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Introduced Invasive Mammals of Argentina

Mamíferos Introducidos Invasores de Argentina












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The Argentine Society for the Study of Mammals (Sociedad Argentina para el Estudio de los Mamíferos – SAREM) was created in 1983, and currently has about 300 members from several countries. SAREM is an interdisciplinary society of natural sciences professionals whose main goals are the promotion of scientific and technical research, the consolidation of national collections and research centers, and the publication and diffusion of research on living and/or extinct mammals. SAREM has organized scientific meetings for mammal researchers since 1994, publishes the journals *Mastozoología Neotropical* and *Notas sobre Mamíferos Sudamericanos*, and has edited books on the systematics, distribution and conservation of the mammals of southern South America, including *Libro Rojo de los mamíferos amenazados de la Argentina* (first ed. 2000, second ed. 2012) and *Mamíferos de Argentina. Sistemática y distribución* (2006), as well as contributing to the *Libro Rojo de los mamíferos y aves amenazados de la Argentina* (currently out of print).

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Introduced invasive species are a major driver of local to global environmental change, including important negative impacts on biodiversity, ecosystem processes, economies, health and other social values. At the same time, however, different social actors can hold diverse representations of these species, particularly of introduced invasive mammals (IIMs). Such divergent values and perceptions can lead to conflicts regarding the management of IIMs, but also invite researchers and managers to be reflexive regarding their own work at a more fundamental level. Therefore, it is key that we advance towards a holistic understanding of IIMs and develop strategies to manage them based on solid technical information and plural perspectives regarding their multiple values. Despite a rich history of initiatives in Argentina to study and manage IIMs, until now there has not been an opportunity to assess the state-of-the-art knowledge in our country. This book seeks to provide rigorous, relevant and legitimate information to support research, policymaking and management decisions regarding IIMs in Argentina. With this objective in mind, the book presents a series of chapters selected to highlight priority topics concerning the conceptualization and implementation of IIM research and management. Then, fact sheets are provided for the different IIMs found in Argentina. Finally, beyond the realm of academic inquiry, the timing of this publication is ideal to re-enforce policy and decision-making, such as the recently approved National Invasive Exotic Species Strategy, which seeks to implement actions and enhance institutional capacities related to invasive species management in Argentina, and the Convention on Biological Diversity's new Global Biodiversity Framework, which also addresses biological invasions as part of broader efforts to attain the 2050 Vision for Living in Harmony with Nature.

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Foreword

Biological invasions by introduced species are one of the great changes rapidly transforming the globe today, with innumerable impacts on economics, human health, ecosystem services, and biodiversity. Mammals are among the most impactful of invasive species, transmitting diseases to humans, livestock, and native animals, trampling native grasslands, voraciously devouring vegetation from groundcover to saplings of forest trees, fouling water, causing erosion, and preying on and outcompeting native animals. They were among the first species humans introduced worldwide and in Argentina, both deliberately (*e.g.*, livestock) and inadvertently (*e.g.*, rats and mice). They have been introduced for sport (*e.g.*, deer, boar) and companionship (*e.g.*, cats, dogs), or simply as attractive ornamentals (*e.g.*, squirrels). Some that are meant to be kept in captivity, such as cats, dogs, and squirrels, escape and establish feral populations.

Argentina looms large in the history of biological invasions by introduced mammals. The earliest permanent European settlers of Buenos Aires in 1580 discovered huge herds of feral horses already on the pampas, and soon after, Vázquez de Espinoza described feral horses in Tucumán that were "in such numbers that they cover the face of the earth…". Many sheep were in Tucumán as well at that time, and of course later sheep were enormously numerous in Patagonia, effecting huge changes in the vegetation and driving land degradation and desertification to this day. When Charles Darwin visited the La Plata region in 1832 during the voyage of the Beagle, he reported that "…countless herds of horses, cattle, and sheep, not only have altered the whole aspect of the vegetation, but they have almost banished the guanaco, deer and ostrich. Numberless other changes must likewise have taken place; the wild pig in some parts probably replaces the peccari; packs of wild dogs may be heard howling on the wooded banks of the less-frequented streams; and the common cat, altered into a large and fierce animal, inhabits rocky hills."

Approximately 40 mammals have been introduced to South America, of which 25–30 have established populations; most of these are in the Southern Cone. In Argentina, I count 23 successfully introduced mammal species, including feral cats, dogs, and cows. Many, such as rats, rabbits, boar, and goats, are widely distributed around the world. By contrast, the hairy armadillo has been introduced nowhere else but from the mainland of Patagonia to Tierra del Fuego Island. Strikingly, except for the rats and house mouse, all these mammals were brought to Argentina deliberately; this is very different from, say, introduced insects. A few of these invasive mammals, like the squirrel, were not intended to be released, but I hesitate to term such invaders truly "accidental," because the people who brought them should have realized that escapes or later releases were almost inevitable. Of course, almost all of these mammals were introduced before the late twentieth century, which was when most scientists and the public began to recognize the extent and importance of impacts of introduced species. However, the squirrel and armadillo introductions were recent enough that potential impacts should have been foreseen. Things could be worse, of course—mammals deliberately brought to Argentina that either were released, but did not establish persistent populations or have not yet escaped from hunting preserves include reindeer, silver fox, mule deer, African buffalo, white-tailed deer, Père David's deer, thar, barbary sheep, wisent, mouflon, chamois, and ibex.

The technology of eradicating introduced invasive mammals has made enormous strides in the last thirty years—at least 31 mammal species have been eradicated from islands worldwide, including relatively large islands like South Georgia. Both Norway and ship rats have been eradicated hundreds of times, and house mice about 100 times. Most large mammals, such as deer and horses, are technologically easier eradication targets—many can simply be tracked and shot, for instance. However, mammals more than any other introduced species pose the complication that many people—especially hunters—simply do not want to eradicate them, and many animal welfare advocates, even those recognizing the damage some invaders cause, object to eradicating them by the only currently feasible means—killing them, humanely if possible. Even rat eradication has been impeded on animal rights/animal welfare grounds, and free-ranging dog and cat populations frequently are seen more as animal welfare issues than as conservation problems to broad sectors of some societies. In Argentina, the problem of implementing feasible eradication programs for invasive mammals is epitomized by the rather schizophrenic attitude taken by the National Parks Administration (Administración de Parques Nacionales – APN) towards red deer. The APN's conservation imperative is supported by the section of Law #22,351 that forbids propagating introduced animals, yet red deer, known to damage native species and ecosystems, are managed in Lanín National Park to foster ongoing hunting, and even to improve the size and quality of the deer for better hunting trophies. Additionally, there is often inconsistent and inadequate funding for managing and eradicating invasive mammals in protected areas, almost always constituting a supervening impediment even when a rational and effective goal is stated.

Argentine scientists have participated heavily in the rapid growth of modern invasion science since its inception in the 1980s, and they and overseas colleagues have conducted substantial research on the biology and impacts of many of the introduced invasive mammals in Argentina, as well as other invasive species. Some of the threats posed by these mammals have even become widely known to the general public in Argentina and beyond—the spread of the beaver from Tierra del Fuego to the mainland has been an international news story. *Introduced Invasive Mammals of Argentina* is therefore an exciting and timely addition to the literature on invasions in southern South America for both the Argentine public (and its political representatives and environmental managers) and scientists worldwide. The many authors assembled for this book explore how these biological invasions happened in the first place, how they spread, what they do to biodiversity, ecosystems, and human enterprises, what has been done about them so far, what can be done about them now, and what might be done with them in the future. The editors and authors are to be congratulated for an excellent exposition of the Argentine part of a growing global phenomenon.

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Sus scrofa
wild boar, jabalí

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Resumen. El jabalí es una especie exótica invasora que fue introducida en Argentina por primera vez en 1906 para la caza deportiva. Es una especie con una alta tasa reproductiva y que se adapta a diferentes condiciones climáticas, por lo que en Argentina actualmente se la encuentra en al menos 10 ecoregiones. Esta especie es omnívora y oportunista, con una dieta mayormente herbívora. El jabalí en Argentina genera una amplia variedad de impactos negativos relacionados con la composición, estructura y biomasa de la vegetación, y cambios en las propiedades del suelo; como también con la transmisión de enfermedades, principalmente a través del consumo de su carne. Por ejemplo, en el Desierto del Monte genera un aumento de la degradación del mismo, mientras que en los Bosques Patagónicos reduce la tasa de descomposición y favorece el establecimiento de especies de plantas exóticas. En cuanto al manejo, si bien el jabalí es considerado como prioritario, los esfuerzos para su control son ineficientes hasta el momento, por lo que es necesario desarrollar una estrategia a nivel nacional para mitigar sus impactos, reducir sus poblaciones y evitar su dispersión.

General description of the species

The boar is a medium-sized species, reaching in some places up to 100 kg. It has a large head with small ears, and the neck is short and thick (Fig. 1; Rosell *et al.*, 2001). Its coat color ranges from black to brownish-red, and it has sexual dimorphism, where males are bigger and with more developed canine teeth than females (Rosell *et al.*, 2001). Their dental formula is 3/3 1/1 4/4 3/3.

The wild boar is an omnivorous species with a diet dominated by plant material (87%–99%) and a smaller representation of animal matter (Schley and Roper, 2003). It has a high reproductive capacity due to characteristics, such as early sexual maturity (5–12 months), a relatively short gestation period (120 days), and a large litter size (5–7 piglets) (Gethöffer *et al.*, 2007; Herrero *et al.*, 2008). Its social organization consists of a matriarchal society, formed by one or more females with their piglets. Also there are groups of young males and solitary adult males.

The boar has a high tolerance to different climatic conditions, reflected in its wide geographic range (Oliver *et al.*, 1993). For that reason it occupies different Argentine ecoregions, such as the Paraná Flooded Savanna, Iberá Marshes, Patagonian Forests, Pampa,

Figure 1. *Sus scrofa* in Argentina. (Photo: Gabriel Rojo).

Patagonian Steppe, High Andean, Espinal, Arid Chaco, and Monte Desert (Ballari *et al.*, 2015a). This species is diurnal and crepuscular although its activities can vary according to type of environment and hunting pressure (Baber and Coblentz, 1986; Baubet *et al.*, 2004).

History of the invasion

The wild boar is native to Eurasia and northern Africa (Long, 2003), but now has one of the widest geographic distributions of any introduced mammal (Oliver *et al.*, 1993). It was first brought to Argentina in 1906, specifically to San Huberto Ranch in La Pampa province, for hunting purposes (Daciuk, 1978). After that, wild boar reintroductions occurred several times in different parts of the country, such as in Collun-có Ranch in Neuquén province in 1917, and in Huemul Ranch in Río Negro province in 1924 (Daciuk, 1978). Furthermore, the continuous installation of game reserves has led to the introduction of new populations of this species around the country (Cuevas *et al.*, 2016). On the other hand, feral populations of domestic pigs have been documented by Carpinetti *et al.* (2016) since their arrival to Argentina in 1536 with the Spanish conquistadors. By the end of the 16th century, the number of free-ranging animals increased, until they eventually became feral.

Patterns of expansion and current distribution

The creation of game reserves throughout the country from the boars' first introduction to the present, and the subsequent escape of animals, make it a very difficult task to determine the spread pattern. The wild boar is a very successful invader, using rivers and streams, roads, paths, and cattle trails as dispersal routes (Ballari *et al.*, 2019). This invasive species is present in almost the entire country (20 of the 23 provinces; Fig. 2) due to natural dispersion and human translocations from one place to another, and it occupies not only ecoregions similar to those found in its native range, but also new habitat types, such as the temperate Monte Desert (Cuevas *et al.*, 2010; Ballari *et al.*, 2019; Cuevas *et al.*, 2021). Today, most of the naturalized populations in Argentina are crossbreeding among the three morphotypes (domestic pigs, feral pigs and wild boar) (Figueroa *et al.*, 2022).

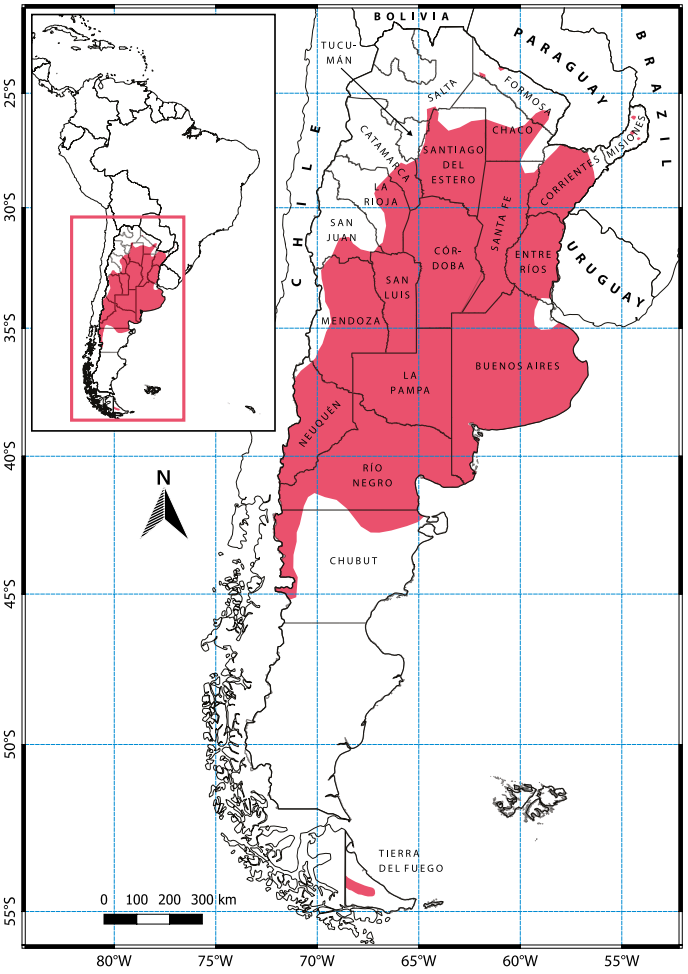

Figure 2. Distribution of *Sus scrofa* in Argentina. Modified from Ballari *et al.* (2019). (Mapping: Ian Barbe and Alfredo Claverie).

Impacts

Wild boar generate several impacts, affecting not only plant and animal communities, but also ecosystem processes (Ballari and Barrios-García, 2012). Studies have shown that boars reduce plant cover in the Monte Desert (Cuevas *et al.*, 2010; Cuevas *et al.*, 2012), but furthermore, over the long-term, disturbed soils show a relatively high (60%) extent of species turnover (rate of species replacement), mainly dominated by annual species. In this way, perennial plant species are negatively affected, and their recovery is very slow (Cuevas *et al.*, 2020). In Patagonian forests, wild boars affect vegetation composition and promote invasive plant establishment and growth (Barrios-García *et al.*, 2014). At the soil level, this species alters properties through its rooting behavior, where in Monte Desert biome this action modifies physical, chemical, and microbiological conditions, leading to wind erosion and subsequent contribution to the acceleration of desertification processes (Cuevas *et al.*, 2012); in Patagonian forests, it produces a substantial change in soil properties, decreasing decomposition rates and soil hardness (Barrios-García *et al.*, 2014). In Parque Nacional El Palmar, boars may serve dual roles as possible seed dispersers of the yatay palm (*Butia yatay*), as they defecate whole seeds upon eating its fruit, and also as predators upon yatay seedlings, where during non-masting periods boars dig around the plant, leaving their roots exposed and causing it to die (Ballari *et al.*, 2015b). This species also damages agricultural crops and preys upon small livestock (Navas, 1987), as well as dispersing introduced plant seeds and promoting its establishment (Ballari and Barrios-García, 2014; Ballari *et al.*, 2015b).

Regarding its social impact, the boar's presence is increasingly frequent in urban areas, which implies dangers of direct contact, rooting in landscaping and traffic accidents (Ballari *et al.*, 2019). In addition, *Sus scrofa* is a reservoir of many viral and bacterial diseases and parasites, which can be transmitted by direct contact with the species or their feces (Aujeszky's, foot-and-mouth disease, brucellosis, tuberculosis, paratuberculosis, toxoplasmosis, and leptospirosis), or by consuming contaminated food or uncooked meat (*Trichinella*) (Cohen *et al.*, 2010; Ballari *et al.*, 2019; Marcos *et al.*, 2021).

Management

The wild boar was categorized as high priority for management by Valenzuela *et al.* (2014). However, no national initiatives have been applied to control their populations, and localized efforts have been found to be mostly ineffective (Ballari *et al.*, 2015a). Nonetheless, various examples were found in the literature that provide seminal efforts to develop and execute control methods, such as in Parque Nacional El Palmar (Ballari *et al.*, 2015a) and Parque Nacional Nahuel Huapi (APN, 2011). Ballari *et al.* (2015a) found that 54% of surveyed protected areas apply some control method. Hunting was the most commonly used technique for wild boar control, a method that protected area managers (*e.g.*, Parque Nacional Islas de Santa Fe, Reserva Provincial Laguna de Llancanelo and Parque Nacional Campos del Tuyú) have reported to be effective for reducing boar populations. However, the methods used were in general ineffective and did not reduce the abundance of this

invasive species. An example of effective wild board management occurs in Parque Nacional El Palmar, where since 2006 a control program for introduced mammals has been applied, whereby hunting has been maintained regularly, managing to remove around 2,000 animals from the area in 10 years. This effort caused a decrease in boar abundance and their negative impacts, such as predation of yatay palm (*Butia yatay*) saplings and rooting the park's soil (Gürtler *et al.*, 2017, 2018). The methods in Parque Nacional El Palmar use bait to attract wild boar with supplemental feeding (*e.g.*, corn), which could in fact have the unintended consequence that boars more frequently use the protected area, rather than the private agricultural lands that surround the park, due to the supplemental food being available the whole year (Cuevas *et al.*, 2016). For that reason the use of baiting to hunt the species remains controversial (Cellina, 2008; Cuevas *et al.*, 2016). In Parque Nacional Nahuel Huapi, the control plan for introduced species is made through the implementation of sport hunting, but to date few individuals have been hunted in the context of this plan (Ballari *et al.*, 2019). Another example is in Reserva Privada Rincón del Socorro, Corrientes province, where between 2006 and 2014 feral pig controls were implemented and 6,500 individuals were hunted. However, this effort was not enough to decrease the pig population (Ballari *et al.*, 2019). In the current scenario of population growth and dispersal, it is necessary to develop national and regional strategies for the control of wild boar populations along the edges of its distribution to reduce the probability of range expansion to new sensitive protected areas and agricultural and rangelands.

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INTRODUCED INVASIVE MAMMALS OF ARGENTINA

Introduced Invasive Mammals (IIMs) are a major driver of global and local environmental change, including negative impacts on biodiversity, ecosystem processes, economies, health and other social values. However, as complex social-ecological systems, invasive species cannot be conceived solely as "negative," nor merely as "biological" invasions. This book presents conceptual and practical perspectives from 49 authors with expertise in communication, ecology, education, genetics, history, philosophy, social sciences and veterinary medicine to better understand and manage IIMs in Argentina. It concludes by providing updated information on Argentina's IIM assemblage, which includes 23 species.

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