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Impact of the wild boar, *Sus scrofa*, on a fragment of Brazilian Atlantic Forest

Impacto do javali europeu, *Sus scrofa*, em um fragmento da Mata Atlântica brasileira

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Abstract

The wild boar (*Sus scrofa* Linnaeus, 1758) was introduced approximately 100 years ago into South America from Europe for commercial reasons but since then it became feral and has caused several environmental impacts. One of the areas invaded by wild boars in the southern Atlantic Forest biome is the Aracuri Ecological Station (EEA), state of Rio Grande do Sul, Brazil. The objective of this study was to estimate the impact of wild boars on the vegetation of the EEA, describing their preferred vegetation types and the area and biomass affected. We sampled 1,521 points in 10 phytophysiognomies throughout the reserve. Among these points, 246 (16.2%) had evidence of wild boars (impacted patches with uprooted vegetation and soil) in the forests, wetlands, and secondary vegetation phytophysiognomies. Areas with *Baccharis* sp. were not impacted. The impacted patches had an average size of 308 ± 54 m^2, ranging from 0.1 to 5,670 m^2 within and between phytophysiognomies, with the largest mean impacted area (781 m^2) in the most conserved forest type. We estimated that boars uprooted 56,186 kg of dry biomass over all the points sampled, 94% of which in the forest environments and 82% in the two most conserved forest types only. These results allow us to conclude that wild boars prefer to forage in forest areas, disturbing the vegetation and the superficial soil layer. Wild boars demonstrated a high potential for producing a strong negative impact on plants and animals in the studied forest fragments, indicating that these processes require further studies.

Key words: invasive species, exotic fauna, environmental impact.

Resumo

O javali europeu (*Sus scrofa* Linnaeus, 1758) foi introduzido na América do Sul a partir da Europa há mais de 100 anos com fins comerciais, mas tornou-se feral e vem causando impactos ambientais. Uma das áreas invadidas pelo javali na Mata Atlântica é a Estação Ecológica de Aracuri (EEA), Rio Grande do Sul, Brasil. Este trabalho teve por objetivo avaliar o impacto causado pelo javali europeu sobre a vegetação da EEA, descrevendo os ambientes preferidos, a área e a biomassa impactada. Foram amostrados 1.521 pontos por toda a área da UC, em 10 fitofisionomias. Destes pontos amostrados, 246 (16,2%) possuíam evidências da presença do javali (manchas de vegetação e solo impactadas) nas fitofisionomias de banhado, capoeira e mata. Não foram encontradas manchas impactadas na fitofisionomia de vassoural (*Baccharis* sp.). O tamanho médio das manchas impactadas foi de 308 ± 54 m^2, com grande variação (0,1 a 5.670 m^2) dentro e entre fitofisionomias, mas com a mata mais conservada com a maior média de tamanho de manchas (781 m^2). Estimamos que o javali impactou 56.186 kg de biomassa seca nos pontos amostrados, sendo que as matas representaram cerca de 94% da biomassa impactada e apenas as duas matas mais conservadas representaram cerca de 82%.

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Os javalis possuem forte preferência por matas em relação a outros ambientes, alterando a vegetação rasteira e a camada superficial do solo do fragmento florestal. O potencial de impacto negativo do javali sobre a fauna e a flora nativa destes fragmentos florestais é grande e necessita ser melhor estudado.

Palavras-chave: espécies invasoras, fauna exótica, impacto ambiental.

Introduction

The European wild boar (*Sus scrofa* Linnaeus, 1758) was introduced into South America (Argentina) around 1904 for commercial purposes (Deberdt and Scherer, 2007), due to the high quality of its meat (Antunes, 2001). Around 1928, it became feral in Uruguay and expanded its geographical distribution, invading Brazil across the borders with Uruguay and Argentina (Deberdt and Scherer, 2007). Latter it became an agricultural pest not only in Argentina but also in Uruguay and Brazil, and population control was impossible (Nogueira-Filho, 1998). In these regions, as well as in several other regions of the world, wild boars are causing serious problems through the destruction of crops and native vegetation, altering the ecological processes of succession and species composition (Hadjisterkotis, 2004).

Because the European wild boar is aggressive and resistant, it competes with native species for food and alters the natural environment by overturning the soil, dislodging and destroying native plants, altering the soil structure and affecting the process of natural regeneration of forests, causing serious long term damage (Massei and Genov, 2004). Nest-building, in particular, has caused a profound impact both on the vegetation and its regeneration (Ickes *et al.*, 2005; Braga *et al.*, 2010). The preferred environments for local invasion have abundant food resources, such as agricultural areas (especially corn fields), but when no food is available boars can travel long distances (Leaper *et al.*, 1999) across degraded areas, fields, forests, plantations, riparian areas and wetlands. These boars have the highest reproductive potential among the ungulate and have low levels of predation, which results in high population growth rates (Heise-Pavlov *et al.*, 2009). It is also important to note the occurrence of fertile hybrids between wild boars and pigs, found both in the wild and in captivity (Tanchev and Katsarov, 1993).

The boar has attracted the attention of governments and researchers and is considered to be one of the 100 worst invasive alien species (Lowe *et al.*, 2000), since it is a cause of environmental and economic damage and does not have natural predators in most areas where it was introduced. In 2005, the Brazilian government issued a normative instruction (IBAMA no. 71 on August 4th, 2005) authorizing the population control and killing of this species in the state of Rio Grande do Sul. This instruction was repealed (ICMBio No. 08 on August 17th, 2010) and reissued by the State Department of Agriculture, Livestock, Fisheries and Agribusiness (SEAPPA-RS - Decree No. 183 on December 2nd, 2010) in 2010, which regulates the control of the occurrence of wild boars and their hybrids, through capture and culling for an indeterminate period of time. The great concern about the European wild boar has stimulated the realization of several studies on their biology and ecology around the world, including genetics and reproduction (Grossi *et al.*, 2006; Albayrak and Üncü, 2007; Cellina, 2008), parasites (Mundim *et al.*, 2004; Gomes *et al.*, 2005; Herrera *et al.*, 2008), ecology, population structure and dynamics (Massolo and Mazzonidella, 2006; Skewes *et al.*, 2007; Thurfjell *et al.*, 2009) and effects on native flora and fauna (Ickes *et al.*, 2001; Massei and Genov, 2004).

Boars can cause a "top-down" effect on communities by directly affecting the abundance and species richness of flora since they feed on whole plants and fruits, seeds and roots (Howe *et al.*, 1981; Singer *et al.*, 1984; Fujinuma and Harrison, 2012). Besides the direct effects on vegetation caused by their uprooting activity and digging to depths ranging from 5 to 15 cm, their daily movements and construction of nests also impact the vegetation (Bratton, 1975; Ickes *et al.*, 2005). Most of the studies of impact on the flora by wild boars have reported that interference with and removal of roots was the major cause of disturbance in the plant communities (Singer *et al.*, 1984; Piroznikow, 1998; Hone, 2002). If the density of boars in an area is high, the impact on the roots can cause a reduction of up to 80-95% in coverage and the local extinction of herbaceous plant species at the site (Bratton, 1974; Howe *et al.*, 1981). The process of removal of the plant roots can also facilitate erosion of slopes (Bratton, 1974).

Thus, this study was aimed considering the great expansion of wild boars distribution, its high potential to population growth and to cause several environmental impacts, and the great lack of studies of its expansion and impact in South America. The following objective was established: to evaluate the impacts of the European wild boar on the vegetation of the Ecological Station Aracuri, in the southern Atlantic Forest, describing their preference for vegetation types, as well as determining the size of the impacted area and affected biomass in each of the phytophysiognomies. We expect to contribute to a better understanding of the impact of the wild boar in South American southern forests by understanding more about how much of a threat it really represents. Our quantitative analyses of habitat use and biomass impacted have important broad implications for several groups of plants and animals that breed or feed in the soil or forest understory, such as survival of saplings of endangered plants or breeding success of ground nesting birds.

Material and methods

Study area

The study was conducted in the Ecological Station Aracuri (EEA) (29º 32'04 "S, 53º 23'26" W), an Integral Protection conservation area in the municipality of Muitos Capões, state of Rio Grande do Sul, Brazil (Figure 1). The EEA has an area of 274.5 ha, consisting of native forests, wetlands, secondary vegetation and "vassorais" (*Baccharis* dominated vegetation) (Brasil, 2008) mainly surrounded by planted areas and pastures. The EEA was chosen to conduct this study because it is one of the few relatively conserved reserves in the southern Atlantic Forest were there are reports of the presence and impacts of the European wild boar for years. Also the existence of several phytophysiognomies and the occurrence of endangered plant and animal species in the reserve make this area adequate for habitat comparisons.

We sampled three major vegetation types, forests, secondary vegetation and wetlands, divided into the 10 phytophysiognomies most common in the EEA: five types of forests, two types of wetlands and three types of secondary vegetation (Table 1). The forests are part of the Atlantic Forest biome (Mixed Ombrophyllous Forest), varying in structure. They were classified into five types, in a decreasing order relative to their degree of conservation. Two of them consisted of more conserved forest environments: *Araucaria* Forest (Mixed Ombrophyllous Forest with *Araucaria angustifolia* (Bertol.) Kuntze or Paraná pine) with ferns and tree ferns (*Dicksonia sellowiana* Hook.) (height > 30 m) (F1) and *Araucaria* Forest with bracken fern (*Pteridium aquilinum* Kuhn) (height 20 m - 30 m) (F2). The remaining three forest categories consisted of altered forest environments: *Araucaria* Forest with *Brachiaria* sp. (height 8 m - 20 m) (F3); *Araucaria* Forest (height 8 m - 20 m) with undisturbed understory (F4), and open forest (height 7 m - 8 m) (F5). The wetlands (height of vegetation above water 1.5 m to 1.8 m) were classified into two types according to the dominant plant species: sedge, *Isolepis setacea* (L.) R.Br. (W1), or vegetation with two grass species, *Brachiaria* sp. and *Eleusine indica* (L.) Gaertn. (W2). The secondary vegetations were classified into three types according to the dominant plant species: *Achyrocline satureioides* (Lam.) DC. and *Trichocline catharinensis* Cabrera (height 2.0 m to 2.5 m) (SV1), *Cichorium intybus* L. (height 2.0 m to 2.5 m) (SV2), and areas dominated by *Baccharis* sp. (height 1 m to 2.5 m) (SV3).

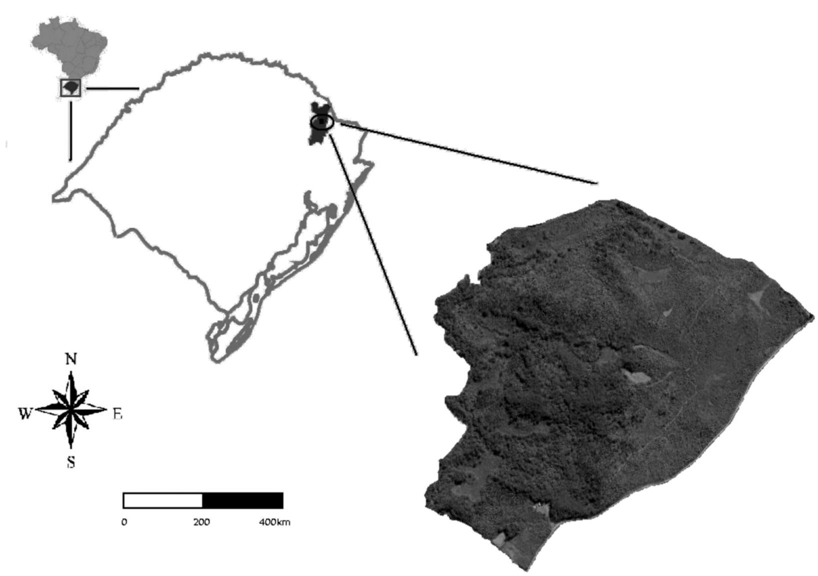

Figure 1. Estação Ecológica de Aracuri, and its location in the municipality of Muitos Capões, state of Rio Grande do Sul, Brazil.

Methods

All sampling was conducted from 16 to 20 April and from 06 to 08 May 2011, when we searched randomly for impacted areas in the EEA in each of the various vegetation types. The number of sampling points in each vegetation type (Table 1) was roughly proportional to the amount of each vegetation type in the reserve, thus giving an adequate relative assessment of impact in each vegetation type. Sampling points were 20 m to 50 m distant from each other, with the distance varying as a function of topographic characteristics and walking constraints. At each point the vegetation and soil in a radius of 10 m was visually inspected for the presence of areas with characteristic impacts of wild boars. The points where the soil was overturned by the wild boars were recorded using a GPS and posteriorly plotted on a map of the EEA, using the program GPS TrackMaker (version 13.7). Each impacted area was measured (length and width) with a tape measure. We used a chi-square test to compare the proportion of points impacted in relation to total number of sampled points in each vegetation type. Due to the non-normality

Table 1. Number (%) of points with the occurrence of wild boars by phytophysiognomy in the Estação Ecológica de Aracuri, state of Rio Grande do Sul, Brazil. Qui-square tests comparing the number of points with wild boars with the expected (16.2%) number of points. See text for a description of each habitat type.

Phytophysiognomy	Number of points sampled	Number of points with wild boars	χ^2	P
Wetlands				
W1) Sedge	63	18 (28.6%)	2.780	0.096
W2) Vegetation with two grasses	31	6 (19.4%)	0.004	0.952
Secondary vegetation				
SV1) *Achyrocline* and *Trichocline* dominated vegetation	114	21 (18.4%)	0.110	0.662
SV2) *Cichorium* dominated vegetation	40	8 (20.0%)	0.001	0.974
SV3) *Baccharis* dominated vegetation	482	0 (0.0%)	84.867	< 0.001
Forests				
F1) Araucaria forest with ferns and tree ferns	176	57 (32.4%)	12.763	< 0.001
F2) Araucaria forest with bracken fern	79	23 (29.1%)	3.758	0.053
F3) *Araucaria* forest with *Brachiaria*	116	23 (19.8%)	0.515	0.473
F4) *Araucaria* forest	308	43 (14.0%)	0.621	0.431
F5) Open forest	112	47 (42.0%)	18.029	< 0.001
Total	**1,521**	**246 (16.2%)**		

of the data, differences in the size of the areas were compared among the phytophysiognomies using the Mann-Whitney or Kruskal-Wallis test and *a posteriori* Student-Newman-Keuls when appropriate and according to the data set.

Since it was impossible to directly estimate the biomass of the areas already impacted by boars, we used the mean values of non-impacted points adjacent to impacted points in each of the 10 vegetation types to estimate the biomass impacted in each correspondent vegetation type. This sampling of the non-impacted biomass was conducted on September 17th 2011 by collecting data at three non-impacted points in each of the 10 vegetation types. Logistic constraints forbid the collection of biomass in April/May, but biomass is not expected to change much from April/May to September since this time interval consists of the winter period in the region. These non-impacted points were at least 150 m - 200 m distant from each other. A quadrat (50 cm x 50 cm) was randomly placed in the vegetation adjacent to each point. We collected all vegetation and soil (3 cm - 5 cm) inside the quadrat. The plant material was separated from the soil and air dried on newspaper for two days (average air temperature of 19^o C and humidity of 37%) and then weighed. The biomass per m^2 was estimated based on the mean values from the 50 cm x 50 cm quadrats.

Differences in biomass between areas within phytophysiognomies were analyzed by ANOVA, t-test or Kruskal-Wallis test and subsequent *a posteriori* tests when appropriate and according to the data set. We tested the preference of wild boars for each of the 10 vegetation types by comparing with qui-square tests the proportion of points impacted of each vegetation type with the expected proportion of points impacted. The expected percentage of points impacted (16.2%) was achieved by dividing the total number of points with wild boars (n = 246) by the total number of points sampled (n = 1,521) (Table 1).

Results

Proportion of impact by phytophysiognomy

Of the 1,521 points sampled, 246 (16.2%) showed evidence of the occurrence of the European wild boar. Of these, 193 were in the forest areas, 29 in the secondary vegetations and 24 in the wetlands (Table 1). Boars showed a strong preference for the forests in relation to other environments and a strong aversion to the areas with *Baccharis* sp. (SV3) (Table 1). Among the forests, there was a preference for the less conserved forest (F5) and the most conserved forest (F1), followed by a marginally significant preference for the second type of most conserved forest (F2) (Table 1).

Size of the impacted patches

The average size of impacted patches was 308 ± 54 m^2, but with large variation (0.1 to 5,670 m^2) within and between physiognomies (Table 2). There were large and small patches in four of the five forest types (except for F3), while in the wetland and secondary vegetation most patches were from average size to small (Table 2). There were no impacted patches in the SV3 areas.

The mean size of the patches impacted by wild boars differed among the three major vegetation types ($H = 7.831$, $p = 0.020$) due to the difference between forests and secondary vegetation (Student-Newman-Keuls). The two types of impacted secondary veg-

Table 2. Area (m^2) of the patches made by the wild boar in each phytophysiognomy in the Estação Ecológica de Aracuri, state of Rio Grande do Sul, Brazil.

Phytophysiognomy	Number of patches	Area (m^2) (range)	Area (m^2) (mean ± SE)
Wetlands			
W1) Sedge	18	1.1 – 416.0	57.8 ± 22.8
W2) Vegetation with two grasses	6	0.2 – 165.3	62.3 ± 32.4
Secondary vegetation			
SV1) *Achyrocline* and *Trichocline* dominated vegetation	21	3.2 – 309.7	62.1 ± 18.9
SV2) *Cichorium* dominated vegetation	8	0.2 – 155.8	22.6 ± 19.1
Forests			
F1) Araucaria forest with ferns and tree ferns	57	0.6 – 5,440.0	781.4 ± 169.9
F2) Araucaria forest with bracken fern	23	0.2 – 4,590.0	415.6 ± 204.8
F3) *Araucaria* forest with *Brachiaria*	23	2.6 – 500.2	107.6 ± 30.0
F4) *Araucaria* forest	43	0.2 – 5,670.0	226.8 ± 131.4
F5) Open forest	47	0.1 – 3,652.5	149.0 ± 83.9
Total	**246**	**0.1 – 5,670.0**	**308.0 ± 54.1**

etation, SV1 and SV2, differed in size of the patches (U = 26.0, p = 0.005), but the two types of wetlands did not differ (U = 52.5, p = 0.920). The five types of forests differed in size of the impacted patches (H = 25.749, p < 0.001). The F1 patches had the largest areas and the F4 patches had the smallest (Table 2).

Impacted biomass

The vegetation where the boars foraged was almost completely destroyed. Seedlings, young plants and roots of trees were uprooted, broken and chewed within the forest patches and the herbaceous vegetation and grass were affected in the clearings, secondary vegetation and wetlands. Aside from the excavation to search for food, nest building, wallowing (in the wetland areas) and trampling of the vegetation in muddy areas also caused damage to the vegetation. The estimate of the total biomass impacted by the wild boar at the sampled points was 56,186 kg, and of this 40,085 kg (71.3%) was in the most conserved forest (F1) (Table 3). At the non-impacted points adjacent to impacted points used to estimate the impacted biomass, the average biomass was generally higher in the wetlands and secondary vegetation (0.84 to 1.40 kg/m^2), but varied widely (from 0.30 to 0.90 kg/m^2) among the five types of forests, increasing from the less conserved forests to the most conserved ("Biomass of non-impacted areas" in Table 3).

From the measured biomass in the non-impacted areas we estimated the following impacted biomass at each phytophysiognomy. The estimate of the average impacted biomass in all the impacted patches was 228.4 ± 42.1 kg/m^2, but with a wide range (0.026 to 4,896 kg/m^2) within and between vegetation types (Table 3). The three major vegetation types did not differ in average impacted biomass (Kruskal-Wallis, χ^2 = 0.245, df = 2, P = 0.885). The two types of wetlands did not differ in average impacted biomass (t = 0.256, df = 22, P = 0.801). However, the average impacted biomass of vegetation patches in the SV1 areas was significantly higher (Mann-Whitney test, P = 0.003) than the biomass in the SV2 areas (Table 3). The five types of forests differed in average impacted biomass (Kruskal-Wallis, χ^2 = 52.334, df = 4, P < 0.001) due to the higher biomass in the F1 areas compared to the three types of altered forests (F3, F4 and F5) (Student-Newman-Keuls). However, the two more conserved forests (F1 and F2) did not differ significantly in average impacted biomass (Table 3).

Discussion

The European wild boar was a generalist in relation to the vegetation types that it exploited. Patches impacted by the wild boar were recorded in 9 of 10 vegetation types sampled in the Ecological Station Aracuri (EEA). Only the *Baccharis* sp. dominated areas were not impacted in the period sampled, but on a visit to EEA in January 2012 we observed impacted patches in this vegetation type. Furthermore, wild boars and/or feral pigs were detected in other natural environments such as sandy coastal plain forests (restinga) (sandy riparian forest, swampy forest), brackish marshes (herbaceous marshes), coastal dunes (psamophyllus vegetation) and ocean beaches in four locations in the municipality of Rio Grande (RS) and another locality in the municipality of Santa Vitória do Palmar (RS) (Santos *et al.*, 2009).

The wild boar showed a preference for two more conserved forest habitats (17% of sampled points), although it was recorded in almost all vegetation types sampled in this study. The wide variation in the size of the uprooted patches suggests that the boar is very selective about the type of soil and can explore more or less intensely a particular area, probably depending

Table 3. Average dry biomass of the non-impacted sampled areas and estimated average biomass and total biomass of impacted patches made by the wild boar at each phytophysiognomy in Estação Ecológica de Aracuri, state of Rio Grande do Sul, Brazil.

Phytophysiognomy	Biomass of non-impacted areas (kg/m²) (mean ± SE)	Patches mean area (m²)	Average impacted biomass (kg/m²)	Total impacted biomass (kg) (%)
Wetlands				
W1) Sedge	0.840 ± 0.200	57.8	48.6	874 (1.6)
W2) Vegetation with two grasses	0.933 ± 0.338	62.3	58.1	349 (0.6)
Secondary vegetation				
SV1) *Achyrocline* and *Trichocline* dominated vegetation	1.400 ± 0.321	62.1	86.9	1,827 (3.3)
SV2) *Cichorium* dominated vegetation	0.867 ± 0.176	22.6	19.6	156 (0.3)
Forests				
F1) Araucaria forest with ferns and tree ferns	0.900 ± 0.351	781.4	703.3	40,085 (71.3)
F2) Araucaria forest with bracken fern	0.633 ± 0.033	415.6	263.2	6,580 (10.8)
F3) *Araucaria* forest with *Brachiaria*	0.433 ± 0.033	107.6	46.6	1,072 (1.9)
F4) *Araucaria* forest	0.380 ± 0.042	226.8	86.2	3,706 (6.6)
F5) Open forest	0.300 ± 0.100	149.0	44.7	2,057 (3.7)
Total	**-**	**308**	**228.4 ± 42.1**	**56,186**

on the type and amount of available resources. The large size of some disturbed patches in the forests revealed that the wild boar can cause extensive impacts in specific areas of its choice. The two more conserved forests, aside from presenting a high impact in about 30% of the sampled points, were the two vegetation types with the highest average area of impacted patches, further increasing the concern in relation to the conservation of these forests.

These data also indicate another point of concern for the conservation and management of these fragments of Atlantic Forest, especially due to the occurrence of *Araucaria angustifolia*, a critically endangered species (IUCN, 2011), the geographic distribution of which is reduced to only 1% to 3% of its original distribution (Gantzel, 1982; Guerra *et al.*, 2002). The boar, aside from disturbing the soil of the most conserved forests with *Araucaria*, consumes its seeds and cones (Deberd and Scherer, 2007), reducing the potential natural regeneration of the species and also probably competes with other native species that use this resource. Aside from *Araucaria*, at least two other species of endangered plants in Rio Grande do Sul (SEMA, 2004) occur in the EEA, the tree fern (*Dicksonia sellowiana*) in forests and *Trichocline catharinensis* in the SV1 phytophysiognomy. Therefore, the possibility of the boar further reducing the population sizes of *Araucaria* and other plant species by disturbing the soil or trampling or decreasing seedling recruitment deserves to be investigated. Furthermore, wild boars can promote or facilitate the invasion of exotic plants promoting a cascading effect on ecosystems (Aplet *et al.*, 1991; Fujinuma and Harrison, 2012).

The destruction of vegetation by the wild boar also implies in a direct impact on local wildlife caused by destruction and loss of diversity of microhabitats (Santos *et al.*, 2009). Their uprooting of the soil is able to promote changes in its chemical characteristics and cause impacts on the biota (GISD, 2007). The almost total destruction through uprooting of the vegetation by the boar is similar to that reported by Santos *et al.* (2009). In areas without water resources, such as the SV1, SV2 and F5 areas, the wild boar apparently causes less impact mainly by trampling the vegetation. The lower proportional impact in the wetlands (2.2%) and secondary vegetation (3.6%) may be related to different types of boar use in these phytophysiognomies. The wetlands may be used mainly for hygiene and the secondary vegetation may be less exploited due to increased soil compaction and the presence of different species of plants available for consumption. Boars probably avoided *Baccharis* areas because it is an almost monospecific stand with dry compacted soil and a shallow litter, apparently offering few feeding resources.

Boars appear to be selective in relation to the plant species consumed, since although the wetlands and secondary vegetation have a higher biomass per area than the natural forests, they were proportionally less impacted. The higher biomass of plants in the more conserved natural forests (F1 and F2) may explain the preference of the wild boar for these areas and the larger average size of the impacted patches. These forests probably have preferred plants in high concentration and are also relatively moister than the other forest types studied. The forests of the EEA have a high density of *Araucaria* pines and the occurrence of boars suggests that they may be attracted to the forests to consume their seeds (pine nuts). The seed production of *Araucaria* can reach values between 117 and 427 kg/ha per year (Solórzano Filho, 2001; Mantovali *et al.*, 2004). The reproductive period of wild pigs is seasonal with an intense demand for food in fall and winter and reproduction in the spring (Leaper *et al.*, 1999). Our study, conducted in the fall, showed the invasion of the European wild boar in the EEA, especially in forested areas, just before the time of fruiting of *Araucaria* in winter (Mantovali *et al.*, 2004).

Wild boars showed to be generalist using almost all habitats sampled, demonstrating a high potential to threat other phytophysiognomies other than the *Araucaria*-dominated forests. Even though they might use and explore almost all kinds of habitats, they prefer more productive humid forests, and might be a threat in the future to other forests, such as other Ombrophyllous forests and gallery forests of central Brazil. At this moment, around 16% of the conservation unit studied was impacted, an impact that could be considered small so far, probably because a large part of the reserve is comprised of vegetation less attractive to boars. Also, the boar recent invasion of the area, and the lack of use of all the area may indicate that its population has not reached the carrying capacity of the area, and that an evaluation of its maximum threat depends on further monitoring. However, its fast expansion in a wide range of Argentina, Uruguay and southern Brazil reveals its potential to become a pest. The amount of plant biomass impacted can be comprehensive, as well as the impact on other live forms, but an extrapolation of the impact to other areas also requires proper studies.

Conclusion

The preference of the European wild boar for conserved natural areas of the EEA reveals a disquieting impact of this species in terms of conservation. From this point of view, this invasive species poses a major threat to forests and protected areas in southern Brazil. It is recommended that management actions and control of the boar population should be promoted by the responsible agencies, including controlled hunting and exclusion of the species from native forests in conservation units. Further studies of impacts on flora and fauna should be conducted in natural environments, including impacts on communities of other vertebrates such as mammals and birds that nest or forage on the ground or in the understory and invertebrates associated with the soil. The impact on threatened plants should also be evaluated, particularly the consumption of *Araucaria* seeds. The behavior of boars should be monitored in relation to landscape use, movements, types of use and dependence on each natural vegetation type or type of plantation.

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