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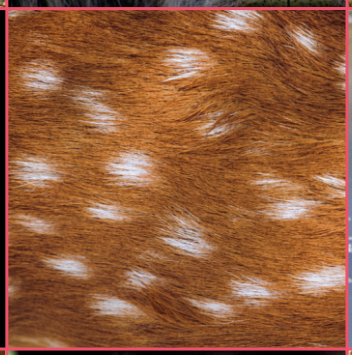
Introduced Invasive Mammals of Argentina

Mamíferos Introducidos Invasores de Argentina













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Introduced Invasive Mammals of Argentina

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SAREM Series A
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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.

Dr. Alejandro E.J. Valenzuela
Dr. Christopher B. Anderson
Editors, Vol. III SAREM Series A

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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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Castor canadensis
North American beaver, castor americano

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Resumen. El castor norteamericano (*Castor canadensis*) fue introducido en Tierra del Fuego (Argentina) en 1946. Mediante su rápida expansión, colonizó casi todas las cuencas del archipiélago antes de los años 1990, llegando a cruzar el Estrecho de Magallanes y actualmente ocupar sectores del continente hasta Puerto Natales (Chile). Sus impactos ecológicos son profundos, provocando cambios que duran décadas y constituyéndose en uno de los mayores factores de cambio a nivel de paisaje en Tierra del Fuego durante el Holoceno. En términos sociales, los efectos producidos por el castor están siendo estudiados recientemente, pero se sabe que pueden ser no solo negativos, sino también positivos o neutros. El manejo de este «ingeniero de ecosistemas» en la Patagonia tanto argentina como chilena ha sido poco efectivo, con esfuerzos aislados de ambos países por varias décadas. Sin embargo, en 2008 se empezó a abordar el conflicto como un problema binacional y en los últimos años se contó con dos proyectos del *Global Environment Facility* para ensayar la erradicación de la especie y la restauración de los ecosistemas afectados.

General description of the species

The North American beaver (*Castor canadensis* Kuhl) is a semi-aquatic rodent that ranges in size from about 14 to 30 kg (Fig. 1). It reaches sexual maturity at approximately two years of age and gives birth to a typical litter of two to three kits in spring. In their native distribution, *C. canadensis* inhabits a broad diversity of freshwater ecosystems, including lakes, rivers, streams, bogs and wetlands, found in forest, grassland, tundra and desert biomes from northern Mexico to northern Canada. They consume herbaceous vegetation and woody plants' leaves and phloem. Beavers also use their large, powerful incisors to cut trees and shrubs that they use to construct dams and lodges, which in turn create, modify and destroy existing habitats, making them the quintessential ecosystem engineer (*sensu* Jones *et al.*, 1994). In their native range, they face predation from medium-sized and large carnivores, such as bears, wolves, alligators, raptors, mustelids and coyotes.



Figure 1. *Castor canadensis* in Tierra del Fuego province, Argentina. (Photo: Sergio Anselmino).

History of the invasion

Primary historical sources, including a government newsreel (Anonymous, 1946) and a personal letter from trapper Tom Lamb (Lamb, 1969), document that the Argentine government purchased 20 beavers trapped near Moose Lake in Manitoba, Canada to "enrich" Tierra del Fuego's fauna with ostensibly valuable furbearers. In 1946, these were introduced to a site on the north shore of Lake Fagnano. In the same newsreel, the government also reports its simultaneous Patagonian projects, including farmland expansion in the north and petroleum exploration around the city of Comodoro Rivadavia. The imposition of this development mentality on Tierra del Fuego also lead the government to successfully introduce muskrats (see Deferrari, this volume), but they failed in a plan to establish a reindeer population with individuals from South Georgia Island (Archibald *et al.*, 2020). While the reason for this introduction was to promote a fur industry, there was never a significant commercial venture for pelts.

Patterns of expansion and current distribution

As an invasive ecosystem engineer, the beaver rapidly expanded across most of the Tierra del Fuego Archipelago (Fig. 2), colonizing the neighboring islands of Navarino, Dawson, Nueva, Lennox, Picton and Hoste (all in Chile); currently, there are no confirmed reports from the Wollaston Islands (Chile) or Staten Island (Argentina) (Anderson *et al.*, 2009; Valenzuela *et al.*, 2014). After the initial introduction in 1946, reports indicate the expansion first occurred in the forest biome, crossing south of the Beagle Channel to

Navarino Island (Chile) by the mid-1960s. Subsequently, beavers achieved relatively high densities in nearly all watersheds in the archipelago by the 1990s (Lizarralde, 1993). Despite the fact that steppe and grassland ecosystems were colonized later than forests (Anderson *et al.*, 2009; Pietrek *et al.*, 2015), a recent demographic study suggests that these are not sub-optimal habitats (Pietrek *et al.*, 2017). The invasion of the mainland was confirmed south of Punta Arenas (Chile) in the mid-1990s (Lizarralde, 1993; Wallem *et al.*, 2007), but a recent dendrochronology study indicates that this arrival to the continent may have been as early as 1968 (Graells *et al.*, 2015). In 2013, beavers were found near the town of Puerto Natales (Chile) (Sanguinetti *et al.*, 2014). Overall, this successful biological invasion has been attributed to ecological conditions (*i.e.*, favorable habitat, lack of predators or competitors) and the beaver's autecology (*i.e.*, relatively fast population growth, the ability to engineer its own trophic and habitat niche) (Wallem *et al.*, 2007). Habitat suitability

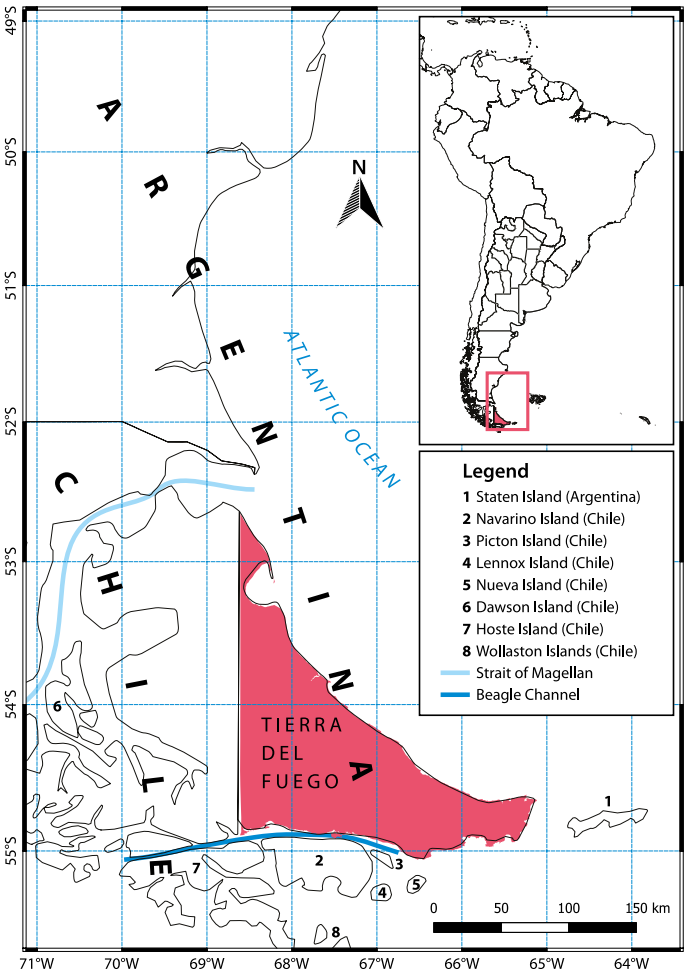


Figure 2. Distribution of *Castor canadensis* in Argentina. Modified from Anderson *et al.* (2019). (Mapping: Ian Barbe and Alfredo Claverie).

models also suggest that site occupation patterns are not only affected by ecological conditions *per se*, but also the time since first invasion (Davis *et al.*, 2016). Furthermore, it is increasingly recognized that social aspects, including the absence of effective control measures and the incorporation of beavers into local-regional cultural and symbols, have combined to make this a socio-ecological phenomenon (see Anderson and Pizarro, this volume).

Impacts

Beavers provoke a wide range of ecological alterations from the species- to landscape-levels, causing some of the largest impacts to Tierra del Fuego in the Holocene (Anderson *et al.*, 2014; Henn *et al.*, 2016). For example, beavers increase the secondary production and dependence on allochthonous organic matter of stream benthic food webs (*e.g.*, Anderson and Rosemond, 2010), convert riparian forests to meadows (*e.g.*, Wallem *et al.*, 2010), and enhance some ecosystem-level processes, such as higher decomposition rates and greater organic matter retention (Anderson *et al.*, 2014). Their overall effect to the landscape includes direct transformation of approximately 30,000 ha in the Argentine portion of Tierra del Fuego (Henn *et al.*, 2016). To date, most research has addressed the beaver as a negative "biological" invasion, but new social science and humanities studies show that while most local residents know that the beaver is negative ecologically, their valuation of this species can be either positive or negative (Berghoefer *et al.*, 2010).

Management

In Argentine Tierra del Fuego, the government has declared beavers as a "harmful species" (Provincial Law #696/2006), which complements an earlier designation in Chile (National Law #19,473/1996 and Executive Order #5/1998). These legal instruments provide the basis for management of this species, but neither country has a specific law or regulations for biological invasions. Parque Nacional Tierra del Fuego (Argentina) has carried out the only systematic control program since 2001, which has successfully returned the beaver population in the southern portion of the park to the early 1980s levels (Sanguinetti *et al.*, 2014). Beginning in the 1990s, Argentina and Chile conducted separate beaver control efforts, focusing on paying hunters a bounty for trapping (Anderson *et al.*, 2011). In 2008, the two governments signed a binational agreement that modified their approach towards the eradication of the species in Patagonia and to promote action to restore the ecosystems affected (Malmierca *et al.*, 2011). In the past few years, a pilot phase of this program was implemented via funding from Global Environment Facility grants to each. Beaver eradication is an extremely ambitious goal whose feasibility is questionable, but internationally, this case has become an extremely high profile example of invasion biology and conservation in southern Patagonia (Choi, 2008). Nonetheless, there are significant obstacles that may hinder such an effort, including explicit social rejection by some stakeholders (see Urbano, 2015), while others, like ranchers in both Chile and Argentina, view such a program favorably (Santo *et al.*, 2015).

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