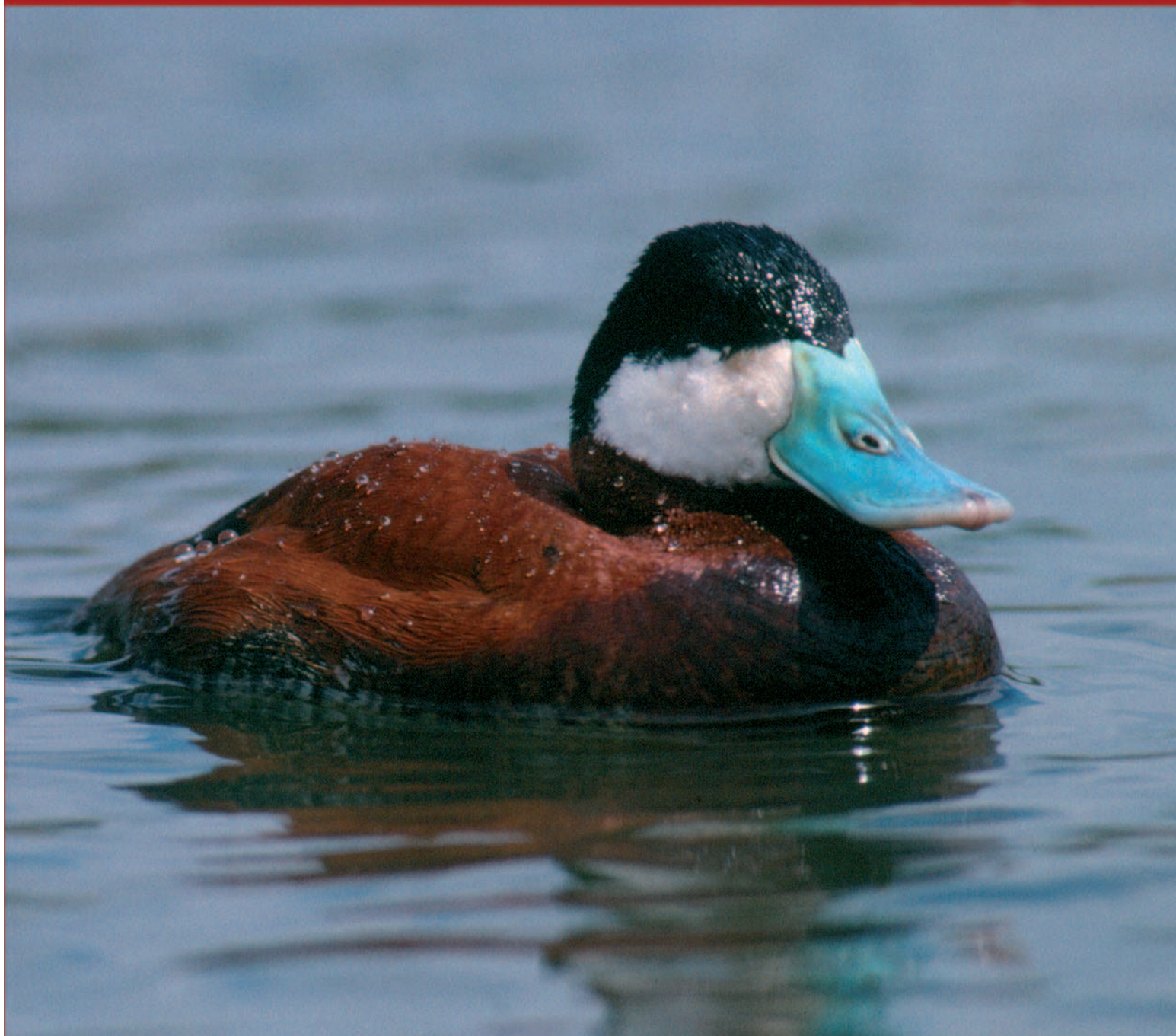


Aliens: The Invasive Species Bulletin

Newsletter of the IUCN/SSC Invasive Species Specialist Group

Issue Number 29, 2010



SSC

Species Survival Commission



ISPRA

Institute for Environmental
Protection and Research

American beaver eradication in the southern tip of South America: main challenges of an ambitious project

Menvielle M. F., Funes M., Malmierca L., Ramadori D., Saavedra B., Schiavini A. & Soto Volkart N.

Eradication may be considered an increasingly powerful tool to obtain significant and durable conservation outcomes. This strategy has been rarely implemented in Chile and Argentina but recently the governments of both countries signed an Agreement for the "Restoration of southern ecosystems affected by the invasion of North American beaver (Castor canadensis)" (2008) under which they commit to develop a project for the eradication of beavers throughout its entire range in Patagonia and Tierra del Fuego. Over 20,000 km of waterways in an area of 7.000.000 ha in the Fuegian Archipelago are already invaded by this ecosystem engineer and all types of ecosystems are affected. Beavers managed to cross the Strait of Magellan and are starting to invade the continent becoming a continental threat. The new vision for the "Beavers Project" is to recover the important ecosystem of austral Patagonia and its ability to provide environmental and economic services for the local and international community. Beaver eradication is a first and necessary step to move towards that vision. A Feasibility Study concluded that eradicating beavers from their entire distribution in Patagonia and Tierra del Fuego is feasible but difficult and a draft of a Strategic Plan for the Beaver Eradication Project has been prepared. The change of vision from 'control' to 'eradication' opened a new context of thinking and planning of conservation and alien species management in Argentina and Chile. Administrative, political, social, and economic challenges derive from this vision. Effective and efficient management of projects, science development in association with management needs, private management incorporating public and common wealth goals, insertion of international cooperation in management, will be needed. Beaver eradication from southern South America is an extremely ambitious goal but it is also the reflection of the international needs and interests in promoting and hopefully supporting

this type of contribution to biodiversity conservation.

Introduction

The historical process of eradication actions, as reflected in the publications of the Conference "Turning the Tide: The Eradication of Invasive Species" (2002) and later publications (Cromarty et al. 2003, Campbell and Donlan 2005, Parkes and Panetta 2009), has shown that eradication may be considered an increasingly powerful tool to obtain significant and durable conservation outcomes. There is a growing confidence in the ability to develop bigger, more complex eradication projects, including a wider range of ecosystems, broadening ecological goals and engaging multiple stakeholders (Saunders 2010). In the last International Conference "Island Invasives: Eradication and Management" (Auckland, February 2010), eradication was highlighted as one of the few examples of effective action against biodiversity loss, but also that there is a need for taking eradication to another level, prioritizing and supporting innovative and ambitious projects which would produce a strong momentum, encouraging the application of this conservation practice (Genovesi 2010, Saunders et al. 2010).

Eradication has sometimes been initiated in Chile and Argentina. One example is rabbits, that have been eradicated from the small island Santa Clara (221 ha), in Juan Fernandez archipelago, in Chile, a global hotspot of plant endemism which suffers severe impacts of invasive species (Bourne et al. 1992). So far, the approach chosen to solve the derived global biodiversity loss has been the implementation of a relatively continued action aimed at "control of invasive species". In this regard, the governments of Argentina and Chile are developing a novel vision for managing invasive species, approach reflected with the recent Agreement for the "Restoration of southern ecosystems affected by the

invasion of North American beaver (*Castor canadensis*)” (2008), under the Treaty on Environment (1992) and the specific Shared Wildlife Protocol. Under this agreement both countries commit themselves to develop a project for eradication of North American beaver throughout its entire range in Patagonia and Tierra del Fuego.



Figure 2. Southern tip of South America: beaver invasion region in Chile and Argentina



Figure 3. Beaver lodge and dam on a waterway in Isla Grande de Tierra del Fuego. Photo: Agricultural and Livestock Service (SAG), Chile

Why this project?

Chile and Argentina share an extremely valuable natural heritage in high latitudes of southern Patagonia and Tierra del Fuego which harbours some of the last of the wild ecosystems that exist in the Southern Cone, with relatively low levels of human impact (Figure 1). Outstanding examples of these ecosystems are the extended, continuous and primary Sub-Antarctic beach forests of Tierra del Fuego and the extended and unique peat bogs in the same region, which have a local and global significance for biodiversity conservation. Argentina and Chile also share the cultural heritage of that region, developed in a landscape marked by isolation, remoteness, harshness. Regardless of its remoteness, these distinctive environments are affected by global threats like the invasion of alien species among which the American beaver (*Castor canadensis*) is one of the most prominent.

Beavers were brought from Canada and introduced near Fagnano Lake, Tierra del Fuego, in 1946 by the Argentinean Navy to establish a fur industry. Since then, their expansion covered around 7,000,000 ha (Lizarralde 1993 in Parkes et al. 2008) including several islands like Isla Grande (4,810,000 ha), Navarino (252,800 ha), Dawson (200,000 ha), Nueva (12,000 ha), Lenox (17,000 ha), and Picton (10,500 ha). In addition, part of the Hoste island (480,000 ha), and many other smaller islands south of the Strait of Magellan have been invaded by beavers (Parkes et al. 2008) (Figure 2). This semi-aquatic rodent lives in so called colonies (i.e., family groups) mainly occupying lodges along waterways where they build dams (Figure 3). They could also live in dens along river banks or lodges built along the shores of larger rivers, and even in lakes where they do not build dams (Parkes et al 2008). According to estimates, over 20,000 km of waterways are already invaded by the species and the vigorous expansion of the beaver population can be seen in Tierra del Fuego Island, where beaver's occupancy is evidenced in almost 100% of the watersheds. The current population was estimated at 65,000 individuals, assuming an average frequency of active colonies over the entire range of 0.5/km

(Parkes et al. 2008). Beavers occupy all types of ecosystems, ranging from Andean prairies and forests to Patagonian steppes, being found from sea level up to about 650 m a.s.l. (Parkes et al. 2008). So far, the only barrier to invasion seems to be the large permanent snowed areas, as for example the ice fields that mantle Andean cordillera in Isla Grande de Tierra del Fuego (Parkes et al. 2008). However, beavers managed to cross the Strait of Magellan to reach the Brunswick Peninsula in mainland Chile, which has continued for sixteen years now (Soto Volkart 2006). Evidence shows that beaver invasion is currently a problem at a near "continental" or at least "sub-continental" scale.

In Patagonia, the impacts of beavers greatly affect the functioning and structure of the ecosystems invaded. Beavers directly harm forest and other types of vegetation by consuming trees and other plants, but the most serious impacts are those derived by the damming of rivers and streams. Dam construction changes the hydrology of the entire watershed, transforming lentic ecosystems to lotic ones. As a result of beaver behaviour, *Nothofagus* forests along the riparian areas in Tierra del Fuego have been killed and replaced by beaver ponds and associated grassland-sedge dominated meadows (Lizarralde et al. 2004, Anderson et al. 2006, Martinez Pastur et al. 2006, Parkes et al. 2008) (Figure 4).

There is also evidence that these beaver meadows are prone to invasions by introduced weeds (Anderson et al. 2005 in Parkes et al. 2008). Chemical composition of once pristine waters, change dramatically after beaver impact (Lizarralde et al. 1996). Beaver effects on riverine environments in steppes and peat bogs are unknown, but changes in hydrology, erosion, and sediment accumulation could be significant. In summary, a beaver certainly have a significant impact on Southern Patagonia ecosystems and biological communities, primarily as a consequence of engineering but also, as Simberloff (2009) concludes, due to other effects derived from the invasive meltdown with other introduced species, thus threatening ecosystem's functioning and persistence in the long term.



Figure 4. Beaver effects in Tierra del Fuego riverine environments: abandoned site where beech forest was replaced by a grassland meadow currently grazed by feral horses (*Equus caballus*). Photo: M. Fernanda Menvielle

Invasions also have economic effects, and beaver invasion is not an exception. Beaver flooding is affecting road infrastructure in Patagonia, as well as ranching infrastructure (Parkes et al. 2008). However, economic impacts are yet to be seen in South America given the fact that *Nothofagus* forests extend northward to about 34 °S in South America (Veblen et al. 1996 in Parkes et al. 2008), meaning that beavers have the potential to expand their range about 2,000 km to the north, going deep in the South American continent. The results of beaver engineering in mainland would significantly increase economic impacts derived from its invasion, affecting forestry and agricultural industry, reducing quality of protected areas, altering the hydrology of catchment areas that are the source for water and power supply (Parkes et al. 2008). Based on the impacts that beavers have in Tierra del Fuego, we can expect that their expansion in the continent will take

not only a qualitatively, but also a quantitatively different dimension, never seen before in South America.

Beaver management in Patagonia

Beaver management in the region has had similar characteristics in Argentina and Chile. It began thirty-five years after beaver introduction in 1981, when hunting was allowed for damage control in Argentina (Parkes et al. 2008). Between 1999 and 2001 both countries started control programs encouraging commercial use as a management tool. The assumption behind these programs was that beaver pelts had a commercial value, based on which, private and public trappers were encouraged by bounties given by governments that also assisted in developing markets, to pursue beaver capture (Parkes et al.

2008). “However, neither campaign was effective in controlling beavers or in stopping their spread” (Parkes et al. 2008). Similarly, governmental environmental agencies of both countries, aware of the seriousness of the problem, followed the issue in national and bi-national forums in order to install the problem as a priority.



Figure 5: Beaver trapped in Brunswick Peninsula. Photo: SAG (Agricultural and Livestock Service Chile)

After 20 years some conclusions arose in the Chilean and Argentinean management experience, including: 1) in the light of international eradication experience, commercial use alone can not solve the invasion problem; 2) beaver ecology (i.e. conspicuous presence derived from dam construction, distribution restricted to riverine environments, relatively slow population growth rate) makes beaver removal something achievable; and 3) beaver invasion represents a continental threat for the South American continent. All these conclusions led to a drastic strategy change which included the development of a new management model for this invasive species. From here, representatives of all national and regional environmental agencies of Chile and Argentina, along with NGO's, started walking a non-travelled path in order to develop a bi-national strategy for the eradication of beavers in their entire range of distribution (Rio Gallegos, August 2006). By that time, a first bi-national committee was created to implement a first agreement for beaver eradication that was further established as the formal bi-national Agreement mentioned above. This was also the result of actions implemented by the environmental agencies of both countries in order to promote the idea of eradication as a priority in both National and Bi-national fora, with the ul-

timate goal of giving a final solution to an old problem. This constitutes a real and significant innovation, considering the complexity and size of the beaver problem that would induce a “sort of fatalism”, as Simberloff says (2002).

Shift in strategy, a new vision and a Feasibility Study

The new vision built to guide beaver management is to recover ecosystems of the southern end of South America, with two associated objectives:

1. To eradicate beavers from its current range of distribution in the southern end of South America.
2. To recover and/or restore the environments affected by beaver.

In addition to boosting the recovery of important ecosystems and the ability to provide environmental and economic services for the local and international community, the beaver eradication project expects to develop a new model for handling complex environmental problems. This new model should be based in bi-national, public/private integration, incorporation of international expertise, and in the development of scientific, technical, administrative, and institutional capacities applied for dealing with regional conservation problems.

The first step implemented under this new vision was the development of a Feasibility Study for beaver eradication, which congregated authoritative and independent expertise in eradication (2007-2008). This study, approved by both countries, summarizes beaver ecology, beavers ecological and economic impacts, beaver management, control techniques, social and political context, and discuss pros and cons of alternative management options (Parkes et al. 2008).

The beaver Feasibility Study concluded that eradicating beavers from their entire distribution in Patagonia and Tierra del Fuego is justified and feasible. Moreover, it indicated that technical, ecological, cultural, and social standpoints are available to ensure complete removal at all management units, all legal tools provided. This study also indicated that an effective and efficient bi-national management structure is required to commit cooperation of funding agencies. The study also pointed out main risks of failure, like the ability to access beavers on lands of all tenures, or the possibility of scaling eradication from the colony to the landscape level, must be resolved before any eradication is attempted. Other risks, such as the ability to manage reinvasions, will have to be tested as operations proceed (Parkes et al. 2008). The Feasibility Study also in-

dedicated beaver eradication on mainland is of high priority and of urgent need to prevent further spread in the continent. To achieve this, the Feasibility Study indicates that Argentina and Chile should start by installing successful pilot eradication projects in areas similar to mainland (i.e. Andean range in Tierra del Fuego), where, with the establishment of buffers and other specific tools, management can secure for a wider eradication strategy in the continent (Parkes et al. 2008).

The Feasibility Study divided the beaver eradication project in phases, like any complex project, and estimated a period of five years from a formal start to complete active eradication (Parkes et al. 2008). Previous phases should be accomplished, including a planning and training phase, before moving into actual eradication. Finally, surveillance and reaction phases should be developed before the end of the eradication operation to assess effectiveness of the whole operation (Parkes et al. 2008). Parkes et al. 2008 made a rough estimation of the costs of implementation and surveillance of the project in the main eradication period, in ca. US\$ 30-40 million, not including the initial phases or the surveillance stage following the active-eradication period.

Moving Forward with the Plan

A draft of a Strategic Plan for the beaver eradication Project was developed by a bi-national and multi agency team designed by Chile and Argentina with the support of New Zealand experts (May 2009). In the meanwhile, another team advanced in the revision of an Action Plan for beaver management in the continent, as was prioritized by the Feasibility Study. The Beaver Eradication Project should be built strategically and it is expected that the Strategic Plan becomes the master document that will guide the entire Project, highlighting the actions needed to set up the Project, emphasizing governance needs to secure national and international co-operation and funding.

The Beaver Eradication Project in Patagonia has no precedent in Argentina and Chile, nor worldwide. It is a complex project for several reasons, including: large spatial scale, several years of work, logistic difficulties inherent to the harsh Patagonian landscapes, participation of two countries, multiple jurisdictions and institutions. In addition to political challenges, the Project has social and cultural implications relating to the territory in which it will be carried out. All these complexities should be addressed systematically and explicitly, and therefore a strategic planning is essential. A document like this should be mutually agreed, should describe the overall project and provide fundamental details of the

project such as anticipated outcomes, project duration, risks and costs. This Strategic Plan could allow politicians, management, or funding agencies as well as other key stakeholders to determine the nature and extent of their support to beaver eradication.

The Strategic Plan first Draft is now being reviewed, to include inputs from all key stakeholders. This Plan expects to be adaptive and it is expected to provide a basis for progress to be evaluated and for new directions and priorities to be set. Five phases were identified including: development, capacity building, eradication and restoration, and surveillance operations, biosecurity and closing. For each phase the Plan lists associated objectives and time for their completion, highlighting decision making needs. This Strategic Plan's Draft emphasizes that the Phases of Establishment and Capacity Building are crucial, and that their appropriate implementation will determine progress toward further stages of the Project.

Lessons learnt in the "beaver process"

The key lesson of this process was the relevance of the change of vision from 'control' to 'eradication'. This change opened a new context of thinking and planning of conservation and alien species management in Argentina and Chile. Administrative, political, social, and economic challenges derive from this new vision, including a change of mind that can be applied and operate at the different levels related to beaver management. Effective and efficient management of projects, science development in association with management needs, private management incorporating public and common wealth goals, insertion of international cooperation in management, will be needed.

Beaver eradication from southern South America is an extremely ambitious goal. Nevertheless, ambitious as it is, it is also the reflection of the international needs and interests in promoting and (hopefully) supporting this type of contributions to biodiversity conservation. In this context, beaver eradication in Patagonia could become a flagship project for conservation worldwide (Piero Genovesi 2010).

The Beaver Project is huge, and requires effective planning, wisely selected and meaningful pilot/demonstrative experiences where good monitoring and effective and efficient reporting system are implemented. Capacity must be built at an administrative, scientific, and technical level. Political and institutional commitment to eradication will also be a prerequisite for success. Nevertheless, it

could be feasible and, moreover, it could become a unique opportunity for South America to improve

conservation practice, helping in addressing other environmental problems along the Southern Cone.



Figure 6. Beavers in Tierra del Fuego National Park, Argentina. Photo: Laura Malmierca, National Parks Administration, Argentina

References

- Anderson CB, Griffith CR, Rosemond AD, Rozzi R, Dollenz O (2006) The effects of invasive North American beavers on riparian plant communities in Cape Horn, Chile. Do exotic beavers engineer differently in sub-Antarctic ecosystems? *Biol Conserv* 128:467–474
- Bourne WRP, Brooke M de L, Clark GS, Stone T (1992) Wildlife conservation problems in the Juan Fernández Archipelago, Chile. *Oryx* 26:43-51
- Campbell K, Donlan J (2005) Feral goat eradication on Islands. *Conservation biology* 19:1362-1374
- Genovesi P (2010) Are we turning the tide? Eradication in times of crisis; how the global community is responding to biological invasions. Keynote Speech: Island Invasives: Eradication and Management. University of Auckland, New Zealand, Invasive Species Specialist Group of the World Conservation Union (IUCN)
- Lizarralde M, Deferrari G, Escobar J, Alvarez S (1996) Nutrient dynamic alterations induced by beaver (*Castor canadensis*) in the southern beech forest (*Nothofagus*). *Ecología Austral* 6:101-105
- Martínez Pastur G; Lencinas MV, Escobar J, Quiroga P, Malmierca L, Lizarralde M (2006) Understorey succession in *Nothofagus* forests in Tierra del Fuego (Argentina) affected by *Castor canadensis*. *Applied Vegetation Science* 9:143-154

- Parkes J, Paulson J, Donlan J, Campbell K (2008) Control of North American beavers in Tierra del Fuego: feasibility of eradication and alternative management options. Landcare Research Contract Report LC0708. Available in Spanish at: www.tierradelfuego.gov.ar/s_desuamb/docs/er-radica_castor.pdf and www.karukinkanatural.cl
- Parkes J, Panetta D (2009) Eradication of invasive species: progress and emerging issues in the 21st century. In: Clout M N and Williams PA (eds) Invasive Species Management. A Handbook of Principles and Techniques, Oxford University Press, pp.47-60
- Saunders A, Parkes J, Aguirre-Muñoz A, Morrison SA (2010) Increasing the pace, scale, and effectiveness of island restoration. Island Invasives: Eradication and Management. University of Auckland, New Zealand, Invasive Species Specialist Group of the World Conservation Union (IUCN)
- Simberloff D (2002) Today Tiritiri Matangi, tomorrow the world! Are we aiming too low in invasives control?. In: Veitch CR, Clout MN (eds) Turning the Tide: The Eradication of Invasive Species. Auckland, New Zealand Invasive Species Specialist Group of the World Conservation Union (IUCN)
- Simberloff D (2009) Rats are not the only introduced rodents producing ecosystem impacts on islands. Biol Invasions 11:1735-1742
- Towns D, Broome K (2003) From small Maria to massive Campbell: forty years rat eradications from New Zealand islands. New Zealand Journal of Zoology 30:377-398
- Menvielle M.F¹, Funes M², Malmierca L³, Ramadori D⁴, Saavedra B⁵, Schiavini A⁶, Soto Volkart N⁷
^{1, 3} National Parks Administration, Argentina; ^{2, 5} Wildlife Conservation Society, Chile; ⁴ National Fauna Direction, Argentina, ⁶ National Scientific and Technical Research Council (CONICET), Argentina, ⁷ Agricultural and Livestock Service (SAG), Chile.