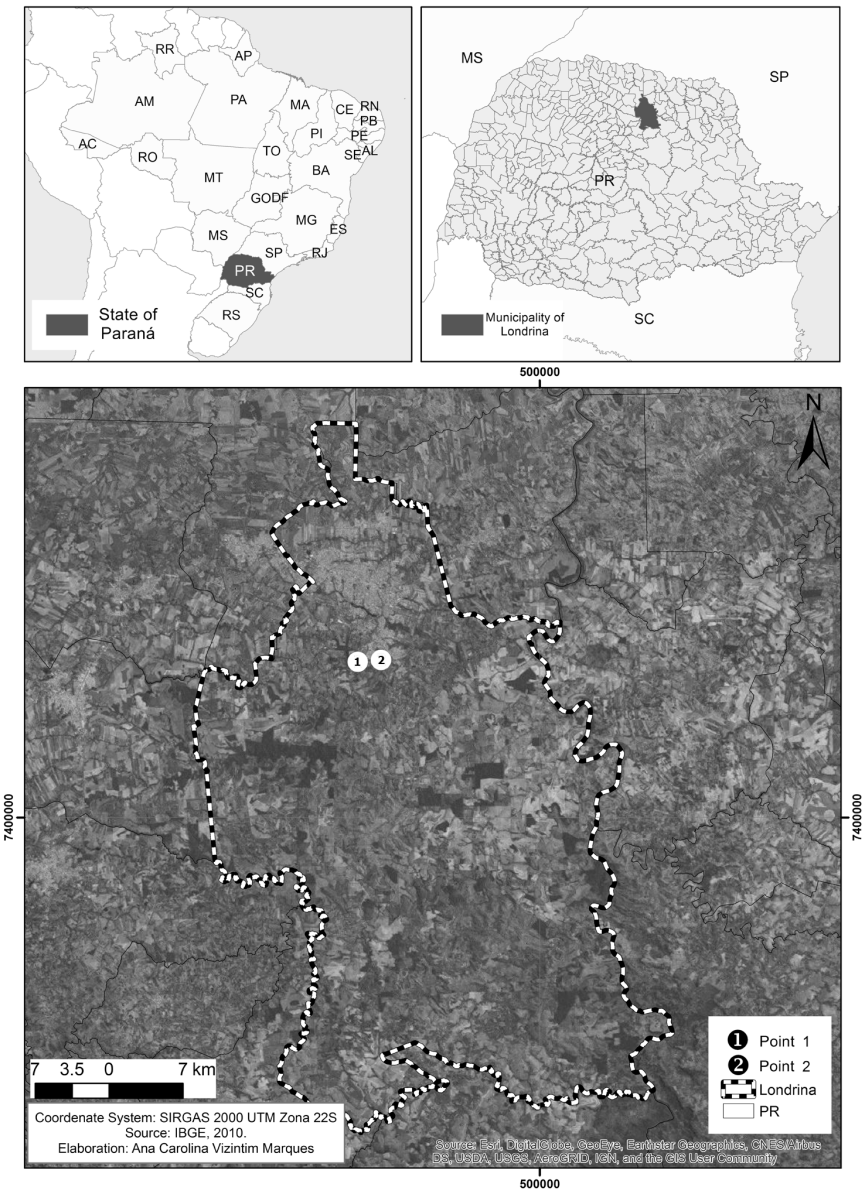

Figure 2. Map showing the introduction area of *Callithrix penicillata* in Londrina PR Brazil in January 2015 (Point 1) and urban area where they were photographed in July 2015 (Point 2).

disturbed habitats and due to their reproduction characteristics, suggesting good acclimatization to new environments (Rylands *et al*., 1993).

In addition to competition between exotic and native species, the introduction of *C. penicillata* and *C. jacchus* can result in predation against native fauna (Vale & Prezoto, 2015). They may endanger local populations of birds by using eggs and offspring as a food source (Passos *et al*., 2006; Galleti *et al*., 2009; Gomes & Lima-Gomes, 2011; Alexandrino *et al*., 2012; Almeida *et al*., 2013), as well as other taxa, such as reptiles

and small amphibians (Rangel *et al.*, 2011; Vale & Prezoto, 2015). The impact of invasive species is one of the major causes of biodiversity loss throughout the world. The invasion success of a species is related to its life history characteristics, such as motility, tolerance to environmental shifts, rapid growth, reproductive and feeding plasticity (Lodge, 1993; Moyle & Light, 1996; Bohn *et al*., 2004; Simberloff & Rejmánek, 2011; Pander *et al*., 2016). Therefore, different regions can be damaged by the introduction of *C. penicillata*.

Specimens of *C. penicillata*, derived from the illegal fauna traffic have been introduced in several municipalities of the state of Paraná, such as Curitiba, São José dos Pinhais, Maringá, Paranaguá and Cianorte, with populations related to urban environmental which interact with people (Passos *et al*., 2006). The ecological importance of the Northern Paraná should be underscored since it includes the Mata dos Godoy State Park, a 690-h forest fragment of the Semideciduous Seasonal Forest, and the riparian vegetation of the Tibagi River basin. This remaining forest may be invaded by the specimens due to the population expansion, with incalculable consequences. Although only a single introduction event has been registered here, the monitoring of the primates is important to determine the geographical range of the problem, since the characteristics of the environment that provides them with food and the propagule pressure (10 specimens) in nature may favor the establishment of the species.

References

Ah-King, M. & Tullberg, B.S. 2000. Phylogenetic Analysis of Twinning in Callitrichinae. **American Journal of Primatology 51** (1): 135–146.

Alexandrino, E.R.; Luz, D.T.A.; Maggiorini, E.V. & Ferraz, K.M.P.M.B. 2012. Nest stolen: the first observation of nest predation by an invasive exotic marmoset (*Callithrix penicillata*) in an agricultural mosaic. **Biota Neotropica 12** (2): 211-215.

Almeida, M.V.; Lucindo, A.S.; Costa, T.V.V. & Paula, H.M.G. 2013. Predation on artificial nests by marmosets of the genus *Callithrix* (Primates, Platyrrhini) in a Cerrado fragment in Southeastern Brazil. **Biotemas 26** (1): 203-207.

Blackburn, T.M.; Pysek, P.; Bacher, S.; Carlton, J.T.; Duncan; R.P.; Jarosik, V.; Wilson, J.R.U. & Richardson, D.M. 2011. A proposed unified framework for biological invasions. **Trends in Ecology & Evolution 26** (7): 333-339.

Bohn, T.; Sandlund O.T.; Amundsen, P.A. & Primicerio, R. 2004. Rapidly changing life history during invasion. **Oikos 106** (1): 138-150.

Carter, J. & Leonard, B.P. 2002. A Review of the Literature on the Worldwide Distribution, Spread of, and Efforts to Eradicate the Coypu (*Myocastor coypus*). **Wildlife Society Bulletin 30** (1): 162-175.

Casimiro, A.C.R.; Ashikaga, F.Y.; Kurchevski, G.; Almeida, F.S. & Orsi, M.L. 2010. Os Impactos das Introduções de Espécies Exóticas em Sistemas Aquáticos Continentais. **Boletim da Sociedade Brasileira de Limnologia 38** (1): 1-10.

Deberdt, A.J. & Scherer, S.B. 2007. O javali asselvajado: ocorrência e manejo da espécie no Brasil. **Natureza & Conservação 5** (2): 31-44.

Galetti, M.; Bovendorp, R.S.; Fadini, R.F.; Gussoni, C.O.A.; Rodrigues, M.; Alvarez, A.D.; Guimarães-Júnior, P.R. & Alves, K. 2009. Hyper abundant mesopredators and bird extinction in an Atlantic forest island. **Revista Brasileira de Zoologia 26** (2): 288-298.

Goldizen A.W. 1987. Tamarins and marmosets: communal care of offspring, pp.34–43. *In*: Smuts, B.B.; Cheney, D.L.; Seyfarth, R.M.; Wrangham, R.W.; Struhsaker, T.T.(eds.). **Primate societies**. Chicago, University of Chicago Press. 578p.

Gomes, F.B. & Lima-Gomes, R.C. 2011. Registro ocasional da predação da pomba de bando (*Zenaida auriculata* Des Murs, 1847) pelo sagui-do-cerrado (*Callithrix penicillata* É. Geoffroy, 1812) no interior de São Paulo, SP. **Neotropical Primates 18** (2): 68-70.

IUCN 2016. The IUCN Red List of Threatened Species. Version 2016-3. Disponível em: <**http://www.iucnredlist.org**>. Acesso em: 10 mai. 2017.

Jones, C.B. 2005. **Behavioral flexibility in primates: causes and consenquences**. New York, Springer. 184p.

Lodge, D.M., 1993. Biological invasions: Lessons of ecology. **Trends in Ecology and Evolution 8** (4): 133-137.

Malukiewicz, J.; Boere, V.; Fuzessy, L.F; Grativol, A.D.; de Oliveira e Silva, I.; Pereira, L.C.M.; Ruiz-Miranda, C.R; Valença, Y.M; Stone, A.C. 2015. Natural and Anthropogenic Hybridization in Two Species of Eastern Brazilian Marmosets *(Callithrix jacchus* and *C. penicillata*). **PLOS ONE 10** (6): e0127268.

Mantoani, M.C.; Dias, J.; Orsi, M.L. & Torezan, J.M.D. 2013. Efeitos da invasão por *Tradescantia zebrina* Heynh. sobre regenerantes de plantas arbóreas em um fragmento de floresta estacional semidecidual secundária em Londrina (PR). **Revista Biotemas 26** (3): 63-70.

Mcgeoch, M.A.; Butchart, S.H.M.; Spear, D.; Maraes, E.; Kleynhans, E.J.; Symes, A.; Chanson, J. & Hoffmann, J.C. 2010. Global indicators of biological invasion: species numbers, biodiversity impact and policy responses. **Diversity and Distributions 16** (1): 95-108.

Modesto, T.C. & Bergallo, H.G. 2008. Ambientes diferentes, diferentes gastos do tempo entre atividades: o caso de dois grupos

mistos do exótico *Callithrix* spp. na Ilha Grande, RJ, Brasil. **Neotropical Biology and Conservation 3** (3): 112-118.

Moyle, P.B. & Light, T. 1996. Fish invasions in California: do abiotic factors determine success? **Ecology 77** (1): 1666-1670.

Oliveira, G.R.; Amora, T.D.; Reis, N.R.; Peracchi, A.L. & Rosa, G.L.M. 2015. Gênero *Callithrix* (Erxleben, 1777), pp.64-78. *In*: Reis, N.R.; Peracchi, A.L.; Batista, C.B. & Rosa, G.L.M.(eds.). **Primatas do Brasil: Guia de Campo**. Rio de Janeiro, Technical Books Editora. 328p.

Orsi, M.L. & Britton, J.R. 2014. Long-term changes in the fish assemblage of a neotropical hydroelectric reservoir. **Journal of Fish Biology 84** (6): 1964-1970.

Pander, I.; Mueller, M.; Sacher, M. & Juergen, G. 2016. The role of life history traits and habitat characteristics in the colonisation of a secondary floodplain by neobiota and indigenous macroinvertebrates species. **Hydrobiologia 772** (1): 229-245.

Passos, F.C.; Miranda, M.D.; Aguiar, L.M.; Ludwig, G.; Bernardi, I.P. & Moro-Rios, R.F. 2006. Distribuição e ocorrência de primatas no Estado do Paraná, Brasil, pp.119-150. *In*: Bicca-Marques, J.C.(ed.). **A Primatologia no Brasil – Volume 10**. Curitiba, Editora SBPr - Sociedade Brasileira de Primatologia. 563p.

Patrocínio, D.N.M. 2009. Saguis (*Callithrix penicillata* e *Callithrix jacchus*), pp.35-47. *In*: Vidolin, G.P.; Tossulino, M.G.P. & Britto, M.M.(eds.). **Plano de controle de espécies exóticas invasoras no estado do Paraná**. Curitiba, Instituto Ambiental do Paraná. 148p.

Primack, R.B. & Rodrigues, E. 2001. **Biologia da Conservação**. Londrina, Editora Planta, 328p.

Rangel, C.H.; Souza, F.S.F. & Grelle, C.E.V. 2011. Dieta de *Callithrix jacchus* (Linnaeus, 1758) e *Callithrix penicillata* (É. Geoffroy, 1812) (Callitrichidae – Primates) e seus híbridos, alóctones no Jardim Botânico do Rio de Janeiro, pp.74-84. *In*: Miranda, J.M.D. & Hirano, Z.B.M.(eds.). **A Primatologia no Brasil - Volume 12**. Curitiba, Editora SBPr - Sociedade Brasileira de Primatologia. 305p.

Rylands, A.B.; Coimbra-Filho, A.F. & Mittermeier, R.A. 1993. Systematics, geographic distribution, and some notes on the conservation status of the Callitrichidae, pp.11-77. *In*: Rylands, A.B.(ed.). **Marmosets and Tamarins: Systematics, Behaviour and Ecology**. New York, Oxford University Press. 396p.

Santos, M.N.; Duarte, M.H.L. & Young, R.J. 2014. Behavioural and ecological aspects of black tufted-ear marmosets, *Callithrix penicillata* (Geoffroy, 1812) (Primates: Callitrichidae) in a semiurban environment. **Revista de Etologia 13** (1): 37-46.

Silva, M.A.M.; Duarte, A.P.M.; Silva, J.P.; Siqueira, N.M.N. & Costa, A.N. 2014. Interferência humana nos hábitos alimentares do saqui-de-tufo-preto *Callithrix penicillata* (PRIMATES) em um Parque Urbano na cidade de Catalão, Goiás. **Enciclopédia Biosfera 10** (19): 63-64.

Simberloff, D. & Rejmánek, M. 2011. Encyclopedia of biological invasions. Californa, University of California Press. 792p.

Vale, C.A. & Prezoto, F. 2015. Invasões Biológicas: O caso do mico estrela (*Callithrix penicillata*). **Ces Revista 29** (1): 58-76.

Vilela, A.A. & Del-Claro, K. 2011. Feeding Behavior of the Black-Tufted-ear Marmoset (*Callithrix penicillata*) (Primata, Callitrichidae) in a Tropical Cerrado Savanna. **Sociobiology 58** (2): 1-6.

Vilela, S.L. & Faria, D.S. 2004. Seasonality of the activity pattern of *Callithrix penicillata* (Primates, Callitrichidae) in the Cerrado (Scrub Savanna Vegetation). **Brazilian Journal of Biology 64** (2): 363-370.

Vitule, J.R.S.; Freire, C.A. & Simberloff, D. 2009. Introduction of non-native freshwater fish can certainly be bad. **Fish and Fisheries 10** (1): 98-108.

Vitule, J.R. & Prodocimo, V. 2012. Introdução de espécies não nativas e invasões biológicas. **Estudos de Biologia: Ambiente e Diversidade 34** (83): 225-237.

Zago L. 2012. **Fatores determinantes no uso do espaço por *Callithrix penicillata* (É. Geoffroy, 1812) introduzidos em fragmento urbano.** Dissertação de Mestrado. Universidade Federal do Paraná. 80p.

Zago, L.; Miranda, J.M.D.; Neto, C.D.; Santos, C.V. & Passos, F.C. 2013. Dieta de *Callithrix penicillata* (É. Geoffroy, 1812) (Primates, Callitrichidae) introduzidos na Ilha de Santa Catarina. **Biotemas 26** (2): 227-235.

Ziller, S.R. 2006. Espécies exóticas da flora invasoras em unidade de conservação, pp.34-52. *In*: Campos, J.B.; Tossulino, M.G.P. & Muller, C.R.C.(eds.). **Unidades de Conservação: Ações para valorização da Biodiversidade.** Curitiba, Instituto Ambiental do Paraná. 348p.

Williamson, M.H. & Fitter, A. 1996. The characters of successful invaders. **Biological Conservation 78** (1): 163-170.

Wood, J.R.; Dickie, I.A.; Moeller, H.V.; Peltzer, D.A.; Bonner, K.I.; Rattray, G. & Wilmshurst, J.M. 2015. Novel interactions between non-native mammals and fungi facilitate establishment of invasive pines. **Journal of Ecology 103** (1): 121-129.

Recebido: 17/05/2017
Revisado: 23/06/2017
Aceito: 11/07/2017