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WILD BOAR *Sus scrofa* (CETARTIODACTYLA, SUIDAE) IN FRAGMENTS OF THE ATLANTIC FOREST, SOUTHEASTERN BRAZIL: NEW RECORDS AND POTENTIAL ENVIRONMENTAL IMPACTS

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ABSTRACT. The wild boar is one of the worst invasive species in the world. This study records the presence of the species in fragments of the Atlantic forest in Southeastern Brazil. These records extend the distribution of this species in the country and provide the first record in the wild, in Rio de Janeiro State. The potential impacts on the native biodiversity caused by the invasion of this exotic species are briefly discussed.

RESUMEN. El jabalí *Sus scrofa* (Cetartiodactyla: Suidae) en fragmentos del Bosque Atlántico del sudeste de Brasil: nuevos registros e impactos ambientales potenciales. El jabalí representa una de las peores especies invasoras del mundo. Este estudio presenta nuevos registros de jabalíes en fragmentos de Bosque Atlántico en el sureste de Brasil. Se presenta el primer registro de jabalí en estado silvestre en el estado de Rio de Janeiro, ampliando la distribución de la especie en el país. Se destacan los impactos potenciales de la invasión de esta especie exótica en la biodiversidad local.

Key words: Biological invasion. Conservation. Exotic species.

Palabras clave: Conservación. Especies exóticas. Invasión biológica.

The invasion of alien species is one of the major threats to biodiversity and can cause changes in the global biota (CBD, 2014). According to the Convention on Biological Diversity, a species is considered an invasive alien when it is introduced outside its native range, becomes established in the new environment, and spreads harming native species and ecosystems.

The wild boar, *Sus scrofa* Linnaeus, 1758, is classified by the International Union for Conservation of Nature (IUCN) as one of the 100 world's worst invasive alien species (Lowe et al., 2000). Native from Europe, Asia, and North Africa, the species is currently present in almost all continents, including some ocean islands (Oliver and Leus, 2008). The species'

high plasticity of diet, ability to adapt in a wide range of environmental conditions, and high reproductive potential represent the main reasons for its success in environments where it has been introduced (Taylor et al., 1998; Rossel et al., 2001; Ditchkoff and Mayer, 2009).

A variety of impacts caused by wild boars, in native and introduced sites, have been recorded (Barrios-Garcia and Ballari, 2012). Wild boars show a typical behavior of rooting producing ecosystem-level effects, and therefore, are considered ecosystem engineers (Crooks, 2002). The rooting behavior directly affects the richness, abundance, and dynamics of biological communities living above and below ground, and may alter habitat structure and resource availability (Cuevas et al., 2010; Barrios-Garcia and Ballari, 2012). Wild boars may reduce plant coverage, seed recruitment, and species composition, diversity, and regeneration in plants communities (Massei and Genov, 2004; Barrios-Garcia and Ballari, 2012; Hegel and Marini, 2013). In an introduced range, wild boars affect different native animal communities such as invertebrates, amphibians, reptiles, birds, and mammals, as a result of resource competition, predation, and habitat and nest destruction (Massei and Genov, 2004; Ditchkoff and Mayer, 2009; Barrios-Garcia and Ballari, 2012). In addition, they are reservoirs of several parasites and diseases, which can be transmitted to the local native fauna, livestock, and humans (Herrera et al., 2008; Ruiz-Fonset et al., 2008).

Wild boars cause significant economic losses and are a source of concern for policymakers in many countries (Pimentel et al., 2001). They cause damages that can amount to millions of dollars per year involving their control and eradication and losses in pasture, crops, and livestock due to predation or diseases (Pimentel et al., 2001, 2005; Campbell and Long, 2009).

The origin of the invasion of wild boars in Brazil is still controversial but may have been the result of natural, accidental, and/or intentional factors. Illegal transportation of wild boars, from Uruguay to Brazil, for breeding and cinegetic purposes have been reported with introductions in the municipality of Palmeira in the Paraná State, in 1960 (Britto and Patrocínio, 2006; Deberdt and Scherer, 2007). However, the

first proven records of wild boars in the Brazilian territory is from around 1989 when wild populations in Uruguay crossed the Jaguarão River, on the border between Brazil and Uruguay, expanding their geographic range to the Brazilian State of Rio Grande do Sul (Deberdt and Scherer, 2007). Currently, beyond their presence in the Rio Grande do Sul State, wild boars have been recorded in the States of Santa Catarina, Paraná, Mato Grosso, Mato Grosso do Sul, Goiás, São Paulo, Minas Gerais, and Bahia (Deberdt and Scherer, 2007; Trovati and Munerato, 2013). The dispersion of the species in the Brazilian territory is probably the result of legal and illegal maintenance of wild boars in captivity and their escapes or releases from farms (Deberdt and Scherer, 2007).

Considering the significant threats from the invasion of wild boars to the biodiversity, and the lack of studies about these impacts and the species' distribution in Brazil, this study registers the occurrence of wild boars at the Darcet Batalha Private Reserve (hereafter RPPN-Darcet Batalha; 20°51'20.9" S, 41°56'49.4" W), in Minas Gerais State, and reported the first species record in the wild in Rio de Janeiro State. The RPPN-Darcet Batalha is located in the Carangola River Basin, in Tombos, Eastern Minas Gerais, bordering the municipality of Porciúncula, Rio de Janeiro State. The reserve consists of approximately 307 ha of semi-deciduous Atlantic Forest (Rizzini, 1997) surrounded by a matrix of pastures and plantations (e.g. maize, sugarcane, bean, and eucalyptus). The climate is characterized by a distinct dry season from May to September and a wet season from October to April.

The record of wild boars in the RPPN-Darcet Batalha was obtained opportunistically through the identification of 2 rooting and 1 tree rubbing occurrences, and directly through one camera trap (Tigrinus model 6.0c) installed inside the reserve between September 18 and November 19, 2010. The camera was installed on a pre-existing transect of around 1400 m long and programmed to take pictures every 1 min for 20 h per day (from 4 pm to midday). Equipment maintenance and replacement of the sampling station was performed every 21 days. Three sampling stations were used in

different sites inside the forest fragment, which was composed of one edge area (25 m from edge) and 2 interior forest areas, approximately 350 m apart from each other. Three different records of wild boars were obtained during 62 days of sampling; the interval between the first and second record was 17 days, and between the second and third was 2 days. All recordings were at night, between 21:40 and 23:48, at 2 interior forest stations. A single adult individual was recorded, but it was not possible to confirm if it was the same individual (**Fig. 1a**). The record of wild boars in Rio de Janeiro State occurred in October 2010 through the observation of hunting records and the detection of some captured individuals in the vicinity of forests fragments in the village of Santa Clara, district of Porciúncula, Rio de Janeiro State (**Fig. 1b**). Interbreeding between wild boars and domestic pigs has occurred in the municipalities of Tombos and Porciúncula and it is doubtful whether other wild populations in the region can be considered genetically pure.

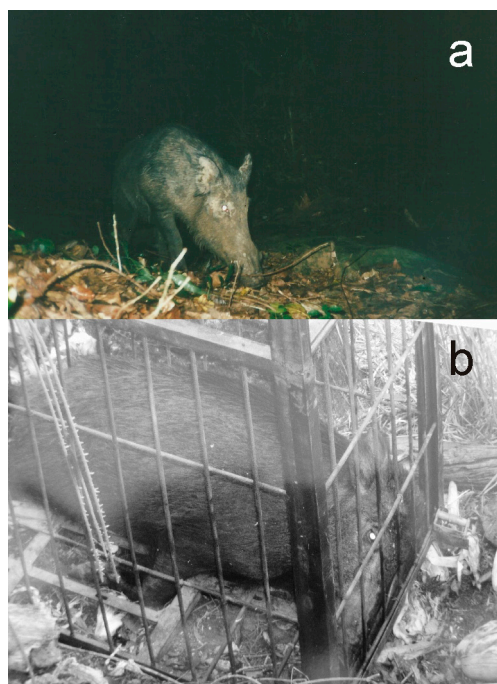


Fig. 1. Wild boar recorded by a camera trap in the RPPN-Darcet Batalha, Minas Gerais, Brazil (a); wild boar captured by trap bait in the region of Carangola Valley, Minas Gerais, Brazil (b).

The presence of wild boars in the region of the Carangola Valley is the result of animals that escaped from a commercial farm (Fazenda Palmeiras) in the municipality of Faria Lemos, Minas Gerais. In mid-2002, during an inspection conducted by IBAMA (Brazilian Institute of Environmental and Renewable Natural Resources), several animals escaped from captivity and found refuge in the forest fragments around the farm. According to residents from the area surrounding the RPPN-Darcet Batalha, the first records of wild boars in Tombos are from 2006. Until 2010, besides the municipalities previously mentioned, government representatives from five municipalities have reported the presence of wild boars in Carangola, Caiana, Espera Feliz, and Divino, located in Minas Gerais, and Varre-Sai in Rio de Janeiro.

The occurrence of wild boars in different municipalities neighboring Faria Lemos, a few years after their escape from captivity, suggests that the wild boar population is growing and adapting to the ecological conditions of the region. This rapid expansion in the distribution range of wild boars can be compared to that experienced in Rio Grande do Sul in which, over a period of six years, the species distribution expanded from 1 to 6 municipalities (Fonseca et al., 2009). The expanded distribution of wild boars in the region of Carangola Valley is alarming because the species may invade important conservation units, such as Serra do Brigadeiro State Park and Caparaó National Park, located 49 and 38 km from the RPPN-Darcet Batalha, respectively. These conservation units show high richness in flora and fauna species, many of them endemic, rare and/or, endangered (Drummond et al., 2005).

The Carangola Valley still presents significant forest remnants in a biome classified as a biodiversity hotspot and is considered a region with extreme biological importance for biodiversity conservation in Minas Gerais, harboring several endangered species of terrestrial fauna such as *Cabassous tatouay*, *Callithrix aurita*, and *Potus flavus* (Drummond et al., 2005), and rare plants in Brazil such as *Mascagnia velutina* and *Barbacenia irwiniana* (Giulietti et al., 2009). In areas of the Atlantic Forest, in Rio Grande do Sul State, wild boars have demonstrated

a strong preference for forests compared to other environments, producing changes in the vegetation and superficial soil layer. Moreover, the species has demonstrated a high potential for producing negative impacts on the native wildlife that typically depends on forests fragments (Hegel and Marini, 2013).

The predation of *Caiman yacare* nests by *S. scrofa* in the Pantanal (Campos, 1993) suggests that animals that build nests near to or on the ground may also be impacted by the establishment of wild boar populations in the Carangola Valley region. The Hoge's side-necked turtle (*Mesoclemmys hoguei*) is of special concern because it is the only freshwater chelonian species in the Official List of Fauna Threatened with Extinction in Brazil (MMA, 2003). This turtle's distribution range is restricted to the Paraíba do Sul River Basin (Rhodin et al., 1982) and can be found in the Carangola River, mainly in the bordering areas between Tombos and Faria Lemos (Drummond, 2002). Species of Brazilian Chelidae build nests particularly far from riverbanks (Souza, 2004); the populations of *M. hoguei* in the Carangola River have a spawning period associated with the end of the rainy season and an incubation period that lasts approximately six months (Drummond, 2002). Therefore, the presence of wild boars in the region may impact this chelonian species. The predation of eggs and hatchlings turtles, such as *Caretta caretta* and *Chelonia mydas*, has been recorded within the range of wild boars' occurrence (Ditchkoff and Mayer, 2009).

Wild boars can play a role in the introduction of exotic plants into forest fragments, such as exotic grasses (*Brachiaria* spp.) that are very common in the grasslands of the Carangola Valley region. They can travel great distances between feeding and resting sites (Rosell et al., 2001) and their attacks on crops have become common during the rainy season in some municipalities in this region (Kaizer, unpublished data), which may result in the transportation of seeds from exotic plants into forest fragments through the wild boar's hair. The hunting of wild boars may also produce indirect impacts on communities of native mammals because the most commonly used

hunting traps are less selective, especially the snare trap. Native mammals, such as *Cuniculus paca* and *Hydrochoerus hydrochaeris*, can have a decline in their populations as a result of accidental capture. In some European countries, the hunting of wild boars with traps and snares have caused the death of grizzly bears (*Ursus arctos*), which became one of the main reasons for mortality in this species (Rosell et al., 2001).

Because the Carangola Valley region presents significant forest fragments and native species diversity, recorded from the last portions of the Atlantic Forest in northwestern Rio de Janeiro and eastern Minas Gerais, the impacts produced by the establishment of wild boar populations in this region can be extensive and affect different taxonomic groups. Regardless of the limited data presented in this study, the results are important for the understanding of the distribution and dispersion of wild boars in this region, and can contribute to the development of management and conservation strategies. Nevertheless, further detailed studies evaluating the abundance and distribution of wild boars and investigating their impact on local biodiversity and ecosystems are needed.

Acknowledgments. We are thankful to Luiz Carlos de Sá for allowing us to conduct the study at the RPPN-Darcel Batalha, to Alba Coli, Claudio Novaes, and the reserve's employees for their field assistance, and to EKP for the financial support. We are also grateful to Luiz Fernando and the environmental secretaries of the municipalities in the Carangola Valley region who contributed with information for this study, and to Arnaud Desbiez for help in species identification.

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