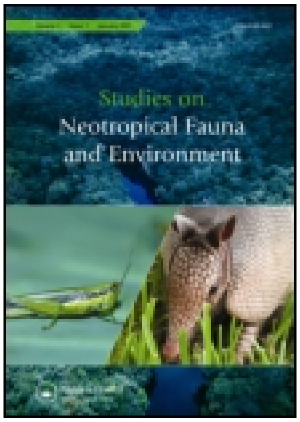

Studies on Neotropical Fauna and Environment

Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/nnfe20

Habitat use of the wild boar, Sus scrofa Linnaeus 1758, in Los Alerces National Park, Argentina

Mauro I. Schiaffini [a] & Alejandro R. Vila [b]

[a] CONICET, Laboratorio de Investigaciones en Evolución y Biodiversidad (LIEB), Facultad de Ciencias Naturales, Universidad Nacional de la Patagonia San Juan Bosco, Esquel, Argentina

[b] Wildlife Conservation Society, Buenos Aires, Argentina

Available online: 27 Feb 2012

To cite this article: Mauro I. Schiaffini & Alejandro R. Vila (2012): Habitat use of the wild boar, Sus scrofa Linnaeus 1758, in Los Alerces National Park, Argentina, Studies on Neotropical Fauna and Environment, 47:1, 11-17

To link to this article: http://dx.doi.org/10.1080/01650521.2012.657916

Studies on Neotropical Fauna and Environment
Vol. 47, No. 1, April 2012, 11–17

ORIGINAL ARTICLE

Habitat use of the wild boar, *Sus scrofa* Linnaeus 1758, in Los Alerces National Park, Argentina

Mauro I. Schiaffini[a]* & Alejandro R. Vila[b]

[a]*CONICET, Laboratorio de Investigaciones en Evolución y Biodiversidad (LIEB), Facultad de Ciencias Naturales, Universidad Nacional de la Patagonia San Juan Bosco, Esquel, Argentina;* [b]*Wildlife Conservation Society, Buenos Aires, Argentina*

(Received 23 February 2011; accepted 12 January 2012)

The aim of this work was to study the patterns of habitat use of the wild boar in Los Alerces National Park, Argentina. We surveyed 262 transects, totaling 26.2 km, searching for fresh signs of the species. The wild boar used low elevations more intensively (600 to 700 m asl) than higher elevations, and forests of *Nothofagus dombeyi* and *N. antarctica* with understory dominated by *Chusquea culeou* than other vegetation types. The occurrence of signs among elevation strips and vegetation types was different between summer and autumn. Our results might be helpful for park managers and park rangers in developing wild boar control plans.

Keywords: *Sus scrofa*; introduced species; vegetation use; elevation use; Argentina; Patagonia

Introduction

Introduced species represent one of the main threats for the conservation of native species and ecosystem functions at regional scales (Kolar & Lodge 2001; Rodríguez 2001). The extinction of native species by competition, predation and/or disease transmission, and the transformation of invaded habitats have been mentioned as the most significant consequences of introduced species (Diamond 1984; Mack et al. 2000).

Many studies that deal with species introductions have been performed in Europe, North America, Australia, and New Zealand, but information on this topic in Argentina is scarce (Novillo & Ojeda 2008). More than 50 animal species have been introduced to this country (Bertonatti & Corcuera 2000), including 18 species of exotic mammals (Novillo & Ojeda 2008). Because American minks (*Mustela vison*), European hares (*Lepus europaeus*), red deer (*Cervus elaphus*), trout, salmon, and wild boars (*Sus scrofa*) were introduced into Argentinean Patagonia (Pagnoni et al. 1986; Jaksic et al. 2002; Novillo & Ojeda 2008), this region provides an opportunity to study species invasions and their effects.

The wild boar is one of the best known cases of introduced species world-wide. Its natural distribution includes Europe, Asia, and northern Africa. The species has been introduced into North and South America, Australia, New Zealand, and many oceanic islands (Rosell et al. 2001). In Argentina, Eurasian wild boars were deliberately introduced between 1904 and 1917 to La Pampa and Neuquén provinces, respectively, for hunting (Daciuk 1978; Bonino 1995).

Wild boars are harmful to agricultural fields and native ecosystems, particularly through their feeding activities. They remove soil and vegetation when searching for underground food, resulting in plant and root death, mixing of soil horizons, and altered rates of nutrient retention (Mack & D'Antonio 1998; Rosell et al. 2001). This rooting activity induces small disturbance processes in which plant succession is initiated, interrupted or redirected, affecting the spatial structure of the ecosystem (Welander 2000). Introduced wild boars also affect ecosystems by facilitating erosive processes, removing or replacing the forest understory, spreading weeds, dispersing both native and exotic plants, preying on invertebrates and small vertebrates, competing with large vertebrates, preventing forest regeneration, and introducing diseases (Mack & D'Antonio 1998; Sierra 2001; McCann et al. 2003; Wilson 2003; Baubet et al. 2004; Tierney & Cushman 2006; Skewes et al. 2007). Because wild boars host several diseases, and because fawns, lambs and goat offspring are among their prey items (Bonino 1995, Pérez-Carusi et al. 2009), they could also negatively impact two native deer species, the endangered huemul (*Hippocamelus bisulcus*) and the southern pudu (*Pudu puda*). Despite these potential impacts, little is known about the biology and ecology of wild boars in Argentina (Pescador et al. 2009; Cuevas et al. 2010). Although the species was introduced almost 100 years ago in Patagonia and its current range includes several

*Corresponding author. Email: mschiaffini@hotmail.com

ISSN 0165-0521 print/ISSN 1744-5140 online

http://dx.doi.org/10.1080/01650521.2012.657916
http://www.tandfonline.com

National Parks (Novillo & Ojeda 2008), its patterns of habitat use have never been studied in most of these protected areas.

In temperate forests of Patagonia, wild boars face seasonal changes in weather conditions (Dimitri 1972; Correa 1998). Temperature, light, and precipitation patterns are reflected in plant physiology and, consequently, both a warm growing period (spring–summer) and a cold dormant period (autumn–winter) have been described for these forests (Schmaltz 1991; Donoso 1993; Veblen et al. 1995). During the dormant period, annual plants die and biennials and perennials cease active growth, thus deciduous plants lose their leaves and evergreens curtail all new growth. The availability of fruits also declines during this season. Low-lying perennial forbs and roots are largely unavailable under the snow at high altitudes during autumn and winter. Thus, in this temperate habitat, wild boar could face severe scarcity of food during the autumn–winter period. In this broad context, we can predict that the wild boar's habitat use changes on a seasonal basis. The objective of this study was to assess the habitat use by the wild boar during summer and autumn in Los Alerces National Park, Argentina.

Materials and methods

Study area

The study was conducted in Los Alerces National Park (LANP, 42°50′ S, 71°52′ W), in the Andean region of northwestern Chubut Province, Argentina (Figure 1). The park was created in 1937, covering 263,000 ha of mountainous terrain that ranges from 300 to 2500 m asl. The park has deep glacial lakes and southern temperate forests. LANP includes two main categories of management: National Park and National Reserve. The National Reserve was conceived as a buffer zone where regulated uses are permitted (e.g. livestock raising, tourism), while the National Park preserves the core area of this conservation unit (Martín & Chehébar 2001).

The climate is temperate–cold, with a mean annual temperature of 8°C (APN 1997). The mean maximum temperature in summer is 14.7°C and mean minimum in winter is 1.8°C. Mean annual precipitation decreases abruptly from west to east, from more than 3000 mm/year on the western side of the National Park, including Valdivian evergreen rain forest, to 800 mm/year at the eastern forest-steppe ecotone (APN 1997). Precipitation occurs mainly from April to October, with snowfall concentrated during autumn to spring (June to September). During this period, precipitation occurs mostly as snow in high altitude. Summers are dry and warm (Villalba & Veblen 1997).

LANP encompasses two phytogeographical provinces: subantarctic and high Andean (APN 1997). Subantarctic forests are dominated by pure or mixed stands of conifers (*Austrocedrus chilensis* and *Fitzroya cupressoides*), evergreen (*Nothofagus dombeyi*), and deciduous (*N. pumilio* and *N. antarctica*) species. *Nothofagus dombeyi* dominated forests include dense understories of a shade tolerant bamboo (*Chusquea culeou*), *Aristotelia chilensis*, and *Schinus patagonicus*. The understory of *Austrocedrus chilensis* dominated stands consists of *S. patagonicus*, *Colletia hystrix*, and *Maytenus disticha*, while the understory of *N. pumilio* stands is dominated by *Berberis pearcei*, *M. disticha*, *C. culeou*, and forbs. The vegetation of the high Andean province includes a mosaic of grasses, shrubs, and forbs that provide extremely sparse cover. This highland community located above the tree line is dominated by bare rocks.

Data collection and analysis

The wild boar is a secretive and shy species, with nocturnal habits and a well-developed olfactory sense (Groves & Giles 1989; Solis-Cámara et al. 2009). The study area is steep, and dense vegetation covers much of the terrain, so that census by direct sighting is impractical. We therefore used an indirect method to evaluate wild boar distribution patterns. We surveyed 262 transects (100 m long by 2 m wide, 135 in summer and 127 in autumn) along seven available footpaths (Figure 1, Table 1). These transects covered different vegetation types and the altitudinal gradient from the valley bottom to above the tree-line in the eastern and more acceded part of LANP. We counted all fresh signs (rooting, feces) of wild boar in each transect during the austral summer of 2008–2009 and autumn of 2009. Isolated tracks (without evidence of foraging) were found on rare occasions (< 5) and recorded as signs of one individual. Multiple tracks were found only once, and due to their different sizes (indicating more than one individual), were recorded as multiple signs. Due to the high number of signs observed (mostly rooting and feces), all the signs counted in each transect were geo-referenced in the central point of the transect using a Garmin E-Trex® GPS.

We evaluated the altitudinal distribution of the species, using elevation values obtained for each point of occurrence from a digital elevation model (DEM), in both summer and autumn. We also superimposed the location of wild boar signs on a vegetation map developed by Barrios Lamunière & Vila (2004) for this area, and the distribution of signs in each habitat type was evaluated in both seasons, using the software ArcView® 3.3 (ESRI 2002). Seasonal differences in the observed proportion of signs between altitudinal

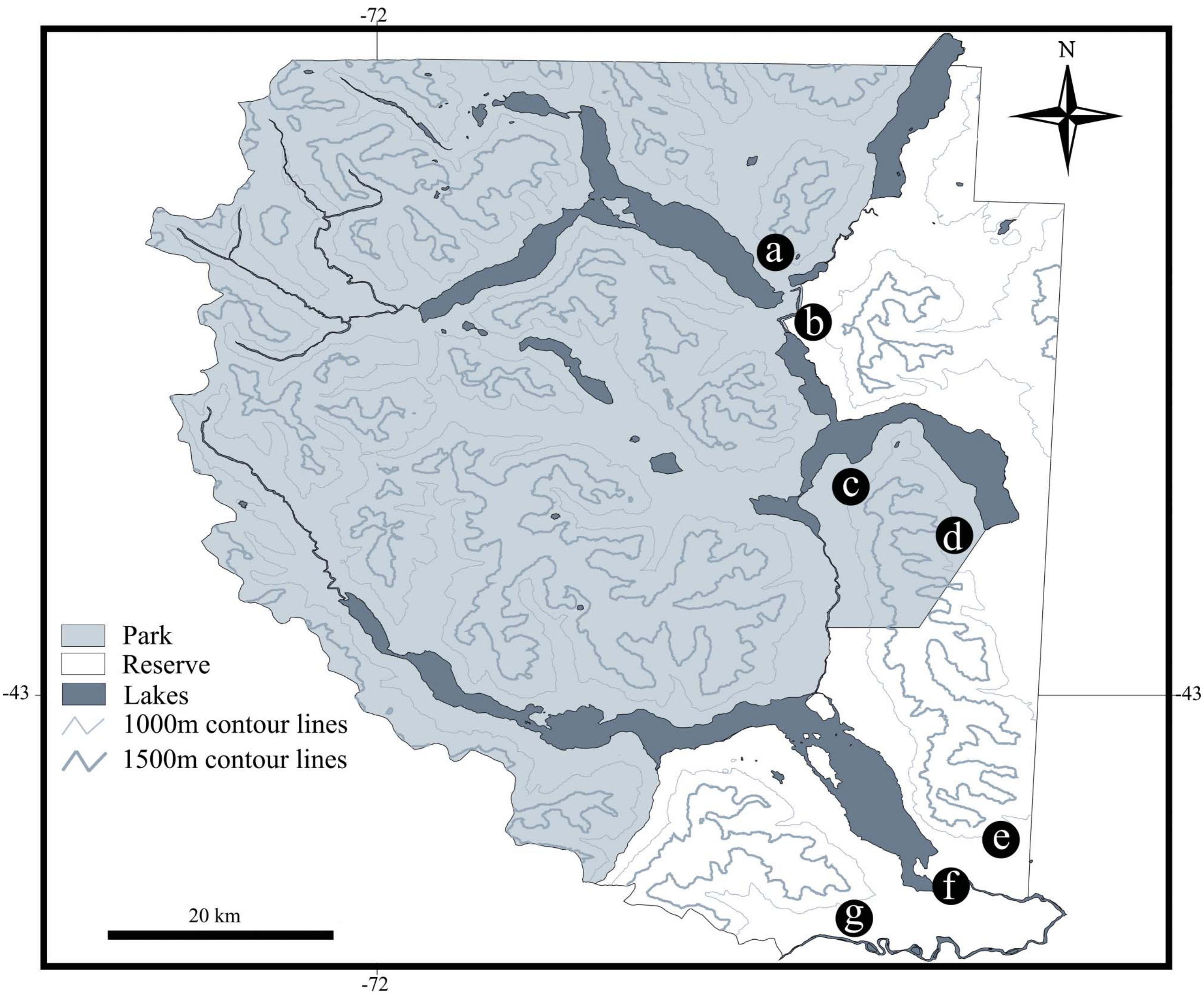

Figure 1. (Color online) Study area and sampling sites in Los Alerces National Park, Chubut province, Argentina; (a) Cerro Petiso, (b) Laguna Escondida, (c) Lago Krugger, (d) Cerro Dedal, (e) Laguna Toro, (f) Playa Disyuntores, and (g) Unión. Only the contour lines of 1000 and 1500 m asl are presented.

strips and vegetation types were analyzed using a χ^2 test (Zar 1996).

Results

We found a total of more than 2300 fresh signs, pooling records of both summer ($n = 963$) and autumn ($n = 1381$) together during our transect surveys. Of these signs 95% were rooting areas. In both seasons, wild boar signs were most abundant between 600–700 m asl. (Figure 2). The number of signs decreased abruptly above 900 m asl and no signs were found at elevations over 1200 m asl. Although wild boars tended to use low elevations more intensively, the distribution of signs along the elevation range was not independent of the season ($\chi^2 = 117.8$; df = 8; $p \leq 0.01$). An increased use of the elevations at 500, 700, and 900 m asl was observed in autumn, while the number of signs at 400 and 600 m asl decreased compared with that observed during summer (Figure 2).

The distribution of signs among vegetation types showed that wild boars did not use the available plant communities uniformly (Figure 3). Wild boars used forests dominated by *N. dombeyi* or *N. antarctica* more intensively than other vegetation types in both seasons. The occurrence of signs among vegetation types was not independent of the season ($\chi^2 = 64.2$; df = 4; $p \leq 0.01$). The use of *A. chilensis* and *N. antarctica* forests declined during the autumn, while the use of stands of *N. pumilio* and grasslands, located at higher and lower elevations than *N. dombeyi* forests respectively, increased from summer to autumn.

Table 1. Sampling effort along footpaths in each season.

Season	Footpath	Number of transects	Survey effort in km	Altitudinal range (m asl)
Summer	Cerro Petiso	20	2	560 – 920
Summer	Laguna Escondida	19	1.9	580 – 900
Summer	Cerro Dedal	47	4.7	560 – 1150
Summer	Laguna Toro	13	1.3	370 – 630
Summer	Playa Disyuntores	2	0.2	358 – 360
Summer	Unión	11	1.1	400 – 570
Summer	Lago Krugger	23	2.3	510 – 990
Autumn	Cerro Petiso	13	1.3	545 – 814
Autumn	Laguna Escondida	11	1.1	750 – 902
Autumn	Cerro Dedal	37	3.7	590 – 1150
Autumn	Laguna Toro	11	1.1	366 – 739
Autumn	Playa Disyuntores	2	0.2	358 – 360
Autumn	Unión	15	1.5	365 – 618
Autumn	Lago Krugger	38	3.8	500 – 990

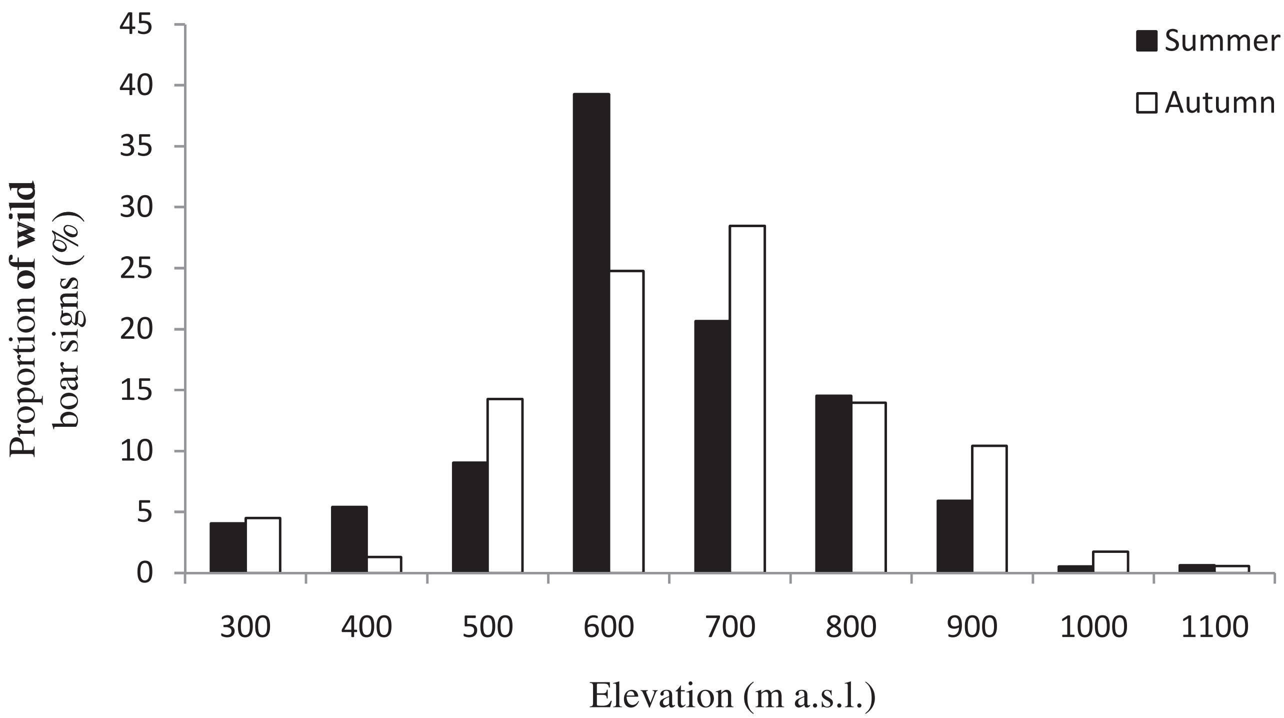

Figure 2. Proportion (in %) of wild boar signs per elevation (in steps of 100 m) recorded along transects from the valley bottom to above tree-line in Los Alerces National Park, Chubut province, Argentina, during summer and autumn.

Discussion

The introduction of wild boars has been recognized as a potential threat to native ecosystems by several authors. However, current information on the species' status and its habitat requirements in Patagonia is scarce (Bonino 1995; Novillo & Ojeda 2008). This work is one of the first efforts to understand the patterns of habitat use by wild boars in the southern cone of South America.

The elevation pattern of habitat use observed in LANP could be explained by several environmental constraints that influence the availability of resources. Seedling density and plant recruitment decreases abruptly above the alpine timberline (Cuevas 2002) and, thereby, food resources (e.g., insects, root, fruits) for wild boar decrease. Wild boar populations in Patagonia seem to be regulated by "bottom-up" processes, in which the availability of food and water

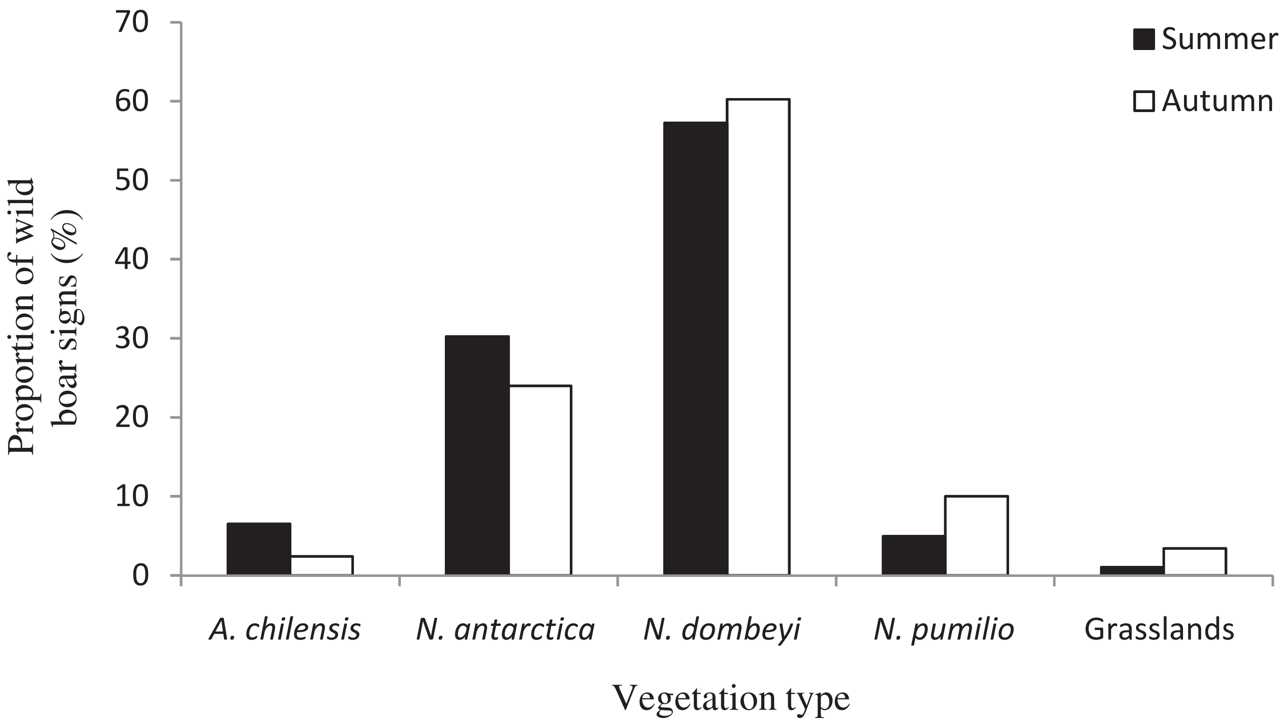

Figure 3. Proportion (in %) of wild boar signs recorded in different vegetation types along transects covering from the valley bottom to above tree-line in Los Alerces National Park, Chubut province, Argentina, during summer and autumn.

are the main driving forces (Pescador et al. 2009). In Europe, several studies have shown the importance of acorns and bulbs in wild boars' diet (Massei et al. 1996; Baubet et al. 2004), but information on feeding habits in Argentina is scarce. In an arid region of Monte Desert of Argentina, Cuevas et al (2010) found leaves and bulbs as the main components of wild boar diet. Sanguinetti & Kitzberger (2008) estimated that each austral autumn, the species consumes about 11% of the *Nothofagus* spp. seeds produced in Lanín National Park, in similar habitat to our study area. Skewes et al. (2007) found that *Chusquea* spp. was a very commonly ingested item found in 75% of the sampled stomachs of wild boars in Chilean *Nothofagus* forest. These observations suggest that wild boars could concentrate their use of habitat in these forests, as was observed in our work.

As wild boars are opportunistic feeders, the type of food they consume and, therefore, their geographic location will be determined by resource availability (Desbiez et al. 2009). Consequently, the high presence of wild boar signs in *Nothofagus* forests seems to be mainly related to food availability in key foraging sites dominated by *Chusquea* spp. Wild boars also rely on behavioral thermoregulation (Desbiez et al. 2009), and temperate forests offer a combination of snow-intercepting canopy and thermal cover (Mysterud & Østbye 1999). In our study site, the presence of *Nothofagus* forests with dense understory in low and mid-elevations could offer more humid and warmer weather conditions that satisfy the species' thermal requirement. The *C. culeou* dominated understory also prevents soil freezing during cold days, allowing wild boars to find food (i.e., roots, bulbs, and insects) under this bamboo cover. As the canopy of mixed *Nothofagus* and *A. chilensis* forests usually reaches 40 m in height (Veblen et al. 1997), the species can also avoid high temperatures during summer months (ca. 30°C) in this habitat. The lack of signs of wild boars above the alpine timberline in LANP might be related to snow accumulation during the coldest months. Snow increases the difficulty of obtaining food from the ground and aerial parts of the plants in this study area (Vila et al. 2009; Vila & Borrelli 2011) and also restricts the movements of wild boars (Rosvold & Andersen 2008).

To reduce its potential impacts on forests and native wildlife, a control plan for wild boars should be developed within the conservation objectives of LANP and immediately implemented to reduce or eliminate their populations. In this scenario, our work provides a baseline for further investigations to understand both the invasion pattern and the spreading rate of the species.

Acknowledgements

We thank the National Park Service of Argentina (APN) for allowing us to carry out this study in Los Alerces National Park (License 968). A. Giménez, L. Pafundi, and G. Omad provided essential assistance in the field. We are also grateful to G. Martin and M. Tejedor for their comments on an early version of this paper. Dr. A. Zillikens, three anonymous reviewers, M. Fox, and C. Briceño provided important comments to improve the manuscript.

References

APN. 1997. Plan preliminar de manejo Parque Nacional Los Alerces. Bariloche (Argentina): Administración de Parques Nacionales.

Barrios Lamunière SD, Vila AR. 2004. Mapa de vegetación del área Andina Cholila- Corcovado, provincia del Chubut. Proyecto Huemul WCS. Mendoza (Argentina): Resúmenes de la II Reunión Binacional de Ecología.

Baubet E, Bonefant C, Brandt S. 2004. Diet of the wild boar in the French alpes. Galemys. 16:99–111.

Bertonatti C, Corcuera J. 2000. Situación Ambiental Argentina. Buenos Aires (Argentina): Fundación Vida Silvestre.

Bonino NA. 1995. Proceedings of the first international wildlife considerations. In: Bissonette JA, Krausman PR,editors.Introduced mammals in Patagonia, southern Argentina: consequences, problems and management considerations. Bethesda (MD): The Wildlife Society. p. 406–409.

Correa MN. 1998. Flora Patagónica del INTA. Buenos Aires (Argentina): Ediciones INTA.

Cuevas JM. 2002. Episodic regeneration at the *Nothofagus pumilio* alpine timberline in Tierra del Fuego, Chile. J Ecol. 90:52–60.

Cuevas MF, Novillo A, Campos C, Dacar MA, Ojeda RA. 2010. Food habitats and impact of rooting behaviour of the invasive wild boar, *Sus scrofa*, in a protected area of the Monte Desert, Argentina. J Arid Environ. 74:1582–1585.

Daciuk J. 1978. Notas faunísticas y bioecológicas de Península Valdés y Patagonia, IV. Estado actual de las especies de mamíferos introducidos en la Región Araucana (Rep. Argentina) y grado de coacción ejercido en algunos ecosistemas surcordilleranos. Anales de Parques Nacionales. 14:105–130.

Desbiez ALJ, Santos SA, Keuroghlian A, Bodmer RE. 2009. Niche partitioning among White-lipped peccaries (*Tayassu pecari*), collared peccaries (*Pecari tajacu*) and feral pigs (*Sus scrofa*). J Mammal. 90:119–128.

Diamond JM. 1984. Normal extinctions of isolated populations. Chapter 6. In: Nitecki, MH editor. Extinctions. Chicago: Chicago University Press. p. 191–246.

Dimitri MJ. 1972. La region de los bosques andinopatagónicos: sinopsis general. Colección Científica del INTA. Buenos Aires (Argentina): INTA.

Donoso C. 1993. Bosques templados de Chile y Argentina: Variación, estructura y dinámica. Santiago (Chile): Editorial Universitaria.

ESRI. 2002. Arcview Version 3.3. Redlands (CA): Environmental System Research Institute.

Groves CP, Giles J. 1989. Fauna of Australia Vol 1b. Suidae. Australia: Australian Government Publishing Service.

Jaksic F, Iriarte MA, Jiménez J, Martínez D. 2002. Invaders without frontiers: cross-border invasions of exotic mammals. Biol Invasions. 4:157–173.

Kolar CS, Lodge DM. 2001. Progress in invasion biology: predicting invaders. Trends Ecol Evol. 16:199–204.

Mack MC, D'Antonio CM. 1998. Impacts of biological invasions on disturbance regimes. Trends Ecol Evol. 13: 195–198.

Mack RN, Simberloff D, Lonsdale WM, Evans H, Clout M. 2000. Biotic invasions: causes, epidemiology, global consequences and control. Ecol Appl. 10:698–710.

Martín C, Chehébar C. 2001. The national parks in Argentinean Patagonia – management policies for conservation, public use, rural settlements, and indigenous communities. J Royal Soc NZ. 31:845–864.

Massei G, Genov PV, Staines BW. 1996. Diet, food availability and reproduction of wild boar in a Mediterranean coastal area. Acta Theriol. 41(3): 307–320.

McCann B, Davie DK, Feldhamer GA. 2003. Distribution, habitat use and morphotypes of Feral Hogs (*Sus scrofa*) in Illinois. Trans Ill State Acad Sci. 96:301–311.

Mysterud A, Østbye E. 1999. Cover as a habitat element for temperate ungulates: effects on habitat selection and demography. Wildl Soc Bull. 27:385–394.

Novillo A, Ojeda RA. 2008. The exotic mammals of Argentina. Biol Invasions. 10:1333–1344.

Pagnoni GO, Garrido JL, Marin MR. 1986. Impacto económico y ambiental del visón *Mustela vison* (Schreber, 1887) en el norte de la Patagonia. Chubut (Argentina): CENPAT-CONICET, Dirección de Fauna Silvestre.

Pérez-Carusi LC, Beade MS, Miñarro F, Vila AR, Giménez-Dixon M, Bilenca DN. 2009. Relaciones espaciales y numéricas entre venados de las pampas (*Ozotoceros bezoarticus*) y chanchos cimarrones (*Sus scrofa*) en el Refugio de Vida Silvestre Bahía Samborombón, Argentina. Ecol Austral. 19: 63–71.

Pescador M, Sanguinetti J, Pastore H, Peris S. 2009. Expansion of the introduced wild boar (*Sus scrofa*) in the Andean region, Argentinean patagonia. Galemys. 21:121–132.

Rodríguez JP. 2001. La amenaza de las especies exóticas para la conservación de la biodiversidad suramericana. Interciencia. 26:479–483.

Rosell C, Fernández-Llario P, Herrero J. 2001. El jabalí (*Sus scrofa* Linnaeus 1758). Galemys. 13:1–25.

Rosvold J, Andersen R. 2008. Wild boar in Norway – is climate a limiting factor? Norges Teknisk-naturvitenskapelige Universitet, Vitenskapsmuseet Rapport Zoologisk Serie, 1:1–23.

Sanguinetti J, Kitzberger T. 2008. Patterns and mechanism of masting in the large-seeded southern hemisphere conifer *Araucaria araucana*. Austral Ecol. 33:78–87.

Schmaltz J. 1991. Deciduous forests of southern South America. In: Röhrig E, Ulrich B,editors.Ecosystems of the world.7. Temperate deciduous forests. New York: Elsevier. p. 557–578.

Sierra C. 2001. El cerdo cimarrón (*Sus scrofa*, Suidae) en la Isla de Coco, Costa Rica: Composición de su dieta, estado reproductivo y genética. Rev Biol Trop. 49:1147–1157.

Skewes O, Rodríguez R, Jaksic FM. 2007. Ecología trófica del jabalí europeo (*Sus scrofa*) silvestre en Chile. Rev Chil Hist Nat. 80:295–307.

Solis-Cámara AB, Arnaud-Franco G, Álvarez-Cardenas S, Galina-Tessaro P, Montes-Sánchez JJ. 2009. Evaluación de la población de cerdos asilvestrados (*Sus scrofa*) y su impacto en la Reserva de la Biosfera Sierra La Laguna, Baja California Sur, Mexico. Trop Cons Sci. 2:173–188.

Tierney TA, Cushman JH. 2006. Temporal changes in native and exotic vegetation and soil characteristics following disturbances by feral pigs in a California grassland. Biol Invasions. 8:1073–1089.

Veblen TT, Burns B, Kitzberger T, Lara A, Villalba R. 1995. The ecology of the conifers of southern South America. In: Enright N, Hill S,editors.Ecology of the Southern Conifers. Melbourne (Australia): Melbourne University Press. p. 120–155.

Veblen TT, Kitzberger T, Burns BR, Rebertus AJ. 1997. Perturbaciones y dinámica de regeneración de bosques nativos del sur de Chile y Argentina. Chapter 9. In: Armesto, JJ, Villagrán C, Arroyo MK,editors.Ecología de los bosques nativos de Chile. Santiago (Chile): Editorial Universitaria. p. 169–198.

Vila AR, Borrelli L. 2011. Cattle in the Patagonian forests: feeding ecology in Los Alerces National Reserve. For Ecol Manag. 261:1306–1314.

Vila AR, Borrelli L, Martínez L. 2009. Dietary overlap between huemul and livestock in Los Alerces National Park, Argentina. J Wildl Manag. 73:368–373.

Villalba R, Veblen TT. 1997. Regional patterns of tree population age structures in northern Patagonia: climatic and disturbance influences. J Ecol. 85:113–124.

Welander J. 2000. Spatial and temporal dynamics of wild boar (*Sus scrofa*) rooting in a mosaic landscape. J Zool (Lond). 252:263–271.

Wilson CJ. 2003. Distribution and status of wild boar *Sus scrofa* in Dorset, southern England. Mammal Rev. 33:302–307.

Zar JH. 1996. Biostatistical Analysis. 3rd ed. New Jersey: Prentice Hall.