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Control of North American Beavers in Tierra del Fuego: Feasibility of Eradication and Alternative Management Options

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Landcare Research Contract Report: LC0708/084

PREPARED FOR:

Comité Binacional para la Estrategia de Erradicación de Castores de Patagonia Austral

DATE: March 2008



ISO 14001

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Summary

North American beaver (*Castor canadensis*) were released at Lago Fagano in the Argentine part of Isla Grande in Tierra del Fuego in 1946 and have since spread to other smaller islands and to the mainland over an area of about 7 million hectares in which they occupy at least 27 000 km of waterway. Following several attempts to manage the beavers, the Governments of Argentina and Chile have requested a report from an international team to assess whether beavers might be eradicated, or if not, what other management options might be implemented. This request resulted from a binational strategy (begun in 2001 and signed in 2006) and Treaty with attached protocols between the two nations (signed in 2007) to restore the ecosystems of Tierra del Fuego. The team visited the area between 16 and 28 October 2007.

Justification for Beaver Control

Beavers adversely affect biodiversity in Tierra del Fuego by engineering changes to the fluvial environment and by killing riparian forest trees. Beavers also negatively affect the economy of Tierra del Fuego particularly where their dams affect roads and cattle ranching.

Beavers continue to impose economic costs to infrastructure in Tierra del Fuego. The costs to repair roads and culverts affected by the engineering of beavers are estimated at up to about US\$4 million per year, judging by the known costs for some years in parts of Chile. Other costs to agriculture, forestry and salmonid fisheries are relatively minor – although can be of considerable nuisance to individual land and business owners.

Beavers have also invaded the mainland of South America and unless this population is removed they will expand their range into the continent and greatly expand the biodiversity and economic costs to Chile and Argentina.

Beavers have some positive economic value when commercially exploited by fur and meat harvesters, who are also subsidised by governments to promote the harvest as a potential control tool, and to the tourist industry who provide opportunities to view beavers. These benefits do not outweigh the costs.

Management Options

Removal from the mainland

Eliminating the current population on the mainland is of highest priority and urgency, either as a stand-alone strategy or as the first step in an attempt at wider eradication. An attempt to do this by removing the beavers on the Brunswick Peninsula and Dawson Island, and creating buffers on Isla Grande, is being made by the Chilean government over the next three years (2007–2009). The budget available for this project is US\$2.18 million. This project is independent of the current feasibility plan, but we note the implications of the Chilean project for the wider management of beavers in Tierra del Fuego. These include brief comments on: The risks of ongoing establishment of beavers on the mainland, and on the management of buffers on the adjacent islands

Some recent developments from other pest eradication operations on search and detection practices that allow managers to measure the probability that lack of detection equals lack of animals, for both this removal strategy and for any wider attempt at eradication

How the ongoing project in Chile might be used for training and learning and how it might evolve into an eradication attempt over the whole of Tierra del Fuego

Eradication from Tierra del Fuego

Eradication of all beavers from South America is possible, but difficult, because of several factors that will have to be resolved as a project operational plan is developed. The main issues to consider are:

(a) Progress in the Chilean project to remove beavers from Brunswick Peninsula and Dawson Island (see above).

(b) A commitment over at least 9 years beginning in 2008 will be required to achieve eradication. We estimate the first phase to plan and set up the eradication infrastructure would take 2 years, depending on the lessons from (a) above. The second phase to cover all of Tierra del Fuego zone-by-zone to reduce beaver populations to near zero (and provisionally declare eradication) would take 5 years. A third phase of active surveillance to either confirm this or to find and kill survivors would take a further period, out to about 2016 depending on results and the level of risk managers are prepared to take. Passive or ad hoc surveillance would continue. The estimated cost for the second phase is over US\$33 million.

(c) A substantial goal-focused governance and project management structure will be required to deliver the binational outcomes required to achieve eradication. We estimate about 60 field staff, 8 project management and operational management staff, plus contracted staff for technical services such as helicopters will be required.

(d) Technically, the ability to guarantee the efficient removal of 100% of beavers from each colony will have to be developed. Removal at this scale is entirely feasible and the techniques to do so are well known from other places and from small-scale control in Chile and Argentina. This will require access to all suitable, legal control tools (including foot-hold traps whose use is currently restricted by European Union regulation for fur harvesting – and thus with implications for the current fur harvest industry in Tierra del Fuego), and change at all levels of management from a ‘harvesting’ or ‘control’ mind-set to one of eradication. This latter change is a common necessity in other large-scale eradications. It is not the number killed that counts, it is the number left!

(e) The ability to scale this colony-by-colony removal up to whole catchments, larger management zones, and whole islands. The ability to scale up is also feasible but has many uncertainties and risks that would need to be managed. These include the currently unknown costs and effort to:

- Detect and kill beavers at low densities, i.e. animals remaining after the initial control, or immigrants moving back into areas thought to be cleared of beavers, or beavers at the edge of the cleared range
- Management of non-target risks and the perception of these risks
- Ensuring access to land of all tenures
- Ensuring the risks of deliberate releases into new or cleared areas are zero

This report expands on some of these issues but their resolution will usually require either more detailed consideration when decisions are made on project management structures, when operational plans are developed (e.g. the costs), or by adaptive management during the operations.

Sustained control

If eradication is not possible, beavers might be managed in perpetuity by a sustained control strategy. This requires an initial control effort to reduce beaver numbers to some low density (or even zero at the targeted site) followed by periodic maintenance control to keep the beavers below some density at which their impacts are tolerable. Understanding relationships between beaver densities and their impacts is essential to determine what densities are 'tolerable', and the rates of recovery of controlled populations must be known to determine how often to apply the maintenance control.

The ongoing costs of sustained control usually mean that this strategy can only be effectively conducted in limited areas. Selection of these areas depends on the conservation values to be protected or on the economic damage being suffered, i.e. managers must set priorities.

If eradication is not possible, the strategy to remove beavers from the mainland becomes a sustained control option. The target is zero density with ongoing control to manage immigrants.

Commercial exploitation

Commercial exploitation of beavers and other fur-bearing animals in Tierra del Fuego may be seen as an end in itself with a sustained harvest taken from beaver populations maintained for that purpose, or as a control tool integrated into a sustained control strategy. By itself, commercial exploitation of beavers has not been an effective control tool in Tierra del Fuego, partly because the effort is restricted to areas close to roads, although at these places it may alleviate some of the problems beavers cause to roading infrastructure.

Integrating commercial harvesting with an eradication strategy is contentious. Eradication success would end commercial harvesting and it is not economically rational for harvesters to expend the unprofitable effort required to kill the last beavers in an area.

Other Issues

Beavers are not the only invasive pests present in Tierra del Fuego and control of these animals and weeds should be considered as consequence of any large-scale management of beavers. The substantial capacity in management and field expertise developed in any attempt to eradicate beavers should be retained and utilised to manage other threats in Tierra del Fuego.

Removal of beavers from Tierra del Fuego may not by itself fully restore the damaged ecosystems either because of the actions of other exotic animals such as cattle and horses, or because of the inability of the forest species to regenerate in the modified habitats. Managers should use the opportunity of any beaver management operation to plan for wider ecosystem restoration goals.

Main Conclusions

Eradication of beavers from Tierra del Fuego is justified both to guarantee beavers will not spread onto mainland South America, and because of the damage they do to biodiversity and to forestry, agriculture, fisheries and infrastructure values within their current range.

Eradication of beavers is feasible in Tierra del Fuego providing all legal tools are available to guarantee complete removal at each ‘unit of management’ – the individual beaver colony, and that Chile and Argentina can develop a suitable project management structure to apply these tools at the large scale required within a time frame that funding agencies will accept and commit to. Some risks of failure, such as the ability to access beavers on lands of all tenures, must be resolved before eradication is attempted. Other risks of failure, such as the ability to manage reinvasions into areas cleared of beavers, will have to be tested as operations proceed.

1. Introduction

North American beaver (*Castor canadensis*) were released at Lago Fagano in the Argentine part of Isla Grande in Tierra del Fuego in 1946 and have since spread to other smaller islands and to the mainland. They adversely affect biodiversity by engineering changes to the fluvial environment and by killing riparian forest trees. Beavers also negatively affect the economy of Tierra del Fuego particularly where their dams affect roads and cattle ranching. However, they also have some benefits by supporting a small fur and meat harvesting industry and as a tourist attraction. Following several attempts to manage the beavers, the Governments of Argentina and Chile have requested a report from an international team to assess whether beavers might be eradicated, or if not, what other management options might be implemented. This request is part of a binational strategy (begun in 2001 and signed in 2006) and Treaty with attached protocols between the two nations (signed in 2007) to restore the ecosystems of Tierra del Fuego. The authors of this report visited the area between 16 and 28 October 2007 (Appendix 1).

2. Objectives and Structure of Report

The February 2007 terms of reference for the feasibility study requested a general analysis of the problem posed by beavers with a focus on the feasibility that beavers might be eradicated. These terms were based on a wider policy document developed in 2006 ‘Towards a binational strategy for the restoration of austral ecosystems affected by the beaver’. These terms of reference were expanded during discussions between the study team and key stakeholders during our visit to Tierra del Fuego. In summary, the objectives of this feasibility report are to summarise the background information on:

- The ecological and economic impacts of beavers on the ecosystems, biodiversity values and productive values of Tierra del Fuego, and to assess the biodiversity and economic benefits of different beaver management strategies, i.e. what level of beaver management is justified by the costs and benefits?
- The control techniques, the skills and capacity required to apply them, and any adverse effects of their use (e.g. on non-target species) that might be legally applied to manage beavers in Chile and Argentina
- The social and government context, in particular options for project organisational structures, under which each proposed management strategy must be carried out

The core of the report then uses the background information to develop five strategic management options:

- Removing the beavers currently on the mainland of South America with sustained control of source populations in buffer zones on the islands and ongoing surveillance (and reaction as necessary) on the mainland
- Eradicating all beavers from Tierra del Fuego

- Sustaining control of beavers (and other exotic pests) in high priority areas in Tierra del Fuego
- Encouraging the commercial exploitation of beavers either as a partial control tool or as an economic asset
- Doing nothing

Critical knowledge gaps that must be filled either before or during each strategic option are identified and ways to meet these needs are described – either by research, by pilot or demonstration projects, or by a ‘learn by doing’ process during control operations.

3. Background

3.1 History of beavers in Tierra del Fuego and the current scale of the problem

Twenty-five pairs of beavers were introduced from Canada and liberated on the Argentinean side of Lake Fagnano (Fig. 1) in 1946 (Jaksic et al. 2002) and have since spread to cover c. 7,000,000 ha (Lizarralde 1993) including the islands of Isla Grande (4 810 000 ha), Navarino (252 800 ha), Dawson (200 000ha), Nueva (12 000 ha), Lenox (17 000 ha), Picton (10 500 ha), part of Hoste (480 000 ha), and many of the smaller islands south of the Straits of Magellan. In the early 1990s beavers crossed the Straits of Magellan to reach the Brunswick Peninsula in mainland Chile (Fig. 1).

Beavers are semi-aquatic animals that live in family colonies in lodges in dams or in bank dens along the edges of larger rivers and in lakes where they do not build dams. Therefore, although their range in Tierra del Fuego is very large, the scale of the problem is better defined as length of waterway inhabited than by area. It is estimated that there are over 20 000 km of waterway (primary to quaternary streams but minus lake edges and excluding the Brunswick Peninsula and smaller islands) within the 7 million hectares of range – about 13 000 km in Chile and about 8400 km in Argentina (Table 1).

Table 1 Estimated length of waterways and lake edges in Tierra del Fuego. These data are taken from published reports but it is unclear whether they include lake edges and whether lower-order streams are included or excluded

Country	Zone	Length of waterways (km)
Chile	North I. Grande	2043
Chile	Central I. Grande	1711
Chile	South I. Grande	3631
Chile	I. Navarino	3634
Chile	I. Dawson	966
Argentina	I. Grande	8400

Beavers are found from sea level up to about 650 m a.s.l. and are present (or have been present) in nearly all catchments. Measures of the frequencies of active beaver colonies along waterways within their range has varied from about 0.1/km at Porvenir up to 8.5/km at

Vicuña Ranch in the north and centre of Chilean Isla Grande, respectively.

They are least abundant in the Patagonian steppe habitats in the north-east of Isla Grande and most abundant in the deciduous and evergreen forest habitats and the Magellanic moorland areas to the east (Moore 1983). They are assumed to be absent above treeline and in the extensive nival areas of the Sierra de Inju Gooyin Beauvoir and the Cordillera Darwin.

There is evidence that the number of occupied colonies is decreasing. For example, in Chile the weighted average frequency of occupied colonies has declined from 0.76/km in 1999, to 0.68/km in 2004, and to 0.27/km in 2006.

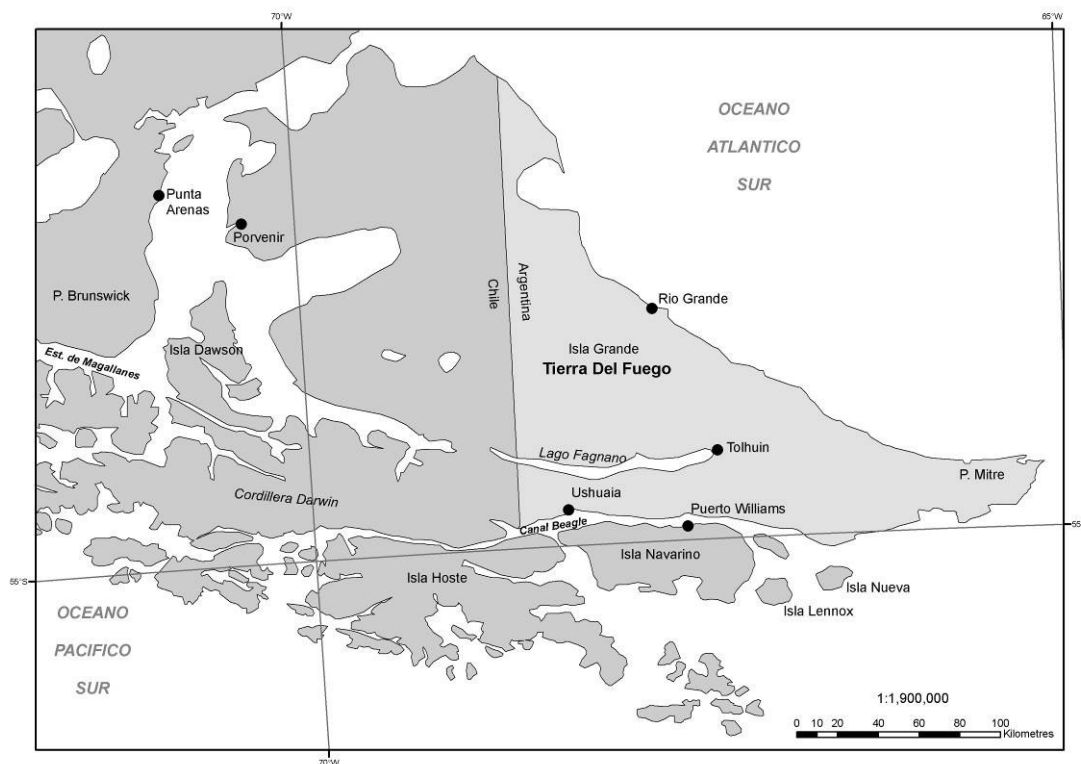


Fig. 1 Tierra del Fuego showing the main islands and places mentioned in the report.

The dynamics of colony occupancy is probably influenced by:

(a) The time since beavers colonised the site. Beavers in Tierra del Fuego almost certainly pass through an irruptive oscillation (e.g. Forsyth & Caley 2006). The evidence from Navarino Island is that averaged over a large area the beavers take perhaps 30 years to attain maximum densities (Fig. 2). At any smaller site, this peak is presumably reached more quickly (see below).

In their natural habitats in North America, beavers occupy a site for a few years until they deplete their available food and then abandon the site until the vegetation adjacent to the site has recovered. Site occupancy times in North America vary from an average of 8-10 years in Wisconsin (Knudson 1962) to 5.8 years in Canada (Fryxell 2001) to 4.8 years in New York (Wright et al. 2004). Full site recovery could take many decades, but in the latter study the

mean time sites were unoccupied was 4.8 years, i.e. the sites had an equal time occupied and abandoned. There are no published data on the time frame of these cycles of occupancy, abandonment, recovery and reoccupancy for beavers in Tierra del Fuego, although it is known that one abandoned site had not reverted to a forested condition even after 20 years (Martínez Pastur et al. 2006).

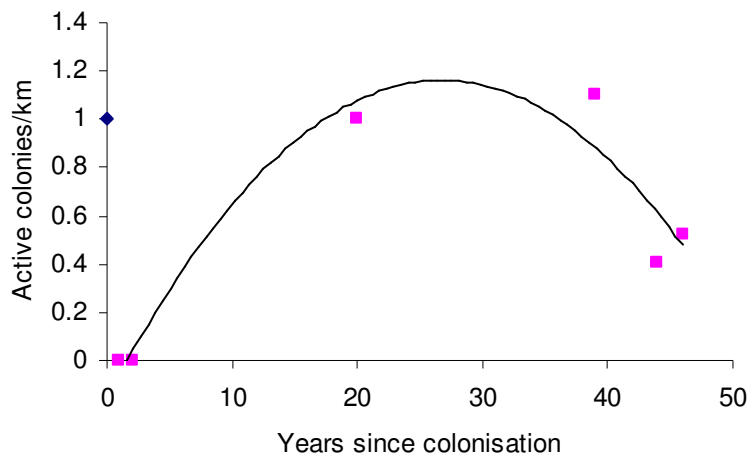


Fig. 2 Occupied beaver colonies per kilometer of waterway on Navarino Island since the island was reached by beavers in 1962 (from references quoted in an unpublished SAG report).

Wright et al. (2004) modelled this cycle of occupancy and abandonment and suggested that where beavers create landscapes dominated by abandoned sites they should produce more colonisers and the patches should take longer to recover. In Tierra del Fuego the recovery rates of *Nothofagus* riparian forests, if in fact they do recover and the state change is not permanent, probably determines the cycle.

(b) The extent and efficacy of fur trapping (see section 4.5). It is unclear whether commercial exploitation of beavers affects the number of colonies or merely the number of beavers within a colony.

(c) Habitat quality for beavers. Beavers prefer rivers bordered by lenga (*Nothofagus pumilio*) forest (Mella & Saavedra 1995) and so are uncommon on the steppe habitats on the eastern side of Isla Grande and more abundant in the Andean habitats to the west (Lizarralde 1993). They also prefer the smaller first- and second-order waterways with a low gradient ($< 6^\circ$) and lateral hanging valleys rather than streams on the hill slopes. They occupy higher-order waterways seasonally (Coronato et al. 2003). These and other factors have been used to develop a habitat suitability model (Soto Volkart 2006) used to predict optimal habitat for beavers on the Brunswick Peninsula (see section 4.1). However, eradication requires all areas are searched irrespective of where beavers are most likely to occur.

As a working figure for our estimates of management costs we assume an average frequency of active colonies over the entire range of 0.5/km, i.e. at least 13 000 colonies containing about 65 000 beavers – assuming the colony size estimated by Lizarralde (1993).

3.2 Population dynamics and life history of beavers

Two population parameters are of particular interest to the management problems we discuss – the intrinsic rate of increase (= the rate of population increase when no resource is limiting for the beavers), and the nature of dispersal (= how beavers spread and colonise new areas or recolonise areas they have abandoned or from where they have been removed).

Beavers in Tierra del Fuego produce one litter per year with an average of four young per litter born in the summer (December–February). The intrinsic rate of increase (r_m) of beavers is not known for Tierra del Fuegian habitats, but using the relationship between body weight (25 kg for beavers) and r_m for mammals (Sinclair 1996),

$$r_m = 1.5W^{-0.36}.$$

The intrinsic rate for beavers is likely to be about 0.47 (a finite rate of 1.6) per annum, i.e. when no resources are limiting a beaver population will double in size every 1.5 years. This estimate is higher than the rates of increase observed in Massachusetts of 0.335 (Lancia & Bishir 1985), and twice the observed rates of increase recorded by Lizarralde et al. (2004) between 1988 and 2002 in the Argentinean part of Isla Grande. Observed rates of increase in Tierra del Fuego presumably reflect the declining rates after up to 40 years of colonisation, and most current rates are either negative or about zero (e.g. see Fig. 2). Note: the estimates of r of about 0.15 given in table 1 in Wallem et al. (2007) are averages over the decades since the initial introduction, not intrinsic rates or even current rates.

Juvenile beavers stay in their parental colony until their second year after which most disperse and either find mates and form a new colony or find a place within an existing colony. Adult beavers may also disperse when their current home range becomes unsuitable, e.g. is flooded out or they have eaten all their preferred foods. Understanding this process is likely to be a key requirement if eradication or containment of beavers is attempted.

Estimates of the rates of colonisation of new range in Tierra del Fuego varied from 2.6 up to 6.3 km/year (Skewes et al. 2006). However, apart from predicting further spread on the mainland (which will be irrelevant if the campaign succeeds), it is the dispersal behaviour of individual beavers within the current range that is of most relevance to current management. In particular, how beavers disperse back into areas cleared of resident animals is of key interest so that surveillance effort to check for immigrant animals can be optimised. For example, do young beavers disperse until they find the first empty or new territory or do they explore more widely before selecting an optimal territory?

There are no data for Tierra del Fuego and only a few studies from North America that may indicate the scale and nature of this problem.

Who disperses?

Sun et al. (2000) in New York found that most juvenile dispersers were 2-year-olds (64%), but some dispersed as 1-year-olds (14%) or as 3-year-olds (21%). They also found that secondary dispersal of adults was mostly by males.

When food is abundant or local population densities are high up to 50% of young beavers do not disperse (Van Deelen & Pletscher 1996).

How far and where do they go?

In general, dispersal distances are generally less than 16 km (Leege 1968). Females move further than males (15.2 ± 2.4 versus 3.5 ± 0.9 km, respectively; Sun et al. 2000) and most (75%) animals moved downstream (Sun et al. 2000). In Montana, dispersing beavers also moved further downstream than upstream (up to 40.6 versus up to 15.1 km, respectively; Van Deelen & Pletscher 1996). However, dispersal distances along streams of over 80 km have been recorded (Muller-Schwarze & Sun 2003).

In Montana, the time between leaving the natal colony and settling in a new place varied from 16 to 181 days (Van Deelen & Pletscher 1996).

3.3 History of control of beavers in Tierra del Fuego

Control of beavers began in Argentina in 1981 when hunting of beavers was permitted to control damage. After 2001, fur hunting was encouraged and the government attempted to enhance the market opportunities by facilitating access of beaver fur to the European market. In Chile, beavers have been officially classified as pests since 1992 and a programme to encourage commercial exploitation as a control tool was begun in 1999, with substantial government support since 2004. Thus, both campaigns relied on the potential commercial value of beaver fur to encourage private and public trapping of beavers as a control tool. Neither campaign was effective at controlling beavers or in stopping their spread.

In response to this perceived lack of success as a pest control tool, an attempt was begun in 2004 to enhance the efficacy of commercial exploitation as a control tactic by providing training for trappers and a subsidy (on beaver tails) to supplement the trappers' income from fur and meat (see section 4.5).

However, recognition that commercial exploitation alone (however well it is managed or enhanced) could not solve the problem has led to the development of the binational programme of which this feasibility report is a part. The current status of the governmental support for commercial use is that in Chile SAG is moving towards direct hiring of trappers to control beavers on Brunswick Peninsula and Dawson Island without relying on the bounty or fur market as a primary driver of the effort. In Argentina, the official position is to continue with support for and subsidisation of the fur industry but essentially to await options that might evolve from this feasibility plan before making decisions on whether to continue, abandon or alter this policy.

3.4 Impacts on biodiversity

The obvious impact of beavers has been the removal of the *Nothofagus pumilio* and *N. betuloides* forests along the riparian zone (generally about 30 m but up to 95 m from the watercourse; Anderson et al. 2006) of most waterways in Tierra del Fuego (Fig. 3). Skewes et al. (1999) noted that 88% of the dead trees were killed by drowning and 12% by beavers' gnawing for food. These riparian forests were protected either within areas preserved for biodiversity or as part of best-practice logging in areas managed for forestry.



Fig. 3 Riparian southern beech (*Nothofagus* spp.) forest killed by beavers at a site they have abandoned, and replaced by a grassland meadow now used by feral horses (*Equus caballus*), cattle (*Bos taurus*), as well as the native guanaco (*Lama guanicoe*).

The effect has been to replace these forests by beaver ponds and associated meadows. The total extent of this deforestation has been about 50 000 ha, judging by the estimate for Chile given by Skewes et al. (1999). Although this is only a small part of the forested area of Tierra del Fuego these riparian forests are nevertheless key ecosystems within the area.

Plant biodiversity is greater in these induced meadows than in the original forests – partly because of invasion by introduced weeds (Anderson et al. 2005). Martínez Pastur et al. (2006) found that at least one of these meadows persisted 20 years after beavers had abandoned the site. Although this meadow contained 25 native species not present in the primary forest, 13 native species once present at such sites had not returned.

Beavers also build dams at treeline and it is likely that this will induce a lowering of the treeline as the forest here (largely *Nothofagus antarctica*) is replaced with alpine tussock grasslands (Fig. 4).



Fig. 4 Beaver dam and damage to high-altitude beech (mostly *Nothofagus antarctica*) forest at treeline.

Beavers also change the hydrological system and sedimentary flow in catchments, and alter the water chemistry of catchments (Lizarralde et al. 2004). These changes (and those of other introduced species such as salmonids, muskrats (*Ondatra zibethicus*) and mink (*Mustela vison*) which may benefit from beaver activity) have unknown impact on native species (Silva & Saavedra in press).

Apart from the grasses and herbs that benefit from beaver activities, some native species also benefit. The vulnerable Magellanic woodpecker (*Campephilus magellanicus*) and waterfowl may benefit from the extra foraging sites provided by beaver dams (Vergara & Schlatter 2004).

Attempts have been made to value conservation assets in dollar terms (e.g. Christie et al. 2006) and perform cost–benefit analyses on alternative management options, but these are not convincing as we do not think it is possible to accrue the conservation benefits in the same currency as the control costs (Parkes et al. 2006). Therefore it is difficult to judge whether the value of the damaged forest habitats is sufficient to justify the cost of eradication – it is a value judgment. However, eradication as a way to permanently remove the risk of invasion of the mainland and further consequent damage clearly adds to the value of benefit. Unless stopped by removal of current mainland populations or by eradication, beavers may expand their range about 2000 km to the north to the province of Neuquén in Argentina and to the Ninth Region in Chile. Apart from similar damage to the southern vegetation communities in common with Tierra del Fuego, the northern riparian ecosystems contain a

variety of riparian communities and species, including the conifer alerces (*Fitzroya cupressoides*), which is already threatened by fire and past logging.

For sustained control options there are economic tools that provide transparent ways to allocate control resources even when the benefits cannot be valued in dollars. Managers can either ask how to optimally allocate a fixed annual budget to control beavers in priority areas (benefit maximisation), or ask how to most efficiently achieve a selected range of control operations (cost minimisation) (Bhat et al. 1993; Choquenot & Parkes 2000).

3.5 Adverse impacts on economic values

The cost of beavers to the economies of Chile and Argentina has been estimated to be over US\$3 million per year (Menvielle et al. unpubl. data) and over US\$4 million per year judging by known costs to roading infrastructure in parts of Chile. These costs would escalate if beavers invaded the mainland.

The main economic cost of beavers is to the road infrastructure in Tierra del Fuego. The flooding caused by beavers and their propensity to use roads as natural dams by blocking culverts (Fig. 5) costs millions of dollars per year. For example, the costs to repair roads in Chile (Islas Grande, Navarino and Dawson) in 2002 and 2005 were US\$2.1 million and US\$2.4 million, respectively (D. Lopez, pers. comm.). The proportion of this due to beaver damage was not given.

Costs to commercial forestry largely stem from damage to roads or because the activity of beavers increases the costs to gain access to logging coupes. Generally, the riparian forests directly destroyed by beavers are reserved from logging so the destruction of such forests has no direct cost to forestry companies.

Beavers also cause significant local damage to ranching infrastructure. In areas where beavers persist in the absence of trees they gnaw ranchers' fence posts as a means of keeping their teeth in check – beavers' incisor teeth grow continuously and the animals must grind them down on wood, which they usually do as part of their feeding behaviour.

One case of beaver impacts on a commercial trout fishery was reported during our visit. Beaver activity caused the loss of 30 000 hatchling trout when the water became too warm when beavers' activities impeded water flow.

Expansion of beavers' range into mainland South America would significantly increase these costs. In addition, there are likely to be adverse effects (e.g. of floating logs in spillways) in the hydroelectric dams to the north.



Fig. 5 Beaver attempts to block a road culvert, Tolhuin, Tierra del Fuego.

3.6 Control methods

Catching beavers for their fur and more latterly for control where they are overabundant and causing damage has a long history in North America. The basic tools have not changed for centuries, but the modern need for more humane control methods has led to an improvement in the devices used. The mix of current control methods should be sufficient to achieve eradication in Tierra del Fuego, but modifications in how they are applied and in what order may be required to suit local conditions. These systems are best developed by the operational teams as they learn and improve their techniques. Novel methods to control beavers, such as toxic baiting, do not need to be considered at this stage for Tierra del Fuego but should not be precluded as options if required and if they are developed.

All the main control tools can be used in Chile and Argentina. However, some would require special permits before they could be used, e.g. foothold traps and sound-suppressed rifles. Of particular importance is the de facto prohibition of leghold traps in both Chile and Argentina imposed by European Union regulations (EU Regulation 3254/91). If Chile and Argentina wish to export beaver fur to the EU they cannot use leghold traps, but may use kill traps that meet internationally agreed standards. The EU Regulation is unclear as to whether leghold traps may be used (e.g. for pest control) so long as the fur or other products from those animals is not exported or if all leghold trapping is prohibited if any fur or product (of any species) is to be exported to the EU.

Article 3 of the Regulation states (with our comments in italics):

The introduction into the Community of the pelts of the animal species listed in Annex 1 (*which includes beaver*) and of other goods listed in Annex 2 (*which includes parts of beavers*)... shall be prohibited as of 1 January 1995, unless the Commission, in accordance with the procedure laid down in Article 5 (*the Commission may seek majority advice from a committee*), has determined that, in the country where the pelts originate:

- there are adequate administrative or legislative provisions in force to prohibit the use of the leghold trap, OR,
- the trapping methods used for the species listed in Annex 1 meet internationally agreed humane trapping standards.

This has critical implications for the management strategies proposed in this report.

3.6.1 Capture devices

Some traps are designed to kill rather than just hold the beaver. This has advantages as it means devices do not have to be inspected daily, as might be required for humaneness reasons if leghold traps were used. Lethal devices have disadvantages (although these are minimised if set correctly by skilled people) where non-target animals are present.

Bodygripping kill traps (e.g. Conibear, Belisle) with rotating jaw are used for beaver. As the beaver enters the space between the jaws, the wire trigger is pushed forward causing the jaws to rotate and close on the animal. The clamping pressure of the jaws constricts the flow of oxygen to the lungs (and carbon dioxide from the lungs) and the flow of blood to and from the brain. The result is unconsciousness that leads to death. The Agreement on International Humane Trap Standards (between Canada, Russia and the European Union) requires irreversible unconsciousness that leads to death in less than 300 seconds. Currently, all commercially manufactured square-jaw bodygripping traps of the appropriate size for beavers meet the requirement. The Belisle 330 bodygripper is the choice among many beaver trappers due to its improved jaw features that increase clamping pressure, improved safety locks, and trigger design. This trap costs US\$24 each.

Foothold traps: Foothold traps used for beaver are either double long-spring or coil-spring type and typically measure 19 cm in jaw spread, targeting a back foot catch. Foothold traps for beaver are typically set in an irreversible submergence system with a cable or rod with a one-way slide lock, allowing the beaver to dive only into deeper water once captured, thereby drowning the animal. Research in recent years has improved the mechanical attributes of these tools, thereby reducing the potential for injuries and increasing efficiency. CRR 7.5 traps cost US\$26 and No. 5 Bridger traps cost US\$24.50 each.

Cable devices (Snares): Cable devices are typically constructed from 7 × 7 (7 strands wrapped by 7 strands) flexible galvanised aircraft cable with a one-way slide lock designed to capture the beaver alive, typically around the body, directly behind the two front legs. Cable devices can also be set in an irreversible submergence system, thereby making it a lethal system. Snares cost about US\$2 each.

Beavers are effectively attracted to trap or snare sets using lures made from their castor sacs.

3.6.2 Firearms

The use of a rifle for beaver control can be an essential tool in areas where beaver have become trap shy, or where only a few animals reside and can be removed with less work than by placing capture devices. Animals can be targeted by the hunter sitting in a concealed spot near a dam or lodge early in the morning or at dusk until after dark. During the daytime a break can be made in the dam to attract beaver to the desired spot for easier shot placement. Beavers have a good sense of smell so the shooting site must be downwind. The desired rifle that fits this task is a .22 Magnum. It provides adequate energy and trauma, with a well-placed shot to the head region. The .22 Magnum has a lower chance of ricochet than most other larger centre-fire cartridges. Equipped with a scope, the .22 magnum rifle can provide consistent accuracy from 70 to 90 m.

Noise-suppressed weapons work by deflecting sound from the muzzle into a baffled cylinder to reduce the sound signature of a rifle being fired. A suppressor is attached to the barrel by threads cut into the muzzle of a rifle. A .22 magnum rifle with an attached suppressor makes an effective tool for shooting beaver. Rifles with an attached suppressor from a well-established company such as AWC Systems Technology out of Phoenix, Arizona, are ideal for taking multiple shots at one spot, because the reduction in muzzle blast reduces the likelihood of scaring other beaver from the area.

Shotguns are smooth-bored weapons that shoot a shell consisting of several pellets that can effectively cover a larger area at shorter ranges. Shotguns range in size (from smallest to largest): .410, 20 gauge, 16 gauge and 12 gauge. The recommended gauge for shooting beaver is a 12 gauge with a 22" to 26" barrel, typically with a modified or full choke to keep the shot pattern size smaller or denser. The recommended shot size is BB or No. 4 buck shot; No. 4 buck shot has a larger pellet size but there are fewer pellets; the BB is a smaller shot size but has more pellets. The length of a shotgun shell also varies from 2 ¾" to 3 ½", but 2 ¾" is adequate for beaver for ranges out to 40 m.

A handheld spotlight or one attached to either the scope of a rifle or the barrel of a shotgun is frequently used while night shooting beaver. Night vision equipment can also be a beneficial tool for the night shooter.

3.6.3 Explosives

Explosives are an effective, cost-efficient tool for removing beaver dams causing damage to property or other resources. Binary explosives consist of a solid (ammonium nitrate) and a liquid (nitro methane), which are mixed together at the dam site to arm the charge. A length of detonation cord (50 grain) is tied to each charge and then strategically placed in holes in the dam. The lines are tied together on one trunkline to allow the Explosive Specialist in Charge to use one detonator. Three different initiation systems can be utilised to set off the charges. Fuse, electric and non-electric shocktube are the three initiation systems that can be used.

The use of explosives in Tierra del Fuego may be necessary for three reasons. First, when dams create deep water it may be necessary to blow the dams to get access to good trapping locations. Second, once dams are cleared of beavers it may be useful to completely drain them by blowing up the dam so that recolonisation can be easily detected, and (c) blowing up dams cleared of beavers may be a necessary step to hasten ecosystem restoration.

3.6.4 Dogs

Detection dogs or beaver dogs can be trained to seek out areas such as bank dens or lodges to chase out existing beaver in a colony, as well as scouring an area to determine if there are any beaver inhabiting an area. Smaller breeds such as Jack Russell terriers or mountain curs have excellent scent trailing ability as well as the ability to get into small confined areas.

3.6.5 Other control methods

No other control methods are available for beavers. There is no obvious need to develop new ones, such as toxic baits, for Tierra del Fuego; but needs may change so we would not preclude exploration of alternatives if necessary.

3.6.6 Applying the tools for eradication or sustained control

The best sequence of tools to use depends on the particular circumstances at each targeted beaver colony and depends on the type of sign and use – number and location of lodges and their entrances, bank dens, crawl-over sites on the dam, feeding locations, scent mounds.

For eradication the aim should be to kill all beavers as quickly as possible, ideally within a few days. To do this the area must be saturated with devices. North American experience suggests that the use of Conibear traps alone will not remove all beavers from many colonies. For example:

- 10–12 bodygripping kill traps, some set unlured in well-used channels and at lodge entrances, and some as lured sets in channels and at scent mounds
- 10–12 cable devices at crawl-over sites on the dam or at scent mounds. Unless the snares are set to drown the beaver, they should not be set close to the lodge as this makes other beavers more wary
- 2–4 foothold traps at crawl-over sites, scent mounds

After the initial check, beaver are removed from traps, traps are reset, and some sets may be moved and sometimes new sets and/or new lure (e.g. from castor sacs) may be used to entice other beaver to work the sets. This routine is continued until the trapper ‘feels’ all of the beaver in the colony are removed. Two trappers operating for 2 or 3 nights will on average kill 100% of the beavers in a colony using this intensity and sequence of effort.

However, when eradication is the aim, this ‘feeling’ must be verified and additional methods to monitor and react to indications of beavers must be initiated.

- An indicator of beaver presence/absence can be accomplished by breaching a small hole in the dam. A foothold trap can be set at the breach to help the trapper determine if all the beaver are removed, as beaver will frequent damaged areas of their dams.
- Evening or night shooting with a spotlight using suppressed .22 magnum rifles. This can be done in association with the trapping regime or as a follow-up method to kill trap-shy survivors.
- Hunting dogs if there is evidence of survivors that cannot be caught or shot.

The effort required for effective sustained control may be less, and that for cost-effective fur harvesting will be much less.

Trapping and/or shooting during winter conditions may consist of several different techniques. Trapping can be conducted under the ice typically near the food cache utilising bodygripping, cable-devices, and/or foothold traps. Fresh bait, branches of palatable trees, is

typically used for under ice sets to entice the beaver to approach a set. Explosives are sometimes used to remove a dam and lower the water level, allowing the trapper to shoot beaver retreating from their bank den or lodge to investigate lowering water levels, or beaver dogs could be sent into bank dens or lodges to chase beaver out, allowing them to be shot by the trapper.

Explosives are typically used after all the beaver are determined to be removed from a colony. All dams are removed from the river, creek or stream which the beaver were inhabiting to restore the area as closely as possible to the way it was before the beaver were there. Occasionally, explosives are beneficial to use prior to trapping or shooting in situations where water levels make it difficult for the trapper to set equipment. Water levels can be lowered with the aid of explosives and then traps can be set to capture the beaver.

In our opinion, any lack of access to the use of leghold traps caused by the desire to export fur to the European Union will increase the risk of failure of eradication and perhaps of the containment strategy. Certainly if eradication is attempted the ability to remove all beavers from colonies without the use of leghold traps must be tested as a matter of urgency - and even if still feasible, the loss of efficiency imposed by the inability to use this tool must be identified. If leghold traps are essential (and we think they will be) this has immediate implications for the fur harvesting industry.

3.7 Social context

The main stakeholders in government (Appendix 2) and landowners see beavers as pests, and although they might debate what to do about them, will probably support responsible and planned campaigns to eradicate them.

Those who wish to sustain a commercial industry have an obvious interest in maintaining populations of beavers – a goal encouraged by the past attempts of governments to support such an industry. The trappers' interest may be diverted if they are employed as hunters in any eradication campaign. The best of these trappers is likely to double his income as a paid employee rather than as a fur harvester. However, it is important that their employment opportunities are promoted past the end of any beaver project, e.g. on other land management or pest control so they can see an ongoing replacement of their current income.

The beaver fur buyers are obviously a time-limited industry under an eradication strategy. Easing their exit from the industry might be considered by giving them access to furs of beavers trapped (e.g. in accessible areas) during the eradication, as long as this did not compromise the efficiency of the eradication. However, if the use of leghold traps is essential to achieve eradication it is likely the market for beaver furs in the European Union would stop immediately and the industry in Tierra del Fuego would cease.

The views of urban people are unknown, but the beaver has some status among some as a tourist symbol, judging by the promotions we observed in Ushuaia where a man in a beaver suit was advertising tourist ventures (Fig. 6). A key role of the communications and public relations expert(s) in the project team(s) would be to manage these public perceptions.



Fig. 6 Advertising beavers as a tourist attraction in Ushuaia, 2007.

Some people are more concerned about the impacts of other introduced species – archaeologists about rabbit (*Oryctolagus cuniculus*) damage to middens, and ranchers about feral and stray dogs (*Canis familiaris*). A benefit of developing a trained, professional capacity to control beavers would be the opportunity during or after any beaver work to offer this expertise as a gesture of goodwill to local landowners and managers to solve their problems with other pests – providing it did not divert too much energy away from the primary target.

4. Strategic Options to Manage Beaver

4.1 Removal from the mainland

Extirpation (= temporary removal) of beavers from the mainland of South America requires urgent action and is, in our opinion, of highest priority either as a stand-alone option or as a necessary first step in an attempt at eradicating beavers from Tierra del Fuego.

There is a project managed by Servicio Agrícola y Ganadero (SAG) to remove beavers from the mainland. In summary SAG intends to hire trappers (and train new ones from among ex-navy servicemen) to remove beavers from the Brunswick Peninsula and Dawson Island, and create buffer control zones on the adjacent shore of Isla Grande (Fig. 7) over the years 2007 to 2009 at a cost of US\$2.18 million. It is intended to use 30 trappers plus six supervisors in this project. The SAG project is based entirely in Chile, but the benefits accrue to both Chile and Argentina, if it succeeds in removing beavers from the mainland.

The planning, funding and conduct of this project is independent of any wider programme to eradicate beavers from all of Tierra del Fuego. Further, it is not our brief to review the strengths and weaknesses of this national Chilean project, but we are obliged make a few points on critical areas because it has implications for the binational strategies (in particular eradication and sustained control) we are commissioned to review.

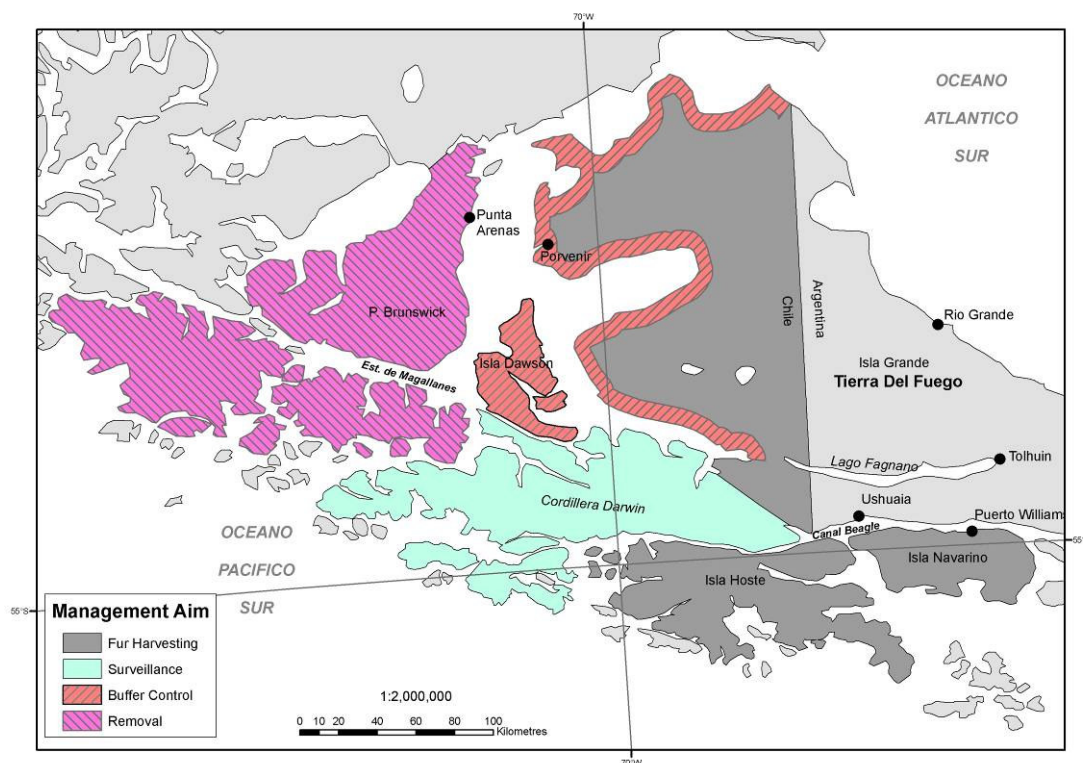


Fig. 7 Management zones for the removal of beavers from mainland South America under SAG's current plan.

4.1.1 Risk of establishment on the mainland

The first confirmed presence of beaver on the Brunswick Peninsula at El Parrilar Lake was in 1994 and that animal was killed. A further three animals were trapped at one site at El Parrilar Lake, and one solitary animal found at Punta Arenas in 1997. A larger survey of 168 km of waterways in 2007 showed a scattering of animals (about 10–20 individuals) were present of which two animals were trapped (N. Soto Volkart, unpubl. report).

The irruption of beavers on the mainland has been slow compared with that on Isla Grande. There are several possible reasons for this effect:

- The rate of immigration might be very low so that individual beavers just do not encounter mates. Forsyth & Duncan (2001) showed that introduction effort, particularly the number of individuals introduced, determined whether exotic ungulate or bird species established populations in New Zealand. At Lake Fagano, 50 beavers were released at a single place, while on Brunswick Peninsula individuals swim the Straits and may never encounter a mate.
- The presence of predators such as puma (*Felis concolor patagonica*) and culpeo fox (*Pseudalopex culpaeus*) on the mainland might make life very dangerous for dispersing beavers without the safety of a lodge or bank den.

4.1.2 Detection and search issues

The project to date has been concerned with confirming the presence of beavers on the Brunswick Peninsula and has used a model of habitat preference to direct searchers to the most likely places (Soto Volkart 2006). As the project moves to an operational phase, this search pattern has to change for two reasons. First, as extirpation is the aim ALL areas capable of harbouring beavers must be searched irrespective of how likely beavers are to use them. Of course the search effort may be different in areas with different a priori estimates of the likelihood that beavers might be present. Secondly, and as with the eradication project on the mainland, a search and destroy operation needs to move across the landscape in some planned way independent of the knowledge that somewhere ahead there are beavers.

Several statistical approaches have been developed in other pest eradication operations to bring more transparency to the difficult phases when few animals are present, i.e. at the edge of the range and once most have been killed. For example, Ramsey et al. (in press) used kill-rate data and the search effort (known from GPS transmitters on the helicopters and ground hunters) to estimate the probability that no feral pigs (*Sus scrofa*) remained on Santa Cruz Island, California, at the end of this eradication when no further pigs could be found, and estimated how many more clear searches would be required to raise this probability to a level at which managers were comfortable. Similarly, Solow et al. (2008) used trapping data from a failed eradication attempt against musk shrews (*Suncus murinus*) on Ile aux Aigrettes, Mauritius, to show how the decision to scale back the trapping effort when few or no shrews were caught was premature. We recommend similar methods should be developed to inform management decisions in Tierra del Fuego, i.e. whether to continue searching for beavers in areas thought to be cleared or to stop and move the effort to new areas.

The apparent assumption, based on where beavers have been found on the mainland, is that the main source populations are from Dawson Island and the main settlement areas are on

Brunswick Peninsula. It is possible that beavers could come from Isla Grande (and thus the buffer zone along the Straits of Magellan), but it is also possible that some may settle along the coast north-east of the peninsula. Whether it is worth conducting formal searches over this area is arguable, but some publicity among local residents about the danger and a reporting system would give an early-warning system to detect any immigrants.

4.1.3 Management in buffers on the islands

The assumption made to justify beaver control in buffers on Isla Grande is that lowering the density (or even removing the local populations as on Dawson Island) will reduce (or eliminate) the incentive for beavers to swim across the Straits of Magellan. This is untested.

4.1.4 Brunswick Peninsula and Dawson Island as demonstration and training sites

The very low densities of beavers on Brunswick Peninsula gives little opportunity to train hunters for the wider campaigns that might follow on Isla Grande, but the high densities on Dawson Island should allow it to be used as a training and demonstration site.

The aim on Dawson Island under the SAG plan is to extirpate the beavers, i.e. to achieve zero density that might also equal the first step in eradication if the wider eradication attempt is subsequently made.

4.1.5 Project management for a wider project

A project management system developed under SAG for the management of beavers on the mainland and Dawson Island will be in place before any decision is made on the wider options to manage beavers in the rest of Tierra del Fuego. We suspect that if this SAG-led management structure works and if the programme's outcomes are met it will continue as the first step in the Chilean part of a binational programme. The consequence would likely be a parallel management structure but with a binational coordinating group to ensure appropriate cooperation in planning and delivery between the two countries, e.g. see section 4.3.1.2 and Fig. 9b). If the SAG project management does not work and if satisfactory progress is not made to remove beavers from the mainland, a major binational review of the implications for the management structures for the wider binational project and its start date should be considered.

4.2 Eradication

Eradication (the permanent removal of all beavers from Tierra del Fuego) is the option preferred by most stakeholders and by the Governments of Argentina and Chile. The question addressed in the core of this report is whether this option is feasible?

Two ways have been used to assess feasibility of eradication for other pests: using past experience to judge whether it is possible in the case under review, and/or by analysis of the obligate conditions that must be met and the constraints peculiar to the case that have to be avoided or managed.

4.2.1 Lessons from past experience in eradication or control of beavers

A very small population of 24 beavers was eradicated from France in the 1980s (Rouland 1985), but this was too small to be of much use as a template for Tierra del Fuego. However, beavers were extirpated by extensive fur trapping in large parts of North America by 1900 (Novak 1987), and the European beaver (*Castor fibre*) became extinct in many countries in Europe, e.g. in Scotland in the 16th century (Nolet & Rosell 1998) due to overhunting.

Beavers are regularly extirpated from many smaller areas in modern North America where they are pests (Novak 1987).

The techniques and effort to achieve these recent extirpations provide key data for the current plan.

The SAG project on Brunswick and Dawson Island will also eventually provide experience in eradication. The proposal to spend \$2.18 million over 3 years (essentially now 2 years) will demonstrate whether the effort and methods used achieve the goals. The results from the high-density Dawson Island will be particularly informative.

4.2.2 Analysis of rules and constraints

A pest may be eradicated if three obligate rules can all be met, and if other constraints can be overcome or avoided (Hone et al. in press). The obligate rules for feasibility are:

- In source populations the average annual rate of removal must exceed the annual intrinsic rate of increase – put another way they must be killed faster than they can replace their losses at all densities and all must be at risk in the source populations.
- There must be no immigration of individuals capable of breeding.
- There must be no net adverse effects on valued species or communities.

The constraints in Tierra del Fuego include:

- Ensuring access to land of all tenures to meet rule 1.
- Social issues, particularly around current expectation about exploiting the beavers as a fur and meat resource.
- Organisational complexities involved with managing the project within a binational framework, developing capacity, and the sheer logistical complexity enforced by the scale and multiple land tenures involved.

4.2.3 Rates of removal – all at risk

The scale of the problem in Tierra del Fuego is, at first sight, daunting. However, beavers do have one potential weakness – they are restricted to waterways or lakes if they are to reproduce. Further, it is clear from experience in North America (and Tierra del Fuego) that the first rule can be met for the beavers in a single dam or colony, and this can be scaled up at least to a catchment or group of catchments. A combination of bodygripping traps, foothold traps, and snares is usually capable of catching all beavers in a colony within 1–3 nights trapping (see section 3.6.6). Occasionally, the use of rifles or dogs to detect and kill survivors might be required. These North American best practice rules will need to be adapted to local conditions and requirements. Beavers inhabiting lakes or large rivers without constructing dams may require independent control methods and detection techniques.

Evidence of failure to remove all beavers in a colony can be detected by breaking small holes in the dam and recording whether any survivors are present to repair it. The simplest way to catch such survivors is to set a leghold trap at the breach (see section 3.6.6). However, if this and other trapping devices fail to catch the survivor(s) it is essential that alternative methods, such as night shooting or the use of tracking dogs, are applied and the animals removed before leaving that area.

The question is whether this local extirpation can be scaled up to large groups of catchments, a whole island, all of Tierra del Fuego? The answer depends again on meeting the rules and managing around the constraints, as well as having a project management structure capable of delivering the control at the appropriate scale and within a time frame driven by the ‘biology’ of the system – rather than by organisational and funding issues.

4.2.4 Detecting and killing immigrants into cleared areas

Immigration, particularly of dispersing juvenile beavers, back into cleared catchments is a potential problem. Therefore, selecting defensible management unit boundaries to minimise immigration into cleared areas, and detecting and killing any such breaches will be critical if eradication is to succeed. Dispersal is seasonal and this should be exploited in the surveillance planning.

How much of a problem dispersal back into cleared areas will prove to be in Tierra del Fuego is unknown. In one study in Tennessee all beavers ($n = 169$) were removed from 22 colonies in about 1700 ha over 7 months and the recolonisation rates monitored. Over 3 years 162 immigrant beavers were caught in the area, mostly at old colony sites and mostly in the autumn and winter (Houston et al. 1995).

The distances up and down rivers moved by beavers in North America suggest each management zone in Tierra del Fuego would need to be perhaps 20+ km deep. However, we suspect that the zone sizes will depend very much on topography if beavers disperse down and around waterways rather than up and over ridges between catchments. In the steppe and where forested habitats are continuous, the zones might have to be larger than in more mountainous terrain where catchments are isolated from their neighbours apart from at the lower reaches.

Clearly, good data are required from Tierra del Fuego on the distance that immigrants are detected from putative source populations, the effort required to detect and deal with any animal, and the number, age, and sex of any supposed immigrants to improve operational decisions on the scale and speed of the advance of control effort across the landscape and on the intensity and location of ongoing surveillance. This can be done during the operations.

Detecting immigrants is possible by creating major breaches in dams cleared of beavers within high-risk areas (e.g. those catchments cleared but immediately behind the rolling-front of action) and monitoring whether they are decolonised. Aerial or even satellite techniques might be developed to assess whether drained dams are refilled with water and thus indicating potential decolonisation – usually in the autumn. Alternatively, immigrants that have not settled in a dam can be detected from fresh sign such as gnawed trees. The former method is probably best as it provides a location for the consequent control effort while the latter might merely indicate a dispersing animal before it settles.

Detecting survivors or immigrants and delimiting the edge of the beavers’ range will require information on detection probabilities and application of search theory so that failure to find beavers can be interpreted as a probability of eradication, and so confidence in decisions to stop searching in one zone and redirect the effort.

4.2.5 No net adverse effects

The use of lethal capture devices potentially places some native animal species at risk. The endangered otter (*Lontra provocax*) is found along the coast and lower reaches of rivers in

Tierra del Fuego, and individuals may be at risk from traps and snares set for beavers.

In North America, traps set for beavers can be set in such a way as to reduce the likelihood of trapping the local otter (*Lontra canadensis*) (J. Paulson, pers. comm.), but whether the same methods will reduce risk to the Patagonian otter is unknown.

The endemic fox (*Dusicyon culpaeus*) is uncommon on Tierra del Fuego but is probably not much at risk from beaver control devices.

Note: eradication effort will only briefly (a few days for the initial effort) expose sympatric non-target animals to any risk. So long as this risk is not severe, the non-target populations may rapidly recover and peoples' concerns may be acute but short-lived. In contrast, sustained control exposes non-target animals at each control application in perpetuity. This effect may permanently suppress the non-target population and may induce ongoing social concerns.

4.2.6 Is there legal access to all beavers?

It is essential that either all landowners agree to allow access by the hunters to beaver colonies on their land, or that government has the power to enforce access where a landowner objects. Some ranchers interviewed were averse to allowing fur trappers on their land because of the bad behaviour of a few. These objections could be overcome when casual fur trappers are replaced by project-employed hunters – whose behaviour can be managed.

4.3 Phases of an eradication operation

Large-scale eradication operations can be divided into four phases – a planning phase, the actual operational phase to kill the pests, a surveillance phase to certify success or deal with failure, and a post-eradication phase that might include some ongoing surveillance (since we can never be 100% sure of success). The post-eradication phase might arguably include any active restoration of the ecosystems, or use of the capacity developed in the project to manage other pests.

4.3.1 Planning phase

Before any beaver is killed, it is essential to have a commitment to fund the operation (of which this feasibility report forms a key part as it is mostly aimed at those making the decision to fund a project), develop a project governance and management structure, and develop a detailed operational plan. In this section we give some ideas on project time frames, governance and management structures, and develop a preliminary budget for the operational part of an eradication plan as an indication to the funding decision-makers as to the budget they will have to provide – although the budget and time frames will of course not be finalised until the project management is in place and the project managers write an operational plan.

4.3.1.1 Project time frame

The attempt to remove beavers from the Brunswick Peninsula and manage them on Dawson Island and in buffers sets the rational starting point for a wider eradication strategy for both Chile and Argentina – in essence both countries should build on this start by beginning true eradication in the Andean part of the range. An example of a time frame for the whole of Tierra del Fuego is summarised in Fig. 8.

We have assumed it will take 2 years (2008–2009) to access the funding, develop a governance and management structure, appoint staff, train field staff, organise the major contractors, and write an operational plan and detailed budget. However, we note that this planning and training process took 5 years from the initial feasibility plan for the feral goat eradication campaigns in the Galapagos (Lavoie et al. 2007), so our time frame might be unrealistic. We have assumed all the active control and some of the surveillance phase will be completed within 5 years from a formal start in say 2010. The costs for the planning phase and for parts of the surveillance phase after 2010 are not included in the tentative budget. The latter will eventually depend on how effective the control has been and the level of risk managers are prepared to take that they have falsely declared eradication. The message here is that some ongoing budget for surveillance and reaction will be required past the dates set out in this chart.

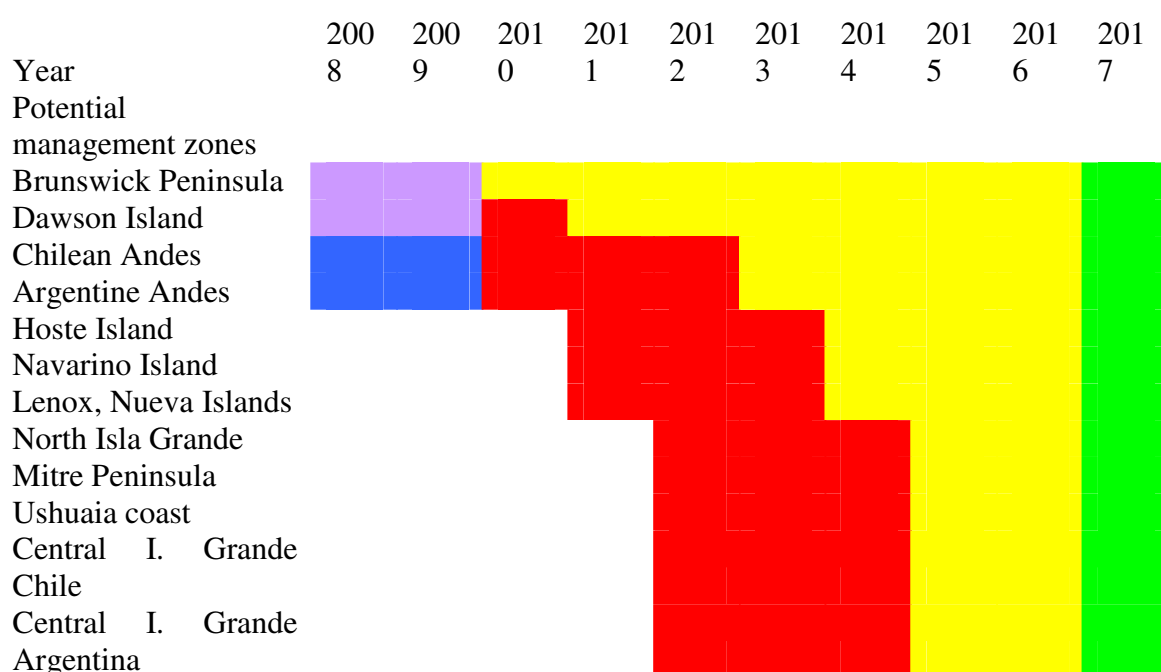


Fig. 8 Example of a hypothetical time frame for eradication across Tierra del Fuego. The purple years are the current SAG project, the blue years are concurrent with SAG's project and allow for planning the wider project, the red years indicate active control, yellow years are active surveillance and reaction, and green years are less active surveillance of risk areas within the zone.

4.3.1.2 Project governance and management options

The ideal project management structure for a large, complex project that requires discipline to meet deadlines on budget is summarised in Fig. 9a. Basically, it requires a project governance system to represent the interests of the funding agencies, a project delivery system to conduct the eradication, and an audit and review system to independently advise the governance group. The delivery system requires a project manager to ensure the functional groups (operations management, data management, financial management, public relations management, and other technical and legal advice) perform, and leads development of the operational plan. The operations manager is responsible for the day-to-day management of the field staff who are killing the beavers.

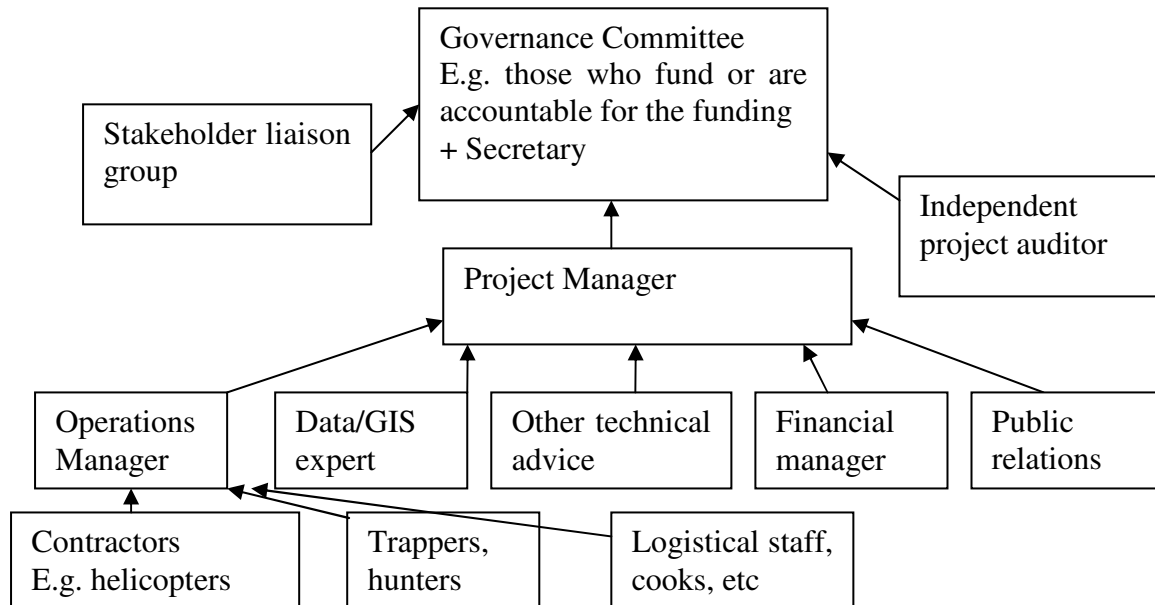


Fig. 9a Project management structure under a single binational Proyecto Castore system.

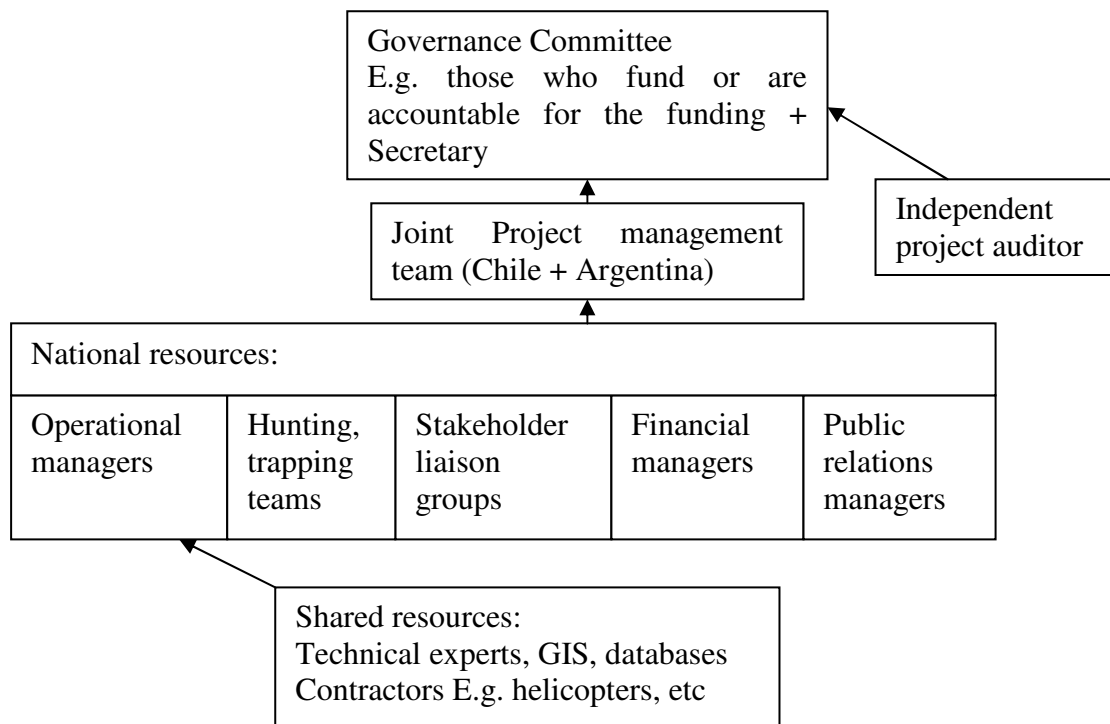


Fig. 9b Project management structure with binational project management but with national

operational teams sharing some technical and advisory elements.

The complexities in the Tierra del Fuego project are that two nations are involved and are currently operating on different timeframes. Thus a case can be made to have either (a) parallel structures with each country having a system similar to Fig. 9a (it would be vital to have some form of binational coordination committee (with say representatives of both governance and operational systems) to ensure coordination where appropriate, e.g. contracting major components such as helicopters), or (b) a single binational governance committee, a joint project manager, but have operational teams in both Chile and Argentina (Fig. 9b). Technical advisory services and contracting for major infrastructure might be shared in this option.

Clearly, a single project operational team accountable to two independent governance groups (however well they talk together) would be very difficult for the project delivery manager.

The functions and skills required in each of the project management systems can be summarised (Table 2). Some of the technical skills would be full-time positions and others part time. Ideally, significant technical personnel should report to the project manager rather than to a manager from an agency who is also on the governance group, but of course this can be achieved either by partial secondments from the agency or by new appointments.

The use of helicopters will be essential if eradication is to be achieved because of the need to operate at large scales within relatively short time frames:

- Much of Tierra del Fuego is inaccessible from roads or by water.
- Large areas must be cleared of beavers quickly, i.e. with maximum effort to reduce risks of recolonisation by beavers.
- Nevertheless, repeated surveillance of these cleared areas will be required.
- Eradication must be achieved within a relatively short period otherwise the risks that funding or organisational commitment will decline are possible.

The costs of helicopters are substantial (65% of the total budget of the operational phase), but we think is essential if the eradication campaign is to succeed and be completed within a five-year time frame. The risks of failure and other costs increase as the time to success increases.

Three types of helicopter are recommended, and we have suggested six machines in total, although this would have to be reconsidered as part of any detailed operational plan. The most efficient way to deploy these is via a contract-for-service agreement with a single provider, but again some services (such as heavy logistic support) might be provided by the armed forces of Chile or Argentina.

Small helicopters such as Robinson R22 are cheap to operate but have some limitations. They are dangerous to fly in sub-zero or wet conditions so their use in Tierra del Fuego's climate may enforce many no-fly days. They also have limited capacity to fly heavy loads. However, they would be ideal to survey operational areas to plan the deployment of the trapping teams, and for the follow-up surveillance in areas thought to be cleared of beavers.

Table 2 Functions and skills required to achieve eradication of beavers in Tierra del Fuego. We assume a single binational structure but see Fig. 9b for one alternative.

Position	Examples of function	Staff
Governance	Oversee major policy decisions Accountable to funders Manage cross-border issues Manage government agency issues	Representatives of funding agencies plus a secretary
Stakeholder liaison group	Group to represent wider stakeholders Receive information on progress Comment on issues of concern to wider public	Representatives of groups directly affected by the project
Project reviewers	Assessment of progress in the project Report to governance group and project manager on key milestones	Independent experts
Project manager	Coordinate and manage the project Accountable to governance body Oversee development of operational plan	One person with project management skills
Operations manager	Manage the hunters and their support systems	One person with practical skills
Spatial data manager	Collate, analyse and report on data collected to plan day-to-day changes and project outcomes	One person with GIS and database skills plus support technicians
Public relations manager	Ensure public input and acceptance of operational plan Manage conflicts Liaise between operations and landowners	Social science and journalist skills
Clerical manager	Operational management of budgets and accounts	Accounts clerk
Technical advisors	Legal advice Training advice on best practice trapping	As needed
Hunters and supervisors (=head hunters)	To kill the beavers and record data Liaise with individual landowners	Leading hunters plus about 45 full-time hunters
Logistics support	Manage equipment and supplies Prepare field camps Cook	A manager plus field support teams and cooks
Contractors	Provision of major infrastructure such as helicopters	Contracts

The weather and scale of operations (many teams and their traps, etc.) suggest a larger helicopter will be required to provide the bulk of the work ferrying control teams and their equipment about in the field. Macdonald Douglas 500 E models are the best helicopter for this purpose, although the Robinson R44 might be considered as it is a cheaper machine.

They have the power to operate at altitude and in inclement weather conditions. They can carry larger loads, e.g. 300 kg or four passengers, and so service several field teams simultaneously.

Finally, there will be an occasional need for a larger machine to lift heavy loads (camps, boats, fuel, larger numbers of field staff, etc.). A helicopter such as the AS350B3 can carry 1200 kg sling load or seven passengers. Its power means it can operate in worse weather than the smaller machines, which means it could also be used when critical work is required in bad weather, e.g. in emergencies.

4.3.1.3 Estimated costs to eradicate beavers

We estimate the cost to eradicate beavers, assuming it is judged feasible, to be up to US\$33 million. The components of these costs are estimated in Table 3, but how they are accumulated and thus the total cost, depends on the timetable and rates at which areas are cleared of beavers. This is NOT an operational budget, but merely an indication of how much an eradication attempt might cost if the primary control and surveillance was to be attempted within 5 years from starting the active eradication phase. It is given here so decision makers can judge whether eradication is feasible with likely national funding sources or if new funds will have to be sought.

To put these costs into perspective, eradication of bovine tuberculosis from feral cattle in Australia cost c.US \$1000 million. About US\$50 million are spent each year to manage brushtail possums (*Trichosurus vulpecula*) in New Zealand. The costs of eradicating feral goats (*Capra hircus*) from three islands in the Galapagos (over c. 560 000 ha) was US\$9 million. The estimated costs to eradicate ship rats (*Rattus rattus*), mice (*Mus musculus*) and rabbits from the 12 000-ha Macquarie Island in Australia are cUS\$25 million.

Table 3 Estimated costs in US\$ to eradicate beavers from Tierra del Fuego. *We have estimated staff costs at local rates although we emphasise that the costs to employ key staff (such as project and operational managers) at international rates would cost twice as much. We assume some costs would go to the Armed Services for components of transport such as boat transport. Other costs (noted by ?) are simply guessed.

Item	Unit costs	Assumptions	Cost
Teams of 2 hunters (initial removal of beavers in colonies)	\$15,000/ person/y for 5 y + operating	30 teams Over 5 years	\$4,500,000
Hunting team (initial removal of beavers in lakes)	\$150/day	Find and clear 3 colonies/5 days Scale of problem unknown	\$500,000?
Hunting team (surveillance and removal of immigrants)	\$150/day	Aerial inspect 100 colonies/day (3 times over 4 y) using R22 helicopter @\$450/h Reclear (say 25% that are recolonised) at 1 colony per day	\$1,250,000 \$610,000
Traps and snares	\$25/device	200 traps etc. per team 30 teams	\$250,000

Blowing dams		Labour, transport and explosives Need unknown	\$750,000?
Mobile base camps and helicopter field hangars	\$150,000/ camp	Sleeping and eating facilities for field staff Two camps	\$300,000
Miscellaneous equipment		Rifles, dogs, GPS, tents, radios, computers, etc.	\$500,000
Helicopter support	2 × R22 @ \$450/h 3 × MD500/E @ \$1050/h 1 × AS350B3 @ \$1650/h Mobilisation, audit, contract development	R22s for survey and ferrying. 1200 h/heli/y for 4.5 y MD500s for main movement of field staff. 1100 h/heli/y for 3.5 y AS350B3 for heavy logistics ferrying etc 650h/y for 3.5 y	\$4,860,000 \$12,124,000 \$3,752,000 \$780,000
Other transport		Road vehicles Boats	\$800,000
Project managers	\$45,000/y salary + operating	2 staff for 5 y	\$450,000*
Operations, GIS, data, PR and communications, managers	\$35,000/y salary + operating	5 staff for 4 y	\$875,000*
Governance costs	\$50,000/y	Secretary + meeting costs for 4 y	\$250,000
Audit and review and training		Consultancy for mid and full-term review Training of hunters	\$80,000
TOTAL			\$32,631,000

4.3.2 Operational phase

The usual rule for large-scale eradication is to start with the outliers and edges and work inwards. For beavers, there is also no point apart from training staff in selecting the easiest areas just because they are easy. It is as well to know if eradication is impossible early in the campaign so that alternatives (research or a change in strategy) can be assessed.

The tentative management zones in Fig. 8 will obviously need to be reconsidered in an operational plan based on the current SAG project on the mainland and Dawson Island and on likely barriers to beaver movements and thus defensible boundaries (e.g. Fig. 10).

Attempting eradication in smaller areas has several potential advantages:

- It can be attempted in such a way that tests some of the uncertainties – e.g. how much effort is required to kill all beavers in a colony, how much reinvasion occurs, can survivors be detected, can non-target animals be avoided?
- It can be used to train hunters.
- It can be used to demonstrate the feasibility of eradication to stakeholders.
- It can be either the first zone in the wider operation or some area selected for its convenience for one or more of the above reasons. If the former, it should be selected because it is defensible until the adjacent zones are attempted.

The SAG project on Dawson Island can be used to demonstrate some of these issues because it is intended to begin in this zone in any event and it is a discrete management unit. We recommend that Argentina should also begin a demonstration project, but here the best location is less clear as Argentina has no discrete islands. Selecting an area to, for example, train trappers or demonstrate the ability to trap beavers but not otters is simple (ease of access or presence of otters are the criteria). However, selecting an area that could be defended until the wider project began is not so obvious.

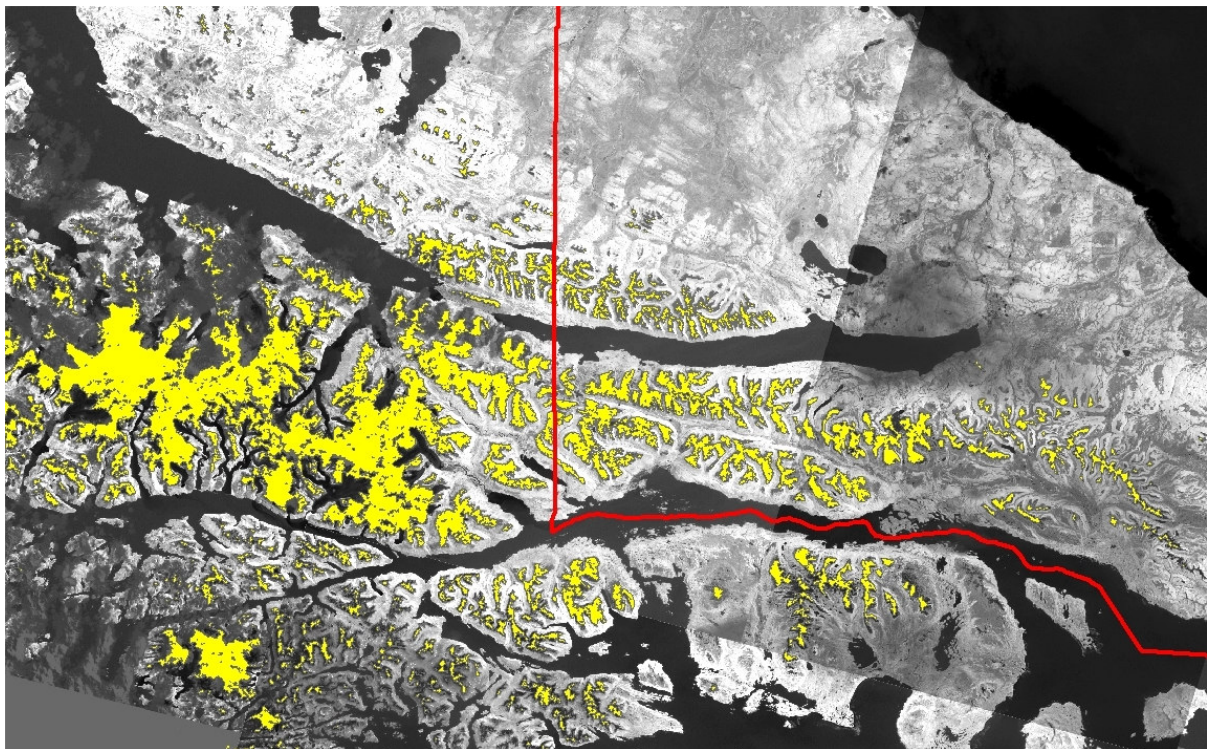


Fig. 10 Some natural barriers to beaver dispersal that might be used to delineate some management zones. The yellow-shaded areas are high-altitude rock and snow and may act as barriers to beavers (after A. Schiavini).

One option might be to begin in the Andean zone from Ushuaia north to the high Cordillera Darwin alpine zone in Chile. That is close enough to roads and boat access to make logistics easier, demonstrate a cross-border operation, and yet be partially defensible from reinvasion.

4.3.3 Active surveillance and certifying success

A key function we have not budgeted is how much surveillance to do after the operational managers think they might have removed all beavers from the whole of Tierra del Fuego. Given we cannot be 100% sure that no beavers remain because we cannot search everywhere and detection is not certain, the answer depends on how confident decision makers wish to be, the costs of more surveillance, and the costs of stopping too soon.

The models to do this need to be developed using data, particularly on detection probabilities, collected during the eradication operation. We have suggested some methods to analyse these data (see section 4.1.2 and the references therein).

4.3.4 Post-eradication actions

A common flaw in eradication campaigns is the lack of post-eradication planning. Extra actions might be needed to restore the ecosystems damaged by beavers, to deal with unexpected negative consequences of removing beavers (see section 4.2.5), and to use the human capacity developed during the project in such areas for control of other pests.

A key question that goes to the core is whether eradication of the beavers will eventually allow these riparian sites to trend towards their original state, or whether the trajectory has been altered permanently (Table 4). There is not enough data to form any certain conclusions, although at the one site noted above, the induced vegetation persisted for 20 years after beavers abandoned the colony. If this time frame is general, active restoration of forest habitats by physical manipulation and planting trees might be required to advance forest recovery. Active restoration might include excluding the large herbivores present (feral cattle, feral horses, and perhaps guanaco) and/or physical replanting of *Nothofagus*.

Table 4 Predicted trajectories for riparian sites under five scenarios of herbivore management. These possible options could be tested by small-scale, but long-term experiments if eradication was not attempted.

Scenario	Management option	Hypothetical ecosystem trajectory
1	Never beavers but large herbivores present in low numbers	Retains <i>Nothofagus</i> canopy with adequate regeneration
2	Beavers present plus large herbivores in medium to high numbers	Permanent state change to meadow habitat
3	Beavers removed but large herbivores in medium to high numbers	Permanent state change to meadow habitat but with more woody vegetation such as <i>Nothofagus antarcticus</i>
4	Beavers and large herbivores present periodically	Depends on periodicity – long period removal might increase forest regeneration
5	Beavers and large herbivores removed	Eventual reversion to forest

4.4 Sustained control

Sustained control aims to reduce pest populations to some low density at which their adverse impacts are absent or tolerable and hold them at or below that density by repeated intervention in perpetuity (Choquenot & Parkes 2000; Hone 2007).

Ideally, it requires managers to know what this tolerable density is and how often and how intensively they have to intervene to keep to it.

4.4.1 Setting target densities

The relationship between beaver damage or the ability of current damage to recover and beaver density is unknown – but we suspect the latter target density is near to zero. If this is the case then local extirpation and frequent removal of immigrants is the appropriate strategy.

4.4.2 Identifying priority areas

The cost to achieve local extirpation can be estimated or learnt from experience (see section 4.2) but the cost of managing immigrants is costly and ongoing. Therefore, for a fixed annual budget of less than the annual budget required for eradication (otherwise the aim should be eradication) managers cannot afford to sustain control everywhere. The question then becomes where should sustained control be undertaken?

We have no answer to this. First it depends on who pays and so who benefits, and second it depends on the values being protected. For biodiversity values, managers might set priorities based on representativeness (= where are the best areas to be protected representing different habitat types?), or on tenure (= should national park areas take priority?), or on public perception (= where is the damage most visible?).

4.4.3 Species based or site based?

Priorities might be set entirely on the above criteria for beavers – a beaver control plan. However, another planning paradigm is to select the best sites and manage all the threats at these places, i.e. beavers plus other invasive species. This optimises the conservation benefits at the chosen sites, but for a fixed budget means fewer sites are managed than when beavers alone were the target.

4.4.4 Options for sustained control project management

Management for sustained control requires long-term commitment, and so can only be done by the landowner or land management agency. The key here is not so much the personnel – they come and go – but the commitment within annual budgeting by the relevant funding agency. This is a critical issue for many sustained control operations around the world, especially when funded by agencies with many problems and limited budgets.

Unless priority sites straddle the border there is no critical reason for binational coordination to conduct sustained control.

4.4.5 Estimated costs of sustained control

The unit costs (removal of all or most beavers from a colony and the ongoing costs to keep intervening) are known, i.e. about 6 hunter-days plus operating costs, so the overall cost of sustained control can either be set by the number of sites to manage or the number of sites managed can be set by the annual budget.

4.5 Commercial harvesting

4.5.1 Current state of the industry

The project to encourage commercial harvesting of fur species and products in Chile and Argentina effectively began in 2005 and trained 276 hunters and provided them with traps (Table 5). In total 303 people gained some employment out of the programme at a total cost for the Chilean component over 3 years of US\$643,000.

The 11 700 beavers killed represents an annual harvest of c. 10% of the population assuming a total population of about 65 000 beavers (13 000 colonies with an average of 5 beavers per colony). Beavers are easily capable of replacing this annual harvest if conditions permit a positive rate of increase. However, as most harvesting is constricted to accessible areas, it is likely that the fur industry has had a significant effect on populations in these areas.

Table 5 Results of the Chilean programme to encourage commercial exploitation of beavers (and other exotic species) as a means of controlling numbers, 2005–2006.

Activity	Results
No. trappers trained (2004–2007)	276
No. trained trappers active in 2005, 2006	45, 30
No. trained trappers active full time	11
No. craftspeople trained	45
No. commercial fur buyers	5
No. beaver traps, snares purchased	1150 Conibear 330, 1500 snares
No. beavers killed	11 700
Monthly average income for an active trapper	US\$187
Monthly range of incomes for active trappers	US\$16 to US\$1,084
Costs to government: 1. Traps provided	US\$118,000
2. Training costs	US\$ 59,550
3. Bounties and payments for fur	US\$226,155

Data for the Argentine programme are incomplete but they provided 1700 Conibear traps to trappers and paid bounties of US\$5 each for 14 000 beaver tails between 2001 and 2003 and 3600 tails between 2006 and 2007 (the latter being accurate tallies) (A. Schiavini, pers. comm.).

The effects of an eradication campaign on the component of the fur industry relying on beavers would be (a) many of the trappers would find jobs as hunters in the campaign at competitive wages, (b) the fur buyers would lose that part of their income from beaver fur either because the EU banned them if leghold traps were used or as beavers were eliminated from accessible areas, and (c) the craftspeople would have to rely on other skins and fur as the supply of beavers declined.

4.5.2 Harvesting as a control tool

Commercial exploitation of pest mammals has rarely achieved sustained population

reductions, let alone local elimination or eradication unless some bioeconomic conditions are met (Parkes 2006). These include:

- The value of the animals increases exponentially as their abundance declines linearly. The increase can be market or subsidy-driven.
- The animals are taken as bycatch when some more abundant species is the primary target that sustains the harvesting industry.
- The harvesters must compete and have access to the whole target population. Otherwise a hunter with an exclusive hunting area may harvest from a maximum sustained yield density (about half carrying capacity or more) which is unlikely to achieve pest management goals. Under other circumstances when the rate of increase of the target population is lower than the bank discount rate it pays to harvest to economic extinction (as with the whaling industry of old) and invest the profits elsewhere (Clark 1990).

For beavers in Tierra del Fuego, none of the above applies and the cost of access to remote areas seems to be one key factor limiting the profitability of fur harvesting, so the control campaigns were at best successful only in areas where hunters had easy access (Fafard & Lafrance 1997). In some respects, the development of a harvesting industry is more of a hindrance than a help if eradication is to be attempted.

4.6 Do nothing

The final option is to do nothing. This is unlikely to be a realistic option given current official and public concerns. Under both the sustained control and commercial harvesting options, nothing is done at most sites because they are of low priority and unaffordable, or too remote and not worth the effort, respectively.

5. Main Conclusions and Recommendations

5.1 Justification for beaver control

Beavers adversely affect biodiversity in Tierra del Fuego by engineering changes to the fluvial environment and by killing riparian forest trees. Beavers also negatively affect the economy of Tierra del Fuego particularly where their dams affect roads and cattle ranching.

Beavers continue to impose economic costs to infrastructure in Tierra del Fuego. The costs to repair roads and culverts affected by the engineering of beavers are estimated at up to about US\$4 million per year, judging by the known costs for some years in parts of Chile. Other costs to agriculture, forestry and salmonid fisheries are relatively minor – although can be of considerable nuisance to individual land and business owners.

Beavers have also invaded the mainland of South America and unless this population is removed they will expand their range into the continent and greatly expand the biodiversity and economic costs to Chile and Argentina.

Beavers have some positive economic value when commercially exploited by fur and meat harvesters, who are also subsidised by governments to promote the harvest as a potential

control tool, and to the tourist industry who provide opportunities to view beavers. These benefits do not outweigh the costs.

5.2 Management options

5.2.1 Removal from the mainland

Eliminating the current population on the mainland is of highest priority and urgency, either as a stand-alone strategy or as the first step in an attempt at wider eradication. An attempt to do this by removing the beavers on the Brunswick Peninsula and Dawson Island, and creating buffers on Isla Grande, is being made by the Chilean government over the next 3 years (2007–2009). The budget available for this project is US\$2.18 million. This report notes the implications of this project for the wider management of beavers in Tierra del Fuego. These include brief comments on:

- The risks of ongoing establishment of beavers on the mainland, and on the management of buffers on the adjacent islands.
- Some recent developments from other pest eradication operations on search and detection practices that allow managers to measure the probability that lack of detection equals lack of animals, for both this removal strategy and for any wider attempt at eradication.
- How the ongoing project in Chile might be used for training and learning and how it might evolve into an eradication attempt over the whole of Tierra del Fuego.

Whatever the outcome of the attempt to remove beavers from Brunswick Peninsula (and perhaps from Dawson Island) by the planned date of late 2009, the binational committee should initiate a review of the implications for the wider attempt at eradication in all Tierra del Fuego, not least in terms of when the latter should start.

5.2.2 Eradication from Tierra del Fuego

Eradication of all beavers from South America is possible, but difficult because of several factors that will have to be resolved as a project operational plan is developed. The main issues to consider are:

(a) Progress in the Chilean project to remove beavers from Brunswick Peninsula and Dawson Island.

(b) A commitment over at least 9 years beginning in 2008 will be required to achieve eradication. We estimate the first phase to plan and set up the eradication infrastructure would take 2 years, depending on the lessons from (a) above. The second phase to cover all of Tierra del Fuego zone-by-zone to reduce beaver populations to near zero (and provisionally declare eradication) would take 5 years. A third phase of active surveillance to either confirm this or to find and kill survivors would take a further period, out to about 2016 depending on results and the level of risk managers are prepared to take. Passive or ad hoc surveillance would continue. The estimated cost for the second phase is over US\$33 million.

(c) A substantial goal-focused governance and project management structure will be required to deliver the binational outcomes required to achieve eradication. We estimate about 60 field staff, 8 project management and operational management staff, plus contracted staff for technical services such as helicopters will be required.

(d) Technically, the ability to guarantee the efficient removal of 100% of beavers from each colony will have to be developed. Removal at this scale is entirely feasible and the techniques to do so are well known from other places and from small-scale control in Chile and Argentina. This will require access to all suitable, legal control tools (including foothold

traps whose use is currently restricted by European Union regulation for fur harvesting – and thus with implications for the current fur harvest industry in Tierra del Fuego), and change at all levels of management from a ‘harvesting’ or ‘control’ mind-set to one of eradication. This latter change is a common necessity in other large-scale eradications. It is not the number killed that counts, it is the number left!

(e) The ability to scale this colony-by-colony removal up to whole catchments, larger management zones, and whole islands. The ability to scale up is also feasible but has many uncertainties and risks that would need to be managed. These include the currently unknown costs and effort to:

- Detect and kill beavers at low densities, i.e. of animals remaining after the initial control, or immigrants back into areas thought to be cleared of beavers, or beavers at the edge of the range
- Management of non-target risks and the perception of these risks
- Ensuring access to land of all tenures
- Ensuring the risk of releases of beavers into areas from which they have been cleared is zero

This report expands on some of these issues but their resolution will usually require either more detailed consideration when decisions are made on project management structures, when operational plans are developed (e.g., the costs), or by adaptive management during the operations.

5.2.3 Sustained control

If eradication is not possible beavers might be managed in perpetuity by a sustained control strategy. This requires an initial control effort to reduce beaver numbers to some low density (or even zero at the targeted site) followed by periodic maintenance control to keep the beavers below some density at which their impacts are tolerable. Understanding relationships between beaver densities and their impacts is essential to determine what densities are ‘tolerable’, and the rates of recovery of controlled populations must be known to determine how often to apply the maintenance control.

The ongoing costs of sustained control usually mean that this strategy can only be effectively conducted in limited areas. Selection of these areas depends on the conservation values to be protected or on the economic damage being suffered, i.e. managers must set priorities.

If eradication is not possible, the strategy to remove beavers from the mainland becomes a sustained-control option. The target is zero density with ongoing control to manage immigrants.

5.2.4 Commercial exploitation

Commercial exploitation may be seen as an end in itself with a sustained harvest taken from beaver populations maintained for that purpose, or as a control tool integrated into a sustained control strategy. By itself, commercial exploitation of beavers has not been an effective control tool in Tierra del Fuego, partly because the effort is restricted to areas close to roads, although at these places it may alleviate some of the problems beavers cause to roading infrastructure.

Integrating commercial harvesting with an eradication strategy is contentious. Eradication success would end commercial harvesting and it is not economically rational for harvesters to expend the unprofitable effort required to kill the last beavers in an area.

5.3 Other issues

Beavers are not the only invasive pests present in Tierra del Fuego and control of these animals and pests should be considered as consequence of any large-scale management of beavers. The substantial capacity in management and field expertise developed in any attempt to eradicate beavers should be retained and utilised to manage other threats in Tierra del Fuego.

Removal of beavers from Tierra del Fuego may not by itself fully restore the damaged ecosystems either because of the actions of other exotic animals such as cattle and horses, or because of the inability of the forest species to regenerate in the modified habitats. Managers should use the opportunity of any beaver management operation to plan for wider ecosystem restoration goals.

5.4 Main conclusions

Eradication of beavers from Tierra del Fuego is justified both to guarantee beavers will not spread onto mainland South America, and because of the damage they do to biodiversity and economic values within their current range.

Eradication of beavers is feasible in Tierra del Fuego providing all legal tools are available to guarantee complete removal at each 'unit of management' – the individual beaver colony, and that Chile and Argentina can develop a suitable project management structure to apply these tools at the large scale required within a time frame that funding agencies will accept and commit to. Some risks of failure, such as the ability to access beavers on lands of all tenures, must be resolved before eradication is attempted. Other risks of failure, such as the ability to manage reinvasions into areas cleared of beavers, will have to be tested as operations proceed.

6. Acknowledgements

We thank Fernanda Menvielle and Barbara Saavedra for hosting our team in Argentina and Chile and for many useful inputs. We also thank all those people who took time to meet with us during the field trip (Appendix 1). We thank Bruce Warburton and Andrea Byrom for comments on drafts of this report, Christine Bezar for editorial help, and the ISSG referees (x and y) for their comments.

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Appendix 1 Meetings with agencies and stakeholders, 15–26 October 2007

Day		Participants	Affiliations
Monday 15	Coordination meeting with Argentinean Project Managers	Fernanda Menvielle (FM)	National Parks Administration Argentina
Tuesday 16	Flight to Ushuaia, Tierra del Fuego, Argentina Coordination meeting with Tierra del Fuego Project Managers	Adrián Schiavini	Director, Center for Austral Research (CADIC) from Argentinean Commission for Scientific and Technical Research (CONICET)
		Laura Malmierca	Field manager of National Park Administration, Tierra del Fuego
		Daniel Ramadori	Director, National Fauna Direction Argentina
Wednesday 17	Meeting with local stakeholders from Public and Private sectors	Diego Valenzuela	Fauna Department, Tierra del Fuego, Provincial Government
		35 attendees	Natural Resources Sub secretary, Tierra del Fuego Government Natural Resources Sub Secretary, Fauna Department Tourism Guide Association Tierra del Fuego, Environmental Direction Tierra del Fuego, Protected Areas Direction Tierra del Fuego, Forest Direction Tierra del Fuego, Productive Development Program Office Natural Resource Press Tierra del Fuego Policy Army Local Social NGOs National Fauna Direction Argentine Federation for Fauna Commercialisation National Parks Administration Fauna Direction from Rio Grande
		Trappers	
Thursday 18	Visit to Tierra del Fuego National Park	Consultants and local managers	
	Internal update and planification		
	Visit and meeting in Tolhuin, another county of Tierra del	17 attendees	Local trappers Fur business people Farmers

Day		Participants	Affiliations
Friday 19	Fuego		Development and Pacification Secretary of Tolhuin Community Government's Secretary Tolhuin Community Civil Association of Drug Addicts National Fauna Direction Fauna Direction from Rio Grande Local veterinarian Fauna Direction Ushuaia Owner of a local aquaculture business CADIC
	Visit to areas with long-term beaver management		
	Overflight of Tierra del Fuego (TdF) Argentina, including Isla Navarino in Chile Internal Update and planification	Consultants and local managers	
Saturday 20	Meeting in Rio Grande, second largest city in TdF Argentina	15 attendees	Local trappers Fur business people Farmers Local NGOs Manager of Protected area Students
	Travel to Tierra del Fuego, Chile Internal update and planification	Consultants and local managers	
Sunday 21	Visit to Tierra del Fuego, Chile, including Karukinka, WCSs private protected area Overflight in Tierra del Fuego, Chile	Local stakeholders	Local trapper, Mark Kniprath Karukinka Park rangers Military Force Local Police
	Travel to Punta		

Day		Participants	Affiliations
Monday 22	Arenas Internal update and planification Technical Meeting with local representatives of public, private, academic stakeholders	Consultants and local managers 15 attendees	National Forest Service University Magallanes National Livestock and agricultural service Marine GEF project National Oil Company Environmental Consultant National Environmental Commission Agricultural Research Institute Tourism Companies Local NGO

Appendix 2 Government agencies with accountabilities in any plan to eradicate beavers in Chile and Argentina

1. Chile (prepared by Claudia Silva)

Instituciones y marco legal para la implementación de un proyecto de erradicación del castor (*Castor canadensis*) en la Patagonia.

Se resumen las principales instituciones con injerencia en el desarrollo de un programa de erradicación del castor en la Patagonia Chilena y se detalla en que aspectos específicos de su funcionamiento tendrían un rol en el programa.

Servicio Agrícola y Ganadero (SAG):

El SAG, por disposición de su Ley Orgánica, tiene el mandato de ‘proteger y mejorar la condición de estado de los recursos productivos silvoagropecuarios en sus dimensiones sanitaria, ambiental, genética y geográfica (...)’.

De sus objetivos estratégicos, los que se relación con el eventual programa de erradicación serían:

Mantener y mejorar la situación fito y zoonosanitaria nacional (...), mediante la vigilancia, mitigación al ingreso de enfermedades exóticas, de plagas cuarentenarias y de especies invasoras, el manejo de emergencias y el control de plagas y enfermedades de importancia económica, de acuerdo a las prioridades de la política silvoagropecuaria del país.

Proteger, mantener y acrecentar el estado y la condición de los recursos naturales renovables, base de la producción agropecuaria, el medio ambiente y la biodiversidad asociada que la conforman, asegurando a través de su manejo y utilización su sustentabilidad.

Por otro lado, la Ley de Caza y su Reglamento regulan la caza, captura, crianza, conservación y utilización sustentable de animales de la fauna silvestre, a excepción de las especies y los recursos hidrobiológicos. En el Reglamento de la Ley de Caza se define a las especies dañinas como las que “causan perjuicios graves a actividades humanas o a los ecosistemas”. Para estas especies se permite su caza durante todo el año y otras actividades como la destrucción de madrigueras y uso de diversas técnicas de caza. Se entrega un listado de las especies consideradas dañinas, entre las que está el castor (*Castor canadensis*) y otras especies invasoras de Patagonia como el visón (*Mustela vison*), la rata almizclera (*Ondatra zibethicus*). Para cazar es necesario poseer un carné de caza, entregado por el SAG.

En la Ley de Protección Agrícola se define como plaga a ‘cualquier organismo vivo que, por su nivel de ocurrencia y dispersión, constituya un grave riesgo para el estado fitosanitario de las plantas o sus productos’ y denomina al SAG como el organismo que determina las plagas que estarán sujetas a control obligatorio. El SAG tiene responsabilidad directa en prevenir, combatir, controlar y erradicar las enfermedades y plagas declaradas de control obligatorio. Asimismo, esta Ley, en su artículo 3º, obliga a los propietarios de los terrenos invadidos por la plaga a implementar medidas de prevención, control o erradicación.

Es importante señalar que en casos de especies dañinas que tengan un efecto principalmente

sobre los recursos naturales renovables y sólo secundariamente sobre la actividad agropecuaria, el SAG considera de importancia su control pero no urgentes. Las estrategias y medidas a tomar serán del orden del mediano a largo plazo.

Comisión Nacional del Medio Ambiente (CONAMA):

Es responsabilidad de CONAMA, actuar como un servicio de consulta, análisis, comunicación y coordinación en materias relacionadas con el medio ambiente, según lo dispuesto en la Ley 19.300, Ley de Bases sobre el Medio Ambiente.

CONAMA debe proponer al Presidente de la República políticas para la gestión ambiental. Además CONAMA es el organismo encargado de ‘coordinar a los organismos vinculados con el apoyo internacional a proyectos ambientales y, junto con la Agencia de Cooperación Internacional del Ministerio de Planificación y Cooperación, MIDEPLAN, ser contraparte en proyectos ambientales con financiamiento internacional’.

Por último, CONAMA administra el Sistema Nacional de Evaluación de Impacto Ambiental (SEIA), al cual deben ingresar obligatoriamente tipos determinados de proyectos, detallados en la Ley 19.300. A modo de ejemplo, si el programa de erradicación de castor incluyera caza y trampeo en áreas silvestres protegidas, entraría obligatoriamente al SEIA, presentando una Declaración o un Estudio, dependiendo de las características específicas del proyecto, también detalladas en la Ley 19.300.

Corporación Nacional Forestal (CONAF):

El rol de CONAF, en términos generales, ‘contribuir al desarrollo del país a través de la conservación del patrimonio silvestre y el uso sostenible de los ecosistemas forestales’.

CONAF administra el Sistema Nacional de Áreas Protegidas del Estado (SNASPE), por lo que cualquier actividad realizada dentro de un área protegida debe ser comunicada y autorizada por ellos.

Uno de los objetivos estratégicos de CONAF es ‘proteger los ecosistemas forestales de los agente y procesos dañinos tales como el fuego, la desertificación y otras formas de deterioro’. Este objetivo se puede relacionar directamente con un eventual programa de erradicación del castor, ya que éste produce daño y muerte del bosque nativo. Asimismo, tiene como objetivo ‘fortalecer la participación de la ciudadanía y de los actores locales asociados a las áreas silvestres protegidas y los ecosistemas forestales (...)’, por lo que podría tener un rol en fomentar la participación de todos los diversos actores locales asociados a un proyecto de erradicación.

Fuentes:

Soto N 2007. El SAG y su competencia con especies invasoras. III Reunión Binacional de Ecología. Septiembre-Octubre 2007.

Oficial websites of SAG (www.sag.cl), CONAMA (www.conama.cl), CONAF (www.conaf.cl).

2. Argentina (prepared by Fernanda Menvielle, Laura Malmierca, Nora Loeckemeyer and Daniel Ramadora)

1. Normativa Internacional

CONVENIO SOBRE DIVERSIDAD BIOLÓGICA (Río de Janeiro, 1972).

La República Argentina lo ratificó mediante **Ley Nacional 24.375**. Este convenio internacional tiene por objetivo la conservación de la diversidad biológica, la utilización sostenible de sus componentes y la participación justa y equitativa en los beneficios que se deriven de la utilización de los recursos genéticos.

Su artículo n° 8.h indica que cada uno de las partes firmantes impedirá que se introduzcan, controlará o erradicará las especies exóticas que amenacen a ecosistemas, hábitats o especies nativas y establecerán las normativas que fueren necesarias para la protección de los recursos. Dicho convenio indica que el manejo de especies exóticas requiere una aproximación integral que abarque la prevención, la erradicación, el control y la mitigación." Además, la Conferencia de las Partes, en su Decisión VI/23, reafirma la prioridad de la aplicación de este artículo debido a que "los riesgos pueden aumentar debido al incremento del comercio mundial, el transporte, el turismo y el cambio climático" y establece unos principios rectores para la prevención, introducción y mitigación de impactos de las especies exóticas invasoras

CONVENCIÓN DE BONN (Convención sobre la Conservación de las Especies Migratorias de Animales Silvestres, CMS)

Promovida por el Programa de las Naciones Unidas para el Medio Ambiente (UNEP), esta convención tiene como objetivo la conservación de las especies migratorias a través de toda su área de distribución geográfica.

Las partes firmantes se comprometen, en su artículo n° III.4.c, a proteger las especies migratorias en peligro "inclusive controlando estrictamente la introducción de especies exóticas, o vigilando o eliminando las que hayan sido ya introducidas"

TRATADO ENTRE LA REPUBLICA DE CHILE Y LA REPUBLICA DE ARGENTINA SOBRE MEDIO AMBIENTE

Aprobado por la Ley Nacional 24.105 el 01/07/1992 publicada en el Boletín Oficial el 04/08/1992. Ver texto completo en Anexo I

Su objetivo general es: emprender acciones coordinadas o conjuntas en materia de protección, preservación, conservación y saneamiento del medio ambiente e impulsarán la utilización racional y equilibrada de los recursos naturales, teniendo en cuenta el vínculo existente entre medio ambiente y desarrollo.

Aspectos relevantes:

A través de la firma de este Tratado, Chile y Argentina coinciden en que las políticas ambientales deben estar al servicio del hombre. En el marco de esas políticas debe prestarse particular atención a las poblaciones autóctonas.

Chile y Argentina deberán llevar a cabo acciones coordinadas o conjuntas principalmente en los siguientes sectores:

- Protección de la atmósfera: cambios climáticos, deterioro de la capa de ozono y contaminación atmosférica transfronteriza.
- Protección del recurso suelo: degradación de los suelos, desertificación y sequía.
- Protección y aprovechamiento del recurso agua.
- Protección del medio ambiente marino.
- Protección de la diversidad biológica
- Prevención de las catástrofes naturales y ecológicas.
- Tratamiento de desechos y productos nocivos.
- Efectos ambientalmente negativos de las actividades energéticas, mineras e industriales.
- Prevención de la contaminación urbana.
- Protección al medio ambiente antártico.

Además, las Partes acordaron constituir, en el ámbito de la Comisión Binacional Chileno - Argentina de Cooperación Económica e Integración Física (1984), una Subcomisión de Medio Ambiente para promover, coordinar y efectuar el seguimiento de la ejecución del Tratado y de sus Protocolos adicionales.

EL Tratado cuenta con diferentes Protocolos, uno sobre la Protección del Medio Ambiente Antártico que tiene como objetivo promover la conservación de los valores naturales y culturales del medio ambiente antártico, mediante las acciones apropiadas de protección de las áreas designadas, la conservación y restauración de los sitios y monumentos históricos, la observancia de las normas de conducta adoptadas para este fin en el marco del Tratado Antártico y la difusión de los valores intrínsecos de la Antártica. El segundo Protocolo trata los Recursos Hídricos Compartidos, con el objeto de establecer reglas sobre el aprovechamiento de estos recursos compartidos, calificados como prioritarios por ambas Partes. Estas convienen en que las acciones y programas relativos al aprovechamiento de los recursos hídricos compartidos se emprenderán conforme al concepto de manejo integral de las cuencas hidrográficas.

Protocolo específico de fauna y flora silvestre compartida entre Chile y Argentina.

Considerando que, de acuerdo con el artículo 2 del Tratado entre la República Argentina y Chile sobre Medio Ambiente, suscrito en Buenos Aires el 2 de agosto de 1991, las Partes llevarán a cabo acciones coordinadas o conjuntas para la protección de la diversidad biológica;

Considerando que uno de los objetivos del Protocolo Específico Adicional sobre la Conservación de la Flora y Fauna Silvestre compartida entre la República Argentina y la República de Chile (PEACFFC), suscrito en Santiago el 2 de mayo de 2002, es favorecer la conservación y restauración de los ecosistemas donde habita la flora y fauna silvestre compartida; y que con tal fin las Partes acuerdan elaborar y ejecutar programas y proyectos específicos de conservación, y uso sustentable de la flora y la fauna silvestre y de sus habitats

(armonizando los criterios ecológicos, sociales, económicos y culturales), y realizar cualquier otra actividad (que se acuerde entre las Partes), que tienda al cumplimiento de los objetivos del referido Protocolo;

REGLAMENTO (CEE) No 3254/91 DEL CONSEJO DE LAS COMUNIDADES EUROPEAS

Establecido el 4 de noviembre de 1991, prohíbe el uso de cepos en la Comunidad y la introducción en la Comunidad de pieles y productos manufacturados de determinadas especies animales salvajes originarias de países que utilizan para su captura cepos o métodos no conformes a las normas internacionales de captura no cruel.

En su artículo 3º apartado 1 establece: A partir del 1 de enero de 1995, quedará prohibida la introducción en la Comunidad de pieles de las especies animales enumeradas en la lista que figura en el Anexo I, así como de los demás artículos citados en el Anexo II siempre y cuando incluyan pieles de las especies mencionadas en el Anexo I.

Anexo I

Lista de especies contempladas en el apartado 1 del artículo 3: Castor: *Castor canadensis*, Nutria: *Lutra canadensis*, Coyote: *Canis latrans*, Lobo: *Canis lupus*, Lince: *Lynx canadensis*, Lince rojo: *Felis rufus*, Marta cibelina: *Martes zibellina*, Mapache: *Procyon lotor*, Rata almizclera: *Ondatra zibethicus*, Pekán: *Martes pennanti*, Tejón: *Taxidea taxus*, Marta: *Martes americana*, Armiño: *Mustela erminea*.

2. Normativa Nacional

Ley Nacional No 22.421 CONSERVACIÓN DE LA FAUNA:

Legisla sobre los aspectos relacionados a la Fauna Silvestre en jurisdicción nacional. Esta norma expresa que “Todos los habitantes de la Nación tienen el deber de proteger la fauna silvestre, conforme a los reglamentos que para su conservación y manejo dicten las autoridades de aplicación”. La Dirección de Fauna Silvestre (DFS) de la Secretaría de Ambiente y Desarrollo Sustentable es la autoridad de aplicación en jurisdicción nacional y en lo referente al tránsito y comercialización interprovincial. Las direcciones de fauna de las provincias son las autoridades de aplicación a nivel provincial.

Asimismo, la autoridad nacional de aplicación queda facultada para otorgar subsidios a las provincias que se adhieran al régimen de la presente ley, para contribuir a la instalación y funcionamiento de las áreas de protección previstas en el artículo 19 inciso a), así como para las tareas de investigación, conservación y manejo de la fauna silvestre autóctona a realizarse en los respectivos territorios.

Además serán funciones de la autoridad nacional de aplicación en los lugares sujetos a su jurisdicción exclusiva:

- a) Ejecutar la política nacional establecida en esta Ley
- b) Fijar los programas inherentes a la fauna silvestre.

- c) Ejercer la administración y el manejo de la fauna silvestre.
 - d) Reglamentar el ejercicio de las actividades cinegéticas.
 - e) Fiscalizar la posesión, comercio, tránsito, transformación y producción de animales de la fauna silvestre, sus productos, subproductos y derivados, manufacturados o no.
- Decreto Nacional 666/97* (Decreto Reglamentario sobre Conservación de la Fauna Silvestre). Trata sobre la Protección y conservación de la fauna silvestre y su aprovechamiento racional. Importación, exportación y comercio interprovincial. Infracciones administrativas - Decomisos.

Resolución SAyDS N° 91/03. Estrategia Nacional para la Biodiversidad de la Argentina:

VIII. Prevención y control de especies exóticas e invasoras
 Prevé la aplicación del principio de precaución, según el cual toda introducción se presupone potencialmente perjudicial para el ambiente, la diversidad biológica, la calidad de vida y las distintas actividades humanas; establecer severas restricciones a la importación e introducción voluntaria o accidental de nuevas especies exóticas al país; fortalecer los mecanismos de control del tráfico de especies vivas, incluyendo los aspectos fito y zoonosanitarios, y exigir la evaluación previa de riesgos e impactos involucrados en la introducción de nuevas especies al país; crear conciencia en el ámbito de los distintos sectores de la comunidad sobre los riesgos y perjuicios derivados de la introducción voluntaria o accidental de especies exóticas; desarrollar programas para revertir o mitigar los efectos negativos ocasionados por las especies ya establecidas.

Para prevenir introducciones involuntarias o accidentales nuevas al país, se prevé el fortalecimiento de los mecanismos de control fito y zoonosanitarios aduaneros, desarrollo de cuarentena, analizando el riesgo de introducciones accidentales de patógenos y de organismos asociados a organismos vivos, productos derivados u otras vías y realizando una adecuada fiscalización y verificación taxonómica de las introducciones.

Insta a establecer mecanismos de detección y control temprano sobre especies exóticas nuevas, y revertir o mitigar los efectos negativos ocasionados por las especies exóticas ya establecidas.

Ley 22.351 Régimen legal de los Parques Nacionales, Monumentos Nacionales y Reservas Nacionales: su artículo 5° inciso g, prohíbe la introducción, transplante y propagación de fauna y flora exótica en los Parques. En el artículo 18, inciso e la misma Ley contempla el: “permitir la caza y pesca deportiva de las especies exóticas dentro de las áreas del sistema de la ley, cuando existan razones de orden biológico, técnico o científico que las aconsejen, así como la erradicación de las mismas especies, cuando ello resulte necesario en virtud de las razones enunciadas”.

Reglamento para la Protección y Manejo de Fauna Silvestre en Jurisdicción de la Administración de Parques Nacionales (Resolución H.D. N° 157/91). Esta reglamentación específica de la APN sobre fauna silvestre define la caza de control como aquella que se realiza con el fin primario de eliminar o disminuir las poblaciones de especies introducidas o exóticas para eliminar o disminuir su impacto negativo sobre el medio natural.

Plan de Gestión Institucional de la Administración de Parques Nacionales (2001) expresa que “Dentro de las áreas protegidas de jurisdicción nacional la invasión de especies exóticas se reconoce como un problema grave, debiendo evitarse la introducción de nuevas especies y el incremento de la distribución de las existentes”, y agrega que “Para los casos ya

detectados se deberán diseñar y ejecutar programas de control o erradicación cuando ello sea factible ecológicamente y socialmente justificable”

Lineamientos estratégicos para el manejo de Especies Exóticas en la Administración de Parques Nacionales (Resolución HD 172/2007): proporcionan el marco conceptual, fundamentos y estrategias para el desarrollo de los planes de manejo de especies exóticas en las áreas protegidas de jurisdicción nacional.

Reglamento de Evaluación de Impacto Ambiental de la Administración de Parques Nacionales (Resolución N° 16/94, Resolución N° 164/98). Establece la obligación de realización de una evaluación ambiental para las actividades u obras que se desarrollen en áreas sujetas al régimen de la Ley N° 22.351, o que se encuentren administradas por la APN. La aplicación de este reglamento alcanza a los proyectos públicos o privados, concernientes a obras, instalaciones, prestaciones de servicios (por ejemplo actividades turísticas), aprovechamiento de recursos, u otras actividades de investigación y manejo.

Los estudios e informes ambientales se usan como instrumento para: a) una evaluación de la factibilidad y conveniencia de ejecutar las obras o actividades que se propongan, b) minimizar los impactos ambientales negativos consecuentes de las actividades u obras, y c) prevenir los impactos ambientales negativos que puedan producir los proyectos.

Se establecen tres niveles de profundidad para las evaluaciones ambientales:

- 1) Informe Medioambiental (IMA),
- 2) Informe de Impacto Ambiental (IIA),
- 3) Estudio de Impacto Ambiental (EIA)

LEY 20.429 DE ARMAS Y EXPLOSIVOS Y SU DECRETO REGLAMENTARIO Decreto Nacional 395/75: es de aplicación en todo el territorio de la Nación. Clasifica las armas de uso permitido en la Argentina, usuarios y permisos.

Todos los actos a que se refieren esta ley que comprendan material clasificado como "armas de guerra", así como la importación de "armas de uso civil y los actos comprensivos de polveras, explosivos y afines, serán fiscalizados y supervisados por el Ministerio de Defensa. Tal fiscalización será ejercida en lo referente a "armas de guerra" e importación de "armas de uso civil", por intermedio del Registro Nacional de Armas; y en lo relativo a pólvoras, explosivos y afines por la Dirección General de Fabricaciones Militares. Los demás actos que comprendan material clasificado como "armas de uso civil", serán fiscalizados por las autoridades que determina el artículo 29 de esta ley, bajo la supervisión del Ministerio de Defensa por intermedio del Registro Nacional de Armas.

A los fines de esta ley, los materiales se clasificarán en las siguientes categorías: 1) Armas de guerra, 2) Pólvoras, explosivos y afines, 3) Armas de uso civil. En las categorías 1) y 2), se determinarán las "de uso exclusivo para las instituciones armadas", las "de uso para la fuerza pública", las "de uso civil condicional", las "de usos especiales" y las "de uso prohibido".

A los efectos de la aplicación de las disposiciones del Decreto-Ley N. 20.429/73 y de su reglamentación se establecen las siguientes definiciones: 1) Arma de fuego: La que utiliza la energía de los gases producidos por la deflagración de pólvoras para lanzar un proyectil a

distancia. 2) Arma de lanzamiento: La que dispara proyectiles autopropulsados, granadas, munición química o munición explosiva. Se incluyen en esta definición los lanzallamas cuyo alcance sea superior a tres metros. 3) Arma portátil: Es el arma de fuego o de lanzamiento que puede ser normalmente transportada y empleada por un hombre sin ayuda animal, mecánica o de otra persona. 4) Arma no portátil: Es el arma de fuego o de lanzamiento que no puede normalmente ser transportada y empleada por un hombre sin la ayuda animal, mecánica o de otra persona. 5) Arma de puño o corta: Es el arma de fuego portátil diseñada para ser empleada normalmente utilizando una sola mano, sin ser apoyada en otra parte del cuerpo. 6) Arma de hombro o larga: Es el arma de fuego portátil que para su empleo normal requiere estar apoyada en el hombro del tirador y el uso de ambas manos. 7) Arma de carga tiro a tiro: Es el arma de fuego que no teniendo almacén o cargador, obliga al tirador a repetir manualmente la acción completa de carga del arma en cada disparo. 8) Arma de repetición: Es el arma de fuego en la que el ciclo de carga y descarga de la recámara se efectúa mecánicamente por acción del tirador, estando acumulados los proyectiles en un almacén cargador. 9) Arma semiautomática: Es el arma de fuego en la que es necesario oprimir el disparador para cada disparo y en la que el ciclo de carga y descarga se efectúa sin la intervención del tirador. 10) Arma automática: Es el arma de fuego en la que, manteniendo oprimido el disparador, se produce más de un disparo en forma continua. 11) Fusil: Es el arma de hombro, de cañón estriado que posee una recámara formando parte alineada permanentemente con el ánima del cañón. Los fusiles pueden ser de carga tiro a tiro, de repetición, semiautomáticos y automáticos (pueden presentar estas dos últimas características combinadas, para uso opcional mediante un dispositivo selector de fuego). 12) Carabina: Arma de hombro de características similares a las del fusil, cuyo cañón no sobrepasa los 560 mm. de longitud. 13) Escopeta: Es el arma de hombro de uno o dos cañones de ánima lisa, que se carga normalmente con cartuchos conteniendo perdigones. 14) Fusil de caza: Es el arma de hombro de dos o más cañones, uno de los cuales, por lo menos, es estriado. 15) Pistolón de caza: Es el arma de puño de uno o dos cañones de ánima lisa, que se carga normalmente con cartuchos conteniendo perdigones. 16) Pistola: Es el arma de puño de uno o dos cañones de ánima rayada, con su recámara alineada permanentemente con el cañón. La pistola puede ser de carga tiro a tiro, de repetición o semiautomática. 17) Pistola ametralladora: Es el arma de fuego automática diseñada para ser empleada con ambas manos, apoyada o no en el cuerpo, que posee una recámara alineada permanentemente con el cañón. Puede poseer selector de fuego para efectuar tiro simple(semiautomática). Utilizan para su alimentación un almacén cargador removible. 18) Revólver: Es el arma de puño, que posee una serie de recámaras en un cilindro o tambor giratorio montado coaxialmente con el cañón. Un mecanismo hace girar el tambor de modo tal que las recámaras son sucesivamente alineadas con el ánima del cañón. Según el sistema de accionamiento del disparador, el revólver puede ser de acción simple o de acción doble. 19) Cartucho o tiro: Es el conjunto constituido por el proyectil entero o perdigones, la carga de proyección, la cápsula fulminante y la vaina, requeridos para ser usados en un arma de fuego. 20) Munición: Designación genérica de un conjunto de cartuchos o tiros. 21) Transporte de armas: Es la acción de trasladar una o más armas descargadas. 22) Anima: Interior del cañón de un arma de fuego. 23) Estría o macizo: Es la parte saliente del rayado del interior del cañón de un arma de fuego. 24) Punta: Es el nombre que se asigna, entre coleccionistas, al proyectil de las armas de fuego. 25) Estampa de culote: Nombre dado por los coleccionistas al grabado efectuado en el culote de las vainas empleadas en cartuchos de armas de fuego.

En el ARTICULO 5 de la Reglamentación de esta Ley se indica que “A los fines de la ley y la presente reglamentación se considerará ARMAS DE USO CIVIL a las que, con carácter taxativo, se enuncian a continuación: 1) Armas de puño: a) Pistolas: de repetición o

semiautomáticas, hasta calibre 6,35mm. (.25 pulgadas) inclusive; de carga tiro a tiro, hasta calibre 8,1 mm. (.32 pulgadas), con excepción de las de tiro Magnum o similares. b) Revólveres: Hasta calibre 8,1 mm. (.32 pulgadas), inclusive, con exclusión de los tipos "Magnum" o similares. c) Pistolones de caza: de uno o dos cañones, de carga tiro a tiro calibres 14,2 mm. (.28), 14 mm. (.32) y 12 mm. (.36). 2) Armas de hombro: a) Carabinas, fusiles y fusiles de caza de carga tiro a tiro, repetición o semiautomáticos hasta calibres 5,6 mm. (22 pulgadas) inclusive, con excepción de las que empleen munición de mayor potencia o dimensión que la denominada ".22 largo rifle" (.22 LR), que quedan sujetas al régimen establecido para las armas de guerra. b) Escopetas de carga tiro a tiro y repetición: Las escopetas de calibre mayor a los expresados en el inciso 1, apartado c) del presente artículo, cuyos cañones posean una longitud inferior a los 600 mm. pero no menor de 380 mm. se clasifican como armas de guerra de "uso civil condicional", y su adquisición y tenencia se regirán por las disposiciones relativas a dicho material.

Son armas de guerra todas aquellas descriptas precedentemente que no se encuentren comprendidas en la enumeración de las "armas de uso civil" o hubieran sido expresamente excluidas del régimen de esta reglamentación.

Las armas de guerra que se clasifican como ARMAS, MATERIALES Y DISPOSITIVOS DE USO PROHIBIDO son: a) Las escopetas de calibre mayor a los establecidos en el inciso 2 apartado c) del artículo 5, cuya longitud de cañón sea inferior a los 380 mm. b) Armas de fuego con silenciadores. c) Munición de proyectil expansivo (con envoltura metálica sin punta y con núcleo de plomo hueco o deformable), d) de proyectil con cabeza chata, con deformaciones, ranuras o estrías capaces de producir heridas desgarrantes, en toda otra actividad que no sea la de caza o tiro deportivo. e)

Dispositivos adosables al arma para dirigir el tiro en la oscuridad, tales como miras infrarrojas o análogas. Asimismo se clasifican como ARMAS DE USO CIVIL CONDICIONAL: Las armas portátiles no pertenecientes a las categorías previstas en los incisos precedentes.

Según el Artículo 7 del Decreto Reglamentario quedan exceptuados del régimen de la reglamentación: a) Dispositivos portátiles, no portátiles y fijos destinados al lanzamiento de arpones, guías, cartuchos de iluminación o señalamiento y las municiones correspondientes. b) Armas portátiles de avancarga. c) Herramientas de percusión, matanza humanitaria de animales o similares y sus municiones.

En el Artículo 8° del CAP I de la Ley se indica que "El Ministerio de Defensa, por intermedio del Registro Nacional de Armas, podrá cuando lo considere conveniente, convocar a los particulares que tengan armas de cualquier categoría, en todo el país o parte de él, para que las presenten a las autoridades competentes, a efectos de realizar la inspección de aquéllas. La presentación se efectuará acompañando la documentación que acredite la tenencia. Para las pólvoras, explosivos y afines, la reglamentación respectiva preverá un régimen de inspecciones de carácter permanente, que comprenderá a todos los actos relacionados con esta ley."

En el Artículo 5° del CAP II dice que "Queda prohibido a todo buque o embarcación de bandera nacional o extranjera navegar armado o con cargamento de materiales clasificados de arma de guerra, en aguas de jurisdicción Argentina, sin patente de autoridad legítima o fuera de los casos determinados por esta ley y su reglamentación. La misma prohibición es

extensiva a las aeronaves que sobrevuelan el territorio nacional”.

En el Artículo 6° referido al tránsito internacional del material se indica que “el tránsito a través del territorio nacional con destino a otro país se efectuará previa autorización del Registro Nacional de Armas, de acuerdo con los convenios internacionales que existieran en la materia, sin perjuicio del cumplimiento de otras disposiciones que rijan al respecto”.

En el Artículo 7° referido al depósito del material se indica que éste se efectuará en los lugares que se hallen habilitados oficialmente a tal efecto.

En lo referido al transporte, embarque o cualquier otra forma de circulación, la Ley indica que se necesitará autorización previa y escrita del Registro Nacional de Armas. La autorización no será necesaria si el transporte se efectúa por un legítimo usuario, en la cantidad y forma que fije la reglamentación. La reglamentación establecerá las demás formalidades a cumplir por los interesados y las empresas de transportes.

En cuanto al material de uso prohibido, el Decreto Reglamentario de la Ley indica que: cuando por causas debidamente justificadas debiere utilizarse material comprendido en la clasificación de "uso prohibido", el organismo, institución o persona interesada deberá interponer por ante el Registro Nacional de Armas la solicitud de autorización para su adquisición con los motivos que la fundamentan y explicando en detalle el empleo a dar y cantidades requeridas. El Registro Nacional de Armas elevará dicha solicitud al Ministerio de Defensa, emitiendo opinión sobre la conveniencia o no de hacer lugar a la misma. Concedida por el Poder Ejecutivo la autorización y establecidas las condiciones de uso, el Registro Nacional de Armas verificará su cumplimiento dentro de los alcances determinados para cada caso.

En cuanto a los explosivos, la Ley indica que, los importadores, exportadores, fabricantes, usuarios y todo aquel que se dedique al comercio, industrialización y empleo de pólvoras, explosivos y afines, deberán inscribirse en el registro que organizará el Ministerio de Defensa de acuerdo con la reglamentación, la que determinará los requisitos y condiciones de la inscripción y documentación correspondiente.

El Decreto reglamentario indica que, todos los actos vinculados a la munición de armas de guerra, no reglamentados específicamente, quedan sometidos a los mismos recaudos que la presente reglamentación establece para estas últimas. Pero, el ARTICULO 115. aclara que no están comprendidos en lo dispuesto por el artículo anterior: 1) Munición para armas de guerra de calibre superior a 20 mm. 2) Munición explosiva. 3) Munición química. 4) Cartuchos para señalamiento, iluminación y lanza guías, para armas no portátiles.

El Artículo 21 del Decreto Reglamentario indica que la importación, exportación, fabricación, comercialización, tenencia y empleo de pólvoras, explosivos y afines sólo podrá ser realizada por agentes inscriptos en el registro establecido en el artículo precedente.

El Decreto Reglamentario indica que el almacenamiento de pólvoras, explosivos y afines debe efectuarse en locales previamente autorizados por el Ministerio de Defensa. La reglamentación determinará las condiciones de emplazamiento de los mismos y sus características, la cantidad máxima a depositar en cada uno de ellos, y toda otra exigencia de seguridad y vigilancia.

En cuanto a los traslados de cargamentos, los buques de matrícula nacional o extranjera que conduzcan cargamentos de armas o municiones con destino a puertos nacionales, o desde éstos hacia el exterior, podrán navegar en aguas jurisdiccionales argentinas, siempre que hayan sido previamente autorizados y sin perjuicio del cumplimiento de las demás disposiciones vigentes. Con la debida anticipación los capitanes y sus agentes deberán dar aviso a la autoridad marítima, la cual autorizará la navegación siempre que se realice de acuerdo a las normas reglamentarias aplicables, adoptando todas las medidas de seguridad pertinentes dentro de su jurisdicción. Igual recaudo se exigirá a las aeronaves con cargamento de armas o municiones, que regirán su entrada, salida y sobrevuelo en la jurisdicción nacional por las convenciones internacionales vigentes.

En cuanto al tránsito internacional de material la Reglamentación de la Ley indica que, el tránsito a través del territorio nacional, en cualquiera de sus formas (marítima, fluvial, terrestre o aérea) de armas o municiones, con destino a otro país, requerirá la autorización previa del Registro Nacional de Armas que la acordará de acuerdo con los convenios internacionales vigentes en la materia y suscritos por la Nación Argentina y sin perjuicio de las demás disposiciones que rijan al respecto. Igual recaudo se exigirá para las operaciones previas al cumplimiento del tránsito (trasbordos o reembarcos).

3. Normativa provincial (Provincia de Tierra del Fuego, Antártida e Islas del Atlántico Sur)

LEY N° 55 MEDIO AMBIENTE: tiene por objeto la preservación, conservación, defensa y mejoramiento del medio ambiente de la Provincia de Tierra del Fuego, Antártida e Islas del Atlántico Sur, estableciendo sus principios rectores a los fines de perpetuar los ecosistemas existentes en su territorio, como patrimonio común de todas las generaciones, debiendo asegurar la conservación de la calidad ambiental, la diversidad biológica y sus recursos escénicos. Prohíbe las acciones u obras que sean susceptibles de degradar en forma irreversible a las comunidades florísticas y faunísticas o a sus individuos, exceptuando de esta prohibición a: a) Las especies declaradas plagas por los organismos competentes de la Nación, de las provincias o de los municipios. También en su **artículo 67** prohíbe la introducción de especies exóticas sin previa autorización de la Autoridad de Aplicación. **En su artículo 9°** indica que las acciones u obras que degraden o sean susceptibles de degradar el ambiente en forma corregible podrán ser autorizadas por la Autoridad de Aplicación teniendo en cuenta el respeto de las características de los ecosistemas, la aptitud de cada zona en función de su caracterización ecológica, la distribución poblacional, la actividad económica, los factores educacionales y culturales y el impacto ambiental de las actividades existentes y la factibilidad ambiental de las que se desea desarrollar.

LEY N° 211 FONDO PARA EL DESARROLLO DE LOS RECURSOS AMBIENTALES NATURALES: fondo específico aplicable entre otras cosas al desarrollo y/o investigación de programas para el manejo de recursos naturales .

LEY N° 272 SISTEMA PROVINCIAL DE AREAS NATURALES PROTEGIDAS

Cuenta entre sus prohibiciones generales (Artículo 17) la introducción de especies vegetales o animales no autorizadas por su condición, tipo o cantidad;

A su vez la Ley prevé, que para la gestión de manejo de las Areas Naturales Protegidas, se tendrá en cuenta, entre otras cosas, que el manejo de las áreas implica tanto, la manipulación activa de las comunidades de plantas y animales, como la protección frente a modificaciones o influencias externas y promueve actividades para la restauración total o parcial de un sistema, que asegure la perpetuación de éste en las mejores condiciones, así como las de estudio e investigación que tengan la misma finalidad.

LEY N° 696: FAUNA – CASTOR: DECLARACIÓN DE ESPECIE DAÑINA Y PERJUDICIAL EN EL ÁMBITO DE LA PROVINCIA. Declara “Especie dañina y perjudicial” al *Castor canadensis* en todo el ámbito de la Provincia de Tierra del Fuego, Antártida e Islas del Atlántico Sur y establece que el Poder Ejecutivo Provincial, a través de la autoridad de aplicación, deberá erradicar o controlar la especie “*Castor canadensis*” en el marco del manejo global de las invasiones biológicas, según reza el artículo 8°, inciso h), de la Ley nacional 24.375. A su vez autoriza al Poder Ejecutivo Provincial a firmar acuerdos marco referentes a esta temática, con provincias y regiones vecinas a efectos de realizar un trabajo en conjunto para la erradicación del mismo.

A partir de 1981 y por los años subsiguientes el Gobierno del, por entonces, Territorio Nacional de Tierra del Fuego, autoriza la caza y comercialización del castor de mayo a septiembre

En 1992 se extiende a todo el año (habilitación permanente la caza comercial y deportiva).

Resolución S.R.N. y A.H. N° 334/1997 Aprueba el programa “Control de daños producidos por castores en Areas Rurales”.

Resolución M.E. N° 745/1997 el Gobierno de la ahora Provincia de Tierra del Fuego autoriza la caza comercial del castor. Se inician estudios conjuntos entre CADIC y la Subsecretaría de Recursos Naturales orientados a ensayar sistemas de captura más avanzados.

Resolución M.E.O y S.P. 28/98 se implementa la utilización de trampas CONIBEAR 330-2 como único sistema autorizado.

Resolución M.E.O. y S.P. N° 33/2001. Aprueba el Proyecto “ Control de Poblaciones de Castor en Tierra del Fuego, República Argentina” El proyecto a probado pretende ser continuación de las iniciativas de control anteriores. Se agrega un sistema de incentivos basado en la entrega de colas de castor

Convenio de colaboración entre la Provincia de Tierra del Fuego y la Secretaría de Ambiente y Desarrollo Sustentable de la Nación, para el trabajo conjunto en los programas de control del castor.

II. INSTITUCIONES INVOLUCRADAS EN EL DESARROLLO DEL PLAN

SECRETARIA DE AMBIENTE Y DESARROLLO SUSTENTABLE. (SAyDS). Es la Autoridad de Aplicación de la ley 22.421 en jurisdicción nacional. La Dirección Nacional de Fauna Silvestre, dependiente de la SAyDS, tiene entre sus funciones y objetivos: desarrollar y fomentar planes, programas y proyectos referidos al manejo adecuado de la fauna silvestre, autóctona y exótica, tendientes a evitar la extinción de las especies, la conservación de sus

habitats y a su utilización sostenible (??)

La Dirección promueve activamente la discusión sobre el control y/o erradicación de la especie *Castor canadensis* y la necesidad de evitar su expansión en el continente desde el año 2001, en el seno de la Subcomisión de Medioambiente argentino-chilena. En 2004 y 2005 organizó junto con el Gobierno de Tierra del Fuego, Argentina, dos reuniones en Ushuaia en las que participaron instancias técnicas nacionales y regionales e investigadores de Argentina (Administración de Parques Nacionales (APN) y Centro Austral de Investigaciones Científicas – Consejo Nacional de Investigaciones de Investigaciones Científicas y Técnicas (CADIC-CONICET), funcionarios de la provincia de Tierra del Fuego y de la SayDS y técnicos de oficinas regionales del Servicio Agrícola Ganadero (SAG), de Chile. Se convino en dar al tema un carácter de prioridad Nacional y en la necesidad de diseñar una estrategia binacional (argentino-chilena) y un proyecto binacional para ser financiado con fondos internacionales. Como resultado de las mismas se firmó un Convenio con la Provincia de Tierra del Fuego que incluyó un Plan de Trabajo y fondos para un “Programa de Control (tendiente a la erradicación)”. También se iniciaron contactos técnicos específicos por tema castor entre Argentina y Chile (CADIC – SAG – APN), contactos que continúan hasta el presente.

En Mayo de 2006 en el marco de la Subcomisión de Medioambiente Argentino Chilena se trabajó para lograr la cooperación para la organización de la Primer Reunión Técnica Binacional para el manejo del castor que estaba siendo organizada por la Administración de Parques Nacionales y Consejo Agrario de Santa Cruz y la Dirección de Fauna Nación, Argentina.

La SayDS a través de la Dirección de Fauna Silvestre ha dado apoyo financiero para la realización del presente EF (ver propuesta)

Es intención de la Dirección de Fauna Silvestre convocar a las partes para la elaboración del Plan Estratégico Binacional de Erradicación (PEBE), el que necesariamente contendrá el Proyecto de Erradicación del castor americano (*Castor canadensis*) del sur de América del Sur (En caso que los resultados del Estudio de Factibilidad indiquen que la erradicación sea factible).

ADMINISTRACIÓN DE PARQUES NACIONALES / PARQUE NACIONAL TIERRA DEL FUEGO (PNTDF):

La APN es la autoridad de aplicación de la Ley 22.351 y por lo tanto es el organismo que planifica y ejecuta -con proyección nacional e internacional- la conservación de la diversidad biológica y cultural de las áreas protegidas bajo su jurisdicción.

La Dirección Nacional de Conservación de Áreas Protegidas (DNCAP) de la APN a través de su Programa de Manejo de Recursos Naturales viene promoviendo la sistematización y profesionalización del manejo de especies exóticas en las áreas del sistema, contando con profesionales idóneos en la temática a nivel de las oficinas centrales del organismo. En este sentido, en el marco de la Planificación del Manejo de Especies Exóticas a nivel Nacional y dicho Programa ha identificado al manejo de la invasión de castor como de prioridad Nacional. Para abordar este problema de importancia Nacional este Programa ha buscado y ha contado con la guía y apoyo Internacional de los más destacados centros de producción de información y de experiencia en el manejo de especies exóticas, como es el Ministerio de

Ambiente y el Departamento de Conservación (DOC) de Nueva Zelanda y el ISSG de la IUCN, quienes vienen participando en el asesoramiento de la estrategia binacional para el manejo de castor. La Delegación Regional Patagonia (DRP), oficina técnica regional, dependiente de la DNCAP con sede en San Carlos de Bariloche y Ushuaia ha venido promoviendo la discusión de la erradicación de la especie y la necesidad de controlar la amenaza de invasión al continente en ámbitos técnicos y diplomáticos. En Agosto de 2006, co-organizó con la DNCAP (APN), la SayDS y la Provincia de Santa Cruz, en la ciudad de Río Gallegos, provincia de Santa Cruz, Argentina la : “Primera reunión técnica de cooperación entre Argentina y Chile sobre el ingreso del castor (*Castor canadensis*) en el área continental de América del Sur”. Dónde se suscribió el documento “Estrategia binacional para la erradicación del castor de la Patagonia Austral”, documento en el que se fija una posición conjunta respecto de esta especie en el cono sur. En uno de sus párrafos se expresa: “...se considera imprescindible plantear como objetivo general de esta Estrategia lograr la completa erradicación del castor de Patagonia austral”. Esta reunión contó con una amplia participación de organismos Estatales chilenos, con instancias de nivel regional y nacional (CONAF; CONAMA; SAG) y representantes gubernamentales de las provincias de Tierra del Fuego y Santa Cruz, del CONICET y de WCS Chile.

En el caso del PNTDF la problemática de las especies exóticas , incluyendo el castor está identificada como una de las principales amenazas del área protegida en el Plan de Manejo (2003, 2007). Se desarrollan tareas de control de la especie desde la década del 80. A partir de 2001 se ha puesto en marcha con presupuesto propio un Programa de control de castor en el sector sur del área protegida, bajo la dirección de la DRP. Se cuenta con personal técnico y guardaparque con experiencia en tareas de control con trampas Connibear y armas de fuego, algunos de ellos con 10 años de trabajo en el tema.

Para los responsables del tema de manejo de *Castor canadensis* dentro de la institución, la erradicación del castor en jurisdicción del PN es un objetivo pero que está supeditado a los acuerdos de acción que se alcancen con las jurisdicciones vecinas (República de Chile y Provincia de Tierra del Fuego)

SECRETARÍA DE AMBIENTE Y DESARROLLO SUSTENTABLE (ex SS DE RECURSOS NATURALES) DE LA PROVINCIA DE TIERRA DEL FUEGO.

Es la autoridad de aplicación en materia de conservación y manejo de recursos naturales de la Provincia. La ex SS (hoy Secretaría de ambiente) ha promovido en conjunto con la Dirección Nacional de Fauna la discusión sobre el manejo de la especie en el ámbito provincial y planteado la problemática de especie exóticas, incluido el castor, en las reuniones del Comité de Frontera Integración Austral.

Dentro de su estructura interna las cuestiones relacionadas a la fauna silvestre autóctona y exótica son responsabilidad del Departamento de Fauna. En la actualidad el Departamento no cuenta con un staff de profesionales capacitados en el manejo de especies exóticas en particular.

El gobierno provincial autoriza la caza comercial y deportiva del castor en toda la provincia y en forma permanente en 1992 y en 1999 inicia el Plan de Control del Castor, el que continúa con altibajos hasta el presente. Este Plan se basa en controlar la población a través del aprovechamiento del recurso, mediante la extracción sostenida de animales (entre 7000 y 10.000 animales/año) apoyada en el interés del mercado por los productos del castor. A partir de 2001 se agrega un sistema de incentivos (pago de colas) como estímulo adicional al del

mercado.

Los principales inconvenientes de los planes implementados fueron por un lado la falta de continuidad en las políticas y acciones, pero también y en forma muy marcada la escasa fuerza de caza.

En 2005 la provincia firmó un acuerdo de colaboración con la SAYDS que incluía un Plan de Trabajo y fondos para mejorar el programa de control, acordando un Plan de trabajo de control tendiente a erradicación. En ese marco en 2006, se sanciona la Ley N° 696 se declara al castor como Especie Dañina y Perjudicial dándole un marco legal y fortaleciendo las acciones de manejo. Por último en 2007 acompañando los acuerdos alcanzados por las instituciones argentinas y chilenas en las reuniones binacionales ya mencionadas se decide orientar parte de los fondos del Plan de control al presente EF.

CENTRO AUSTRAL DE INVESTIGACIONES CIENTÍFICAS (CADIC) – CONICET. Este Centro de Investigaciones ubicado en la ciudad de Ushuaia depende del Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), principal organismo dedicado a la promoción de la ciencia y la tecnología en Argentina.

Los investigadores miembros del CADIC cuentan con una larga tradición de investigación y trabajo colaborativo con las autoridades provinciales en materia de control de la especie. La mayor parte del conocimiento sobre los castores disponible en Argentina proviene de equipos de investigación de esta institución, incluyendo los fundamentos técnicos para la elaboración del Plan de Control del Castor, así como los niveles de captura de control propuestos y el esfuerzo necesario para ello. Además a asesorado en la capacitación trampeo para de cazadores en las etapas iniciales del plan mencionado. El CADIC tiene un rol fundamental en el presente EF .

III: OTRAS INSTITUCIONES QUE DEBERÍAN ESTAR INVOLUCRADAS EN DIFERENTES ETAPAS DE UN PLAN DE ERRADICACIÓN O CONTROL.

- Policía de la Provincia de Tierra del Fuego
- Gendarmería Nacional
- Prefectura Naval Argentina
- Armada Argentina
- Ministerio de Educación de la Provincia
- INFUETUR (Instituto Fueguino de Turismo)
- Sociedad Rural de Tierra del Fuego
- Asociaciones de pesca
- Asociación de guías de turismo
- Asociaciones ambientalistas

IV. FINANCIAMIENTO

Ninguna de las agencias gubernamentales involucradas cuentan con financiamiento propio suficiente para encarar la erradicación. Todas cuentan con amplia experiencia en el manejo de fondos externos.

