


# Control vs Fencing:

## relative cost-effectiveness for protecting biodiversity


# Questions

- Is pest control over a wider area a cheaper, or more expensive, option than fencing?
- What are the key parameters that decide this?

# Definitions

- Control = sustained reduction in pest abundance

  (excluding mice)

- Fencing = eradication of pests

  (either excluding or including mice)

# Who and what is this for?

- For projects starting out
- Provide some economic rigour to decision of whether or not to fence
- This is not about cost-benefit
- Assumes ecological benefit of control is similar to fencing (e.g. Grand and Otago skinks)
- Knowledge gap for most species
- Ignores peninsulas

# Other studies

Conservation Biology

*Contributed Paper*

## How to Build an Efficient Conservation Fence

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**Abstract:** *Barriers are used to achieve diverse objectives in conservation and biosecurity. In conservation management, fences are often erected to exclude introduced predators and to contain diseased animals or invasive species. Planning an efficient conservation fence involves a number of decisions, including the size and design of the enclosure. We formulated the first general framework for building a fence that minimizes long-term management costs by balancing the expense of constructing a more secure barrier against the costs of coping with more frequent failures. The approach systematically considers the range of potential solutions to a well-defined fencing problem and results in a solution that maximizes conservation return on investment. We illustrated this method by designing efficient fences to address two different conservation goals: exclusion of invasive predators from populations of threatened eastern barred bandicoots (*Perameles gunnii*) and maintenance of isolated populations of healthy Tasmanian devils (*Sarcophilus harrisii*). A systematic approach to conservation fencing allows the best fence design to be chosen quantitatively and defensibly. It also facilitates conservation decisions at a strategic level by allowing fencing to be compared transparently with alternative conservation management actions.*

**Keywords:** biosecurity barrier, eastern barred bandicoot, predator exclusion, return on investment, Tasmanian devil facial tumor disease

Cómo Construir un Cerco de Conservación Eficiente

**Resumen:** *Las barreras son utilizadas para alcanzar objetivos diversos en conservacion y bioseguridad. En el manejo de conservación, a menudo se erigen cercos para excluir depredadores introducidos y contener animales enfermos o invasores. La planificación de un cerco de conservación eficiente implica un número de decisiones, incluyendo el tamaño y diseño del encierroFormulamos el primer marco de referencia general para la construcción de una barrera que minimiza los costos de manejo a largo plazo balanceando el costo de la construcción de una barrera más segura con los costos de asumir fracasos más frecuentes. El método sistemáticamente considera el rango de soluciones potenciales para un problema bien definido y resulta en la solución que maximiza el retorno de conservación sobre la inversión. Aplicamos este método en el diseño de cercos eficientes para abordar dos metas de conservación diferentes: exclusión de depredadores invasores de poblaciones de* Perameles gunnii *y mantenimiento de poblaciones aisladas de demonios de Tasmania sanos. Un método sistemático de cercado de conservación permite que el mejor diseño de cerco sea seleccionado cuantitativa y defendiblemente. También posibilita decisiones de conservación a nivel estratégico al permitir que el cercado sea comparado transparentemente con acciones de manejo de conservación alternativas.*

**Palabras Clave:** barrera de bioseguridad, enfermedad de tumor facial del demonio de Tasmania, exclusión de depredadores, *Perameles gunnii*, retorno de la inversión

### Introduction

Conservation, wildlife, and veterinary managers routinely use fences to exclude introduced (Moseby & O'Donnell 2003; Moseby & Read 2006; Hayward & Kerley 2008) and native (LaGrange et al. 1995; Pople et al. 2000) predator species from endangered populations, restrict the spread of infectious diseases (Taylor & Martin 1987; Sutmoller et al. 2000), exclude grazers from vulnerable habitats (Boone & Hobbs 2004), and exclude humans

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Procedure for optimising fence design and length for given probability of failure

# Other studies

## Cost-effectiveness of exclusion fencing for stoat and other pest control compared with conventional control

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ABSTRACT

The costs of exclusion fencing for stoats (*Mustela erminea*) and other pests using the Xcluder™ design of multi-species pest-proof fence and conventional pest control were compared for a variety of scenarios. Cost-effective pest control can be achieved by exclusion fencing in reserves of 5000 ha or more, and on peninsulas. The cumulative cost of conventional control would exceed the initial cost of a fence plus maintenance costs after as few as 4 years. Fencing may be a cost-effective option for pest control in reserves of 100–1000 ha, depending upon cost factors such as the fenceline length to reserve area ratio, numbers of gates and water crossings, site work required to install the fence, access to the fence for maintenance, the number of abutting fences, the presence of stock outside the reserve, and the current costs of materials and freight. Smaller reserves are unlikely to be cost-effective to fence, even though conventional control is likely to cost more per hectare at these sites than in larger reserves. Despite the higher costs, fencing may still be a viable option for these sites, because it allows for a pest-free status not achievable by conventional methods. The costs of a non-electric barrier fence were also compared with those of an electric fence. The Xcluder™ fence would cost a similar amount to an electric fence, but would exclude more pest species, and be less prone to failure. The advantages and limitations of using exclusion fencing for pest control are outlined. Non-electric fences are recommended for pest control in large reserves and on peninsulas. More work is required to develop accurate costs for conventional pest control and reliable monitoring systems for the assessment of the efficacy of different pest control systems. The impact of exclusion fencing and conventional control on non-target species, the environment and social issues also needs to be assessed.

**Keywords:** pest control, *Mustela erminea*, fence, electric, barrier, non-lethal, poisoning, toxin, trapping.


Clapperton, B.K.; Day, T.D. 2001: Cost-effectiveness of exclusion fencing for stoat and other pest control compared with conventional control. *DOC Science Internal Series 14*. Department of Conservation, Wellington. 19 p.



- Concluded that 100 – 1000 ha cheaper to fence cf. conventional control
- Fence costs only $50-85 per m
- Conventional control = "predator control" + "possum/rat control" ($81-135 $ha^{-1}$ $yr^{-1}$)
- No buffer used
- No depreciation/discounting

# Recent debate

312 Available on-line at: http://www.newzealandecology.org/nzje/

FORUM ARTICLE

## Are predator-proof fences the answer to New Zealand's terrestrial faunal biodiversity crisis?

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**Abstract**: A review of pest-exclusion fences throughout New Zealand shows that the goals of fence projects are frequently not achieved and cost-benefit analyses often do not adequately quantify ongoing costs. The creation of these sanctuaries enclosed by predator-proof fences often creates small expensive zoos surrounded by degraded habitat that will never be able to sustain the animal and plant species contained within the fence. We examine what fence proponents and conservation trusts believe they are achieving and ask whether the evidence available demonstrates that fenced areas are capable of fulfilling these objectives.

**Keywords**: conservation; economics; pest-exclusion fences

### Introduction

Mainland New Zealand is currently experiencing a decline in terrestrial faunal diversity unprecedented since the 1870s (MfE2007; Robertson et al. 2007; Cranston 2010; Hitchmough et al. 2010; Newman et al. 2010). Predation by introduced predators has been shown by numerous studies to be the fundamental cause of this decline (King 1984). Furthermore this has been exacerbated by prey-switching in stoats following large-scale possum eradication (Murphy & Bradfield 1992; Innes & Barker 1999) and disease (Newman et al. 2010). Whatever the causes of the current crisis, New Zealand Department of Conservation (DOC) data show that in the three years between 2002 and 2005, the conservation status of 40 bird species worsened (Hitchmough et al. 2007). Twenty-one bird taxa that were assessed as 'Nationally Critical' in 2005 remained in that most threatened category in 2008 and 13 had declined further (Miskelly et al. 2008). Similar trends exist in other terrestrial fauna (MfE 2007; Hitchmough et al. 2010; Newman et al. 2010).

To deal with this crisis and to give structure to their biodiversity operations, DOC in conjunction with the New Zealand Ministry for the Environment implemented a New Zealand Biodiversity Strategy in 2002. A review of this strategy in 2006 (Green & Clarkson 2006, p. 19) concluded that '77% of the acutely or chronically threatened species still lack targeted recovery work and are most likely in decline. The inability to deal with these "priority" species appears to be due to a lack of resources'.

It is well known that biodiversity management cannot be entirely reliant on government departments and in recent years a groundswell of private organisations, 'not for profits', local and regional government have sought to 'do their bit'. A notable feature in recent years is that many of these conservation organisations have established predator-'proof' fence projects throughout New Zealand. The best known of these is the Karori Sanctuary, now known as Zealandia, in the suburbs of Wellington (Campbell-Hunt 2002).

These fences were promoted by an important publication in 2001, which strongly suggested that exclusion fencing for stoats and other pests was the most cost-effective way of preserving large areas of natural habitat for conservation benefit (Clapperton & Day 2001). The analyses of conventional pest control versus exclusion fencing costs reported in that study are flawed as they do not calculate present values for the 25-year-long projects and hence do not provide a sound basis for making comparisons of cost-effectiveness. As well, a recent review of pest-exclusion fences throughout New Zealand shows that the goals of fence projects are frequently not achieved and cost–benefit analyses often do not adequately quantify ongoing costs (Brown, in Sanders et al. 2007). Furthermore several overseas authors recently questioned whether fences are indeed the panacea that will solve the global extinction crisis (Hayward & Kerley 2008; Bode & Wintle 2010); with one paper going so far as to suggest that wholesale fence creation will restrict endangered species' evolutionary potential (Hayward & Kerley 2008). We consider that in many cases the creation of sanctuaries enclosed by predator-proof fences is little more than the creation of expensive zoos surrounded by degraded habitat that will never be able to sustain the animal and plant species contained within the fence.

To enable a better informed debate on the merits of the predator-'proof' sanctuaries, we carried out a survey of some of the predator-proof-fenced sanctuaries in New Zealand to determine why the fences were established, how much they cost, who paid for them, and what it was hoped the projects would achieve. The aim of this forum article is to use the results of this survey and a general literature review to air widely held, but rarely published, opinions about predator-exclusion fences and to pose questions that we hope can be asked before further investments in predator-proof fences occur.

### Methods

Little has been written in the scientific literature on predator-proof fences and, as most of the organisations funding these

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- Scofield et al. (2011) discredit fencing on the grounds of high cost and low ecological benefit (cf. islands and mainland)
- They pose the question: Is pest control over a larger area a viable alternative to a fenced sanctuary?
- As said.....today's talk addresses this question on a cost basis only, not cost-benefit analysis

# Methods

- Simple spread sheet model in Excel
- Fence and control costs equalised over same period (life time of fence)
- Separate models for:
  - Community groups
  - Government department/business (depreciation or borrowing rates)
- Two measures of cost:
  - Unadjusted total cost (or annual)
  - Net present value (discount rates)

# Net present value

Sum of discounted costs (over life of fence)

$$NPV = \sum_{t=1}^{T} \frac{C}{(1+r)^t}$$

C = Cost for year t
T = final year of fence
r = interest rate or ‘discount’ rate

# <u>Fence cost </u>adjustable parameters

- Cost per m ($250)
- Maintenance costs (2%, includes incursion costs)
- Life of fence (25 yr)
- Pest eradication costs ($500/ha)
- Interest or discount rates (8%)
- Eradication scale efficiency

- Uses real relationship between fence perimeter and area protected

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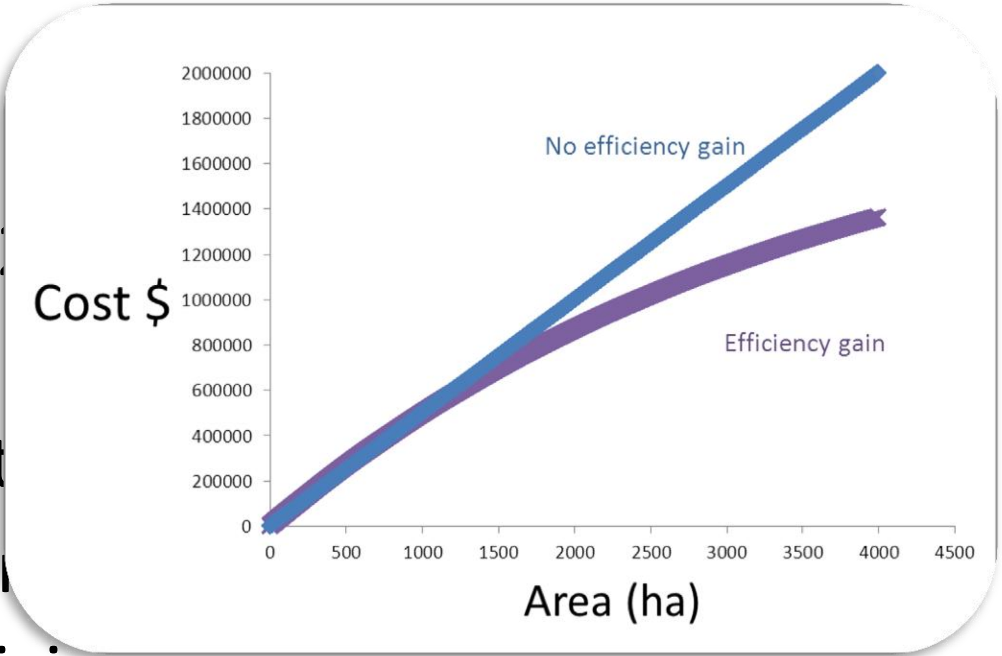


- Uses real relationship between fence perimeter and area protected

# Fence cost adjustable parameters

- Cost p
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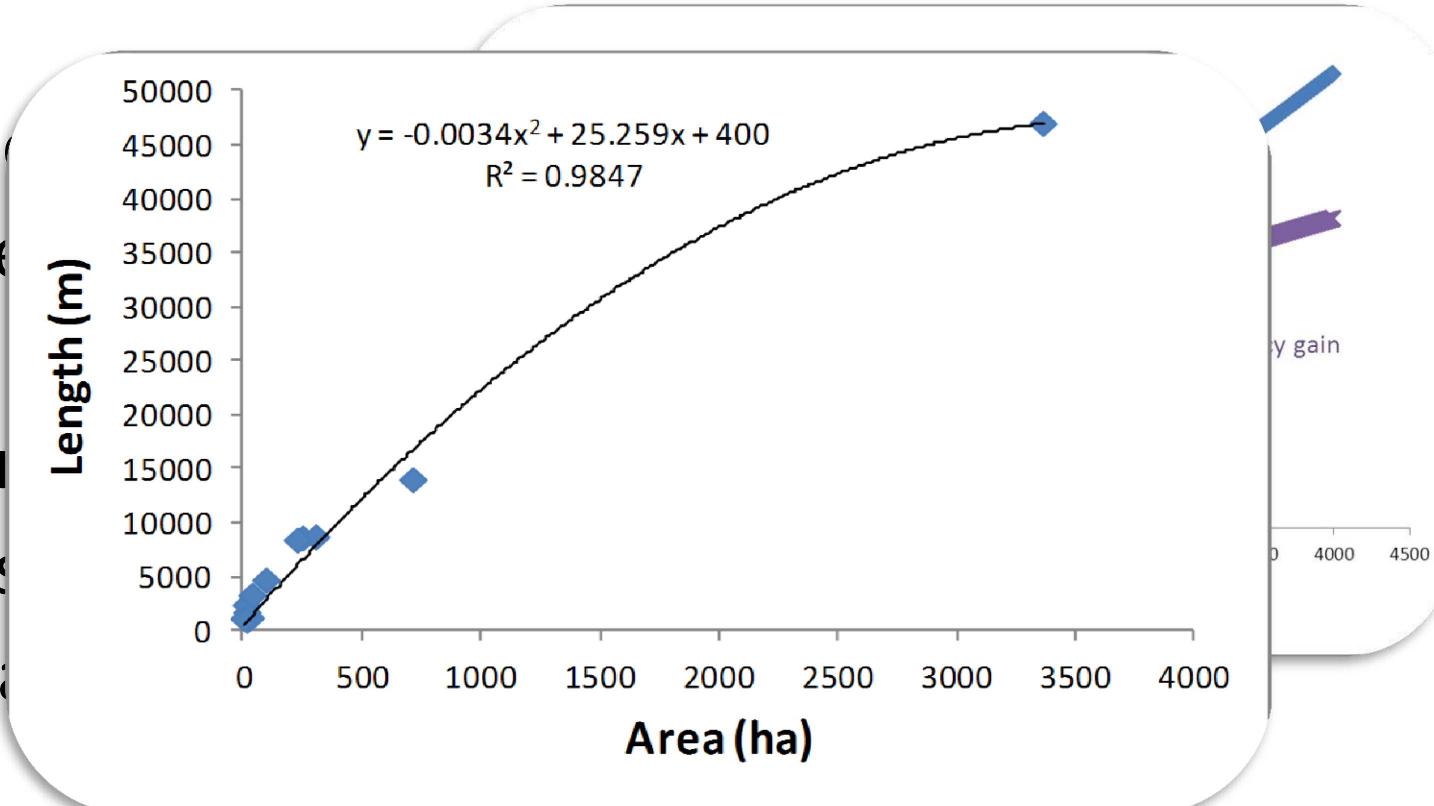
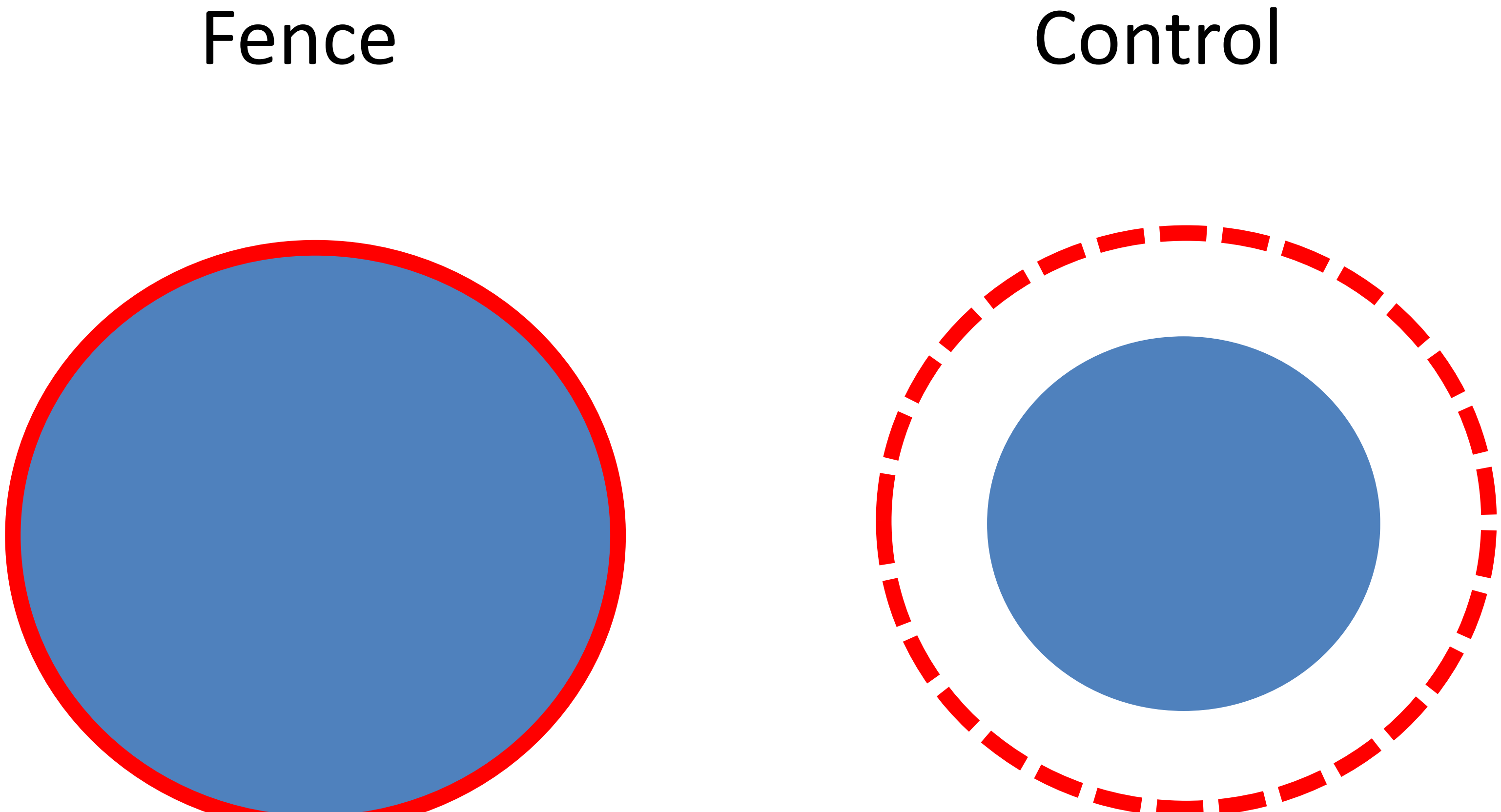



- Uses real relationship between fence perimeter and area protected

# Control cost adjustable parameters

- Control buffer width (1500m)

# Area protected



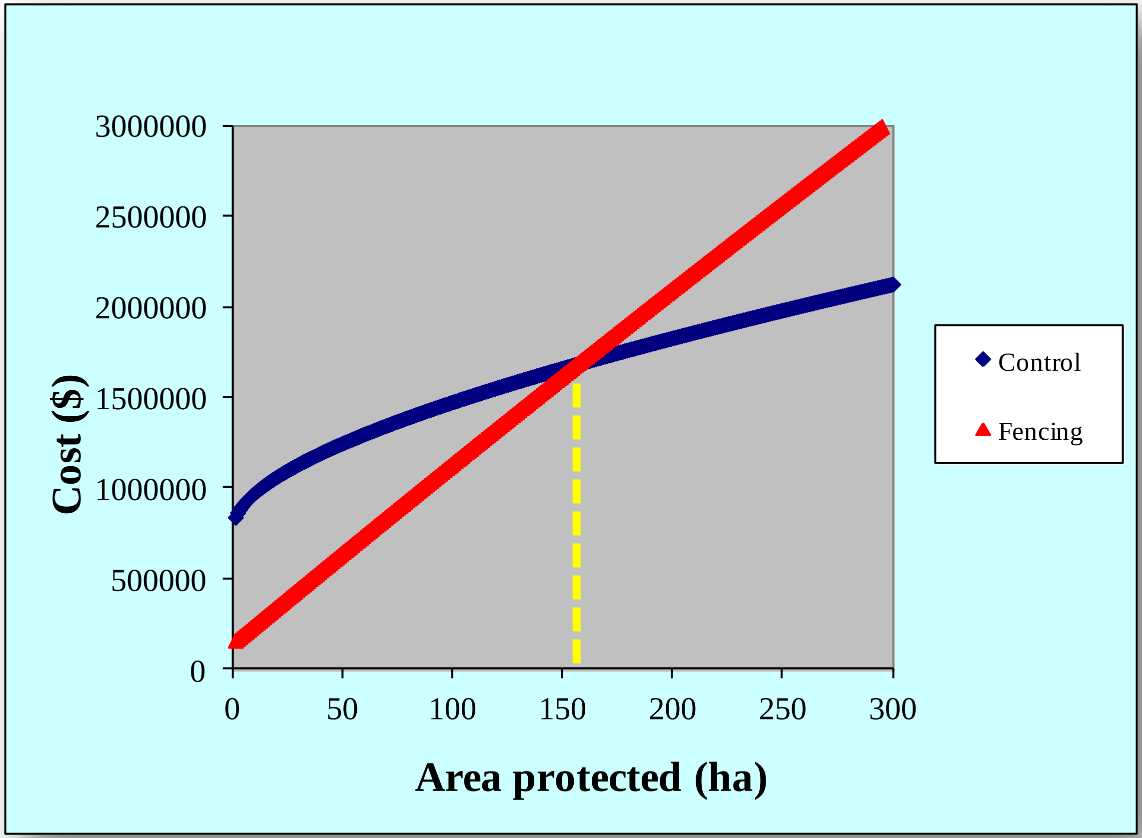
# Control cost adjustable parameters

- Control buffer width (1500m)
- Device costs ($63)
- No. devices deployed (0.3/ha)
- No. devices checked per day (133)
- Device check frequency (weekly)
- Device replacement frequency (7 yr)
- Pest contractor costs ($350/day)
- Proportional ecological benefit cf. fencing

# Some results

- For community groups only
- Lots of assumptions.....choice of parameter values will vary with project
- Results not meant to be prescriptive – just provide example of how tool works

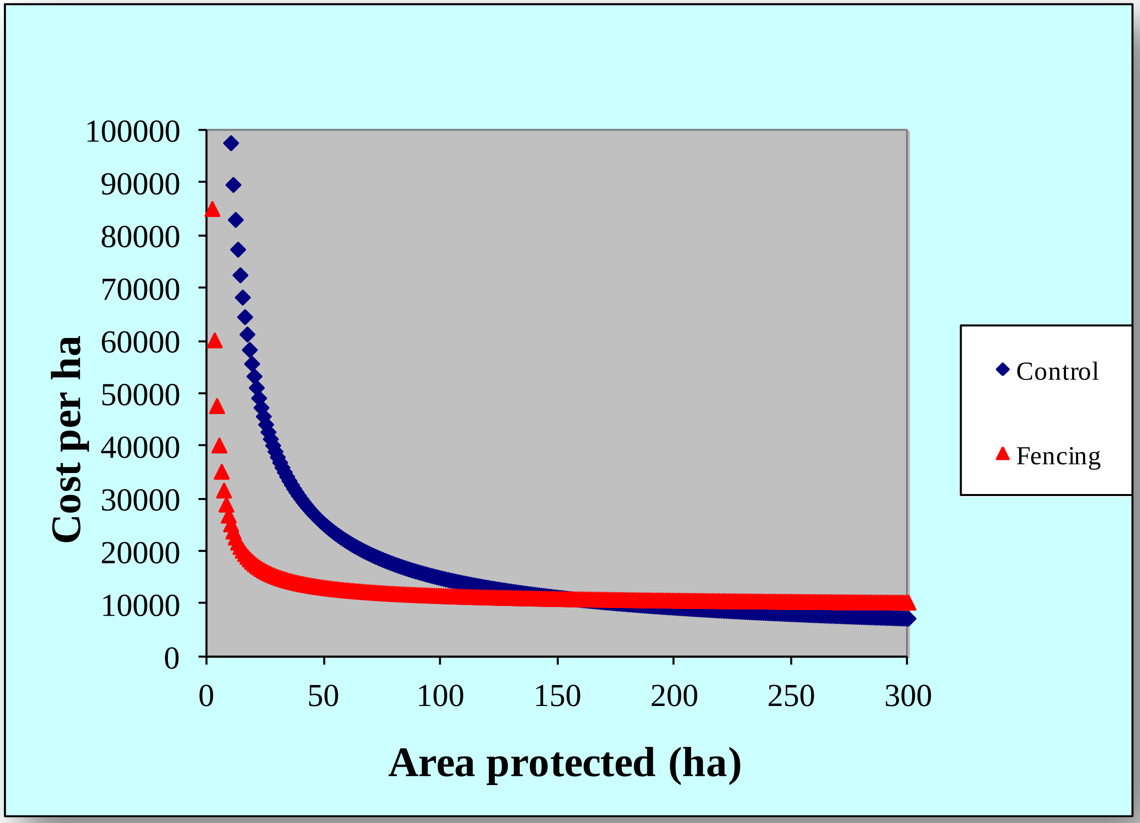
# Unadjusted total costs



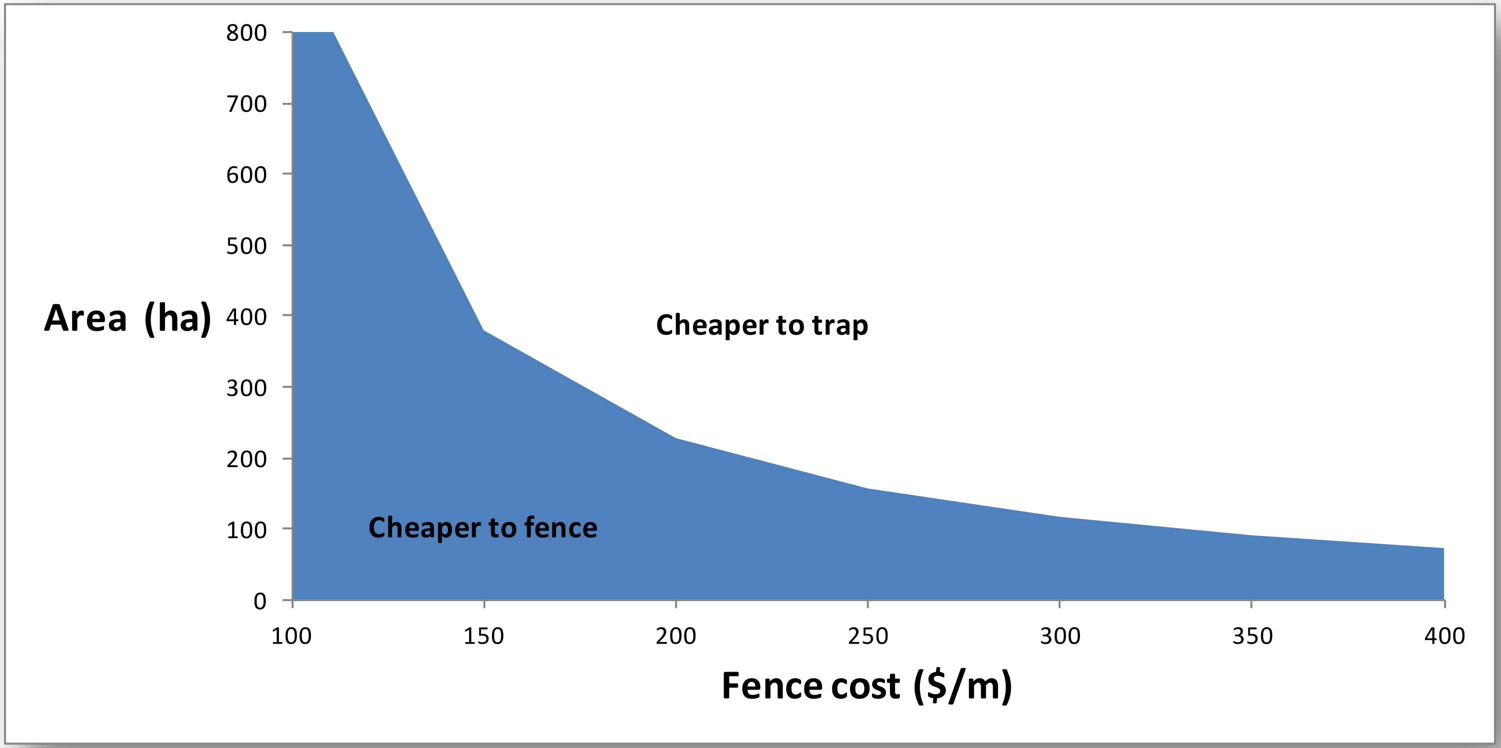

Assuming:

- $250/m for fence
- 25 year fence life
- 1500 m control buffer width
- 1 device per 3.3 ha
- etc

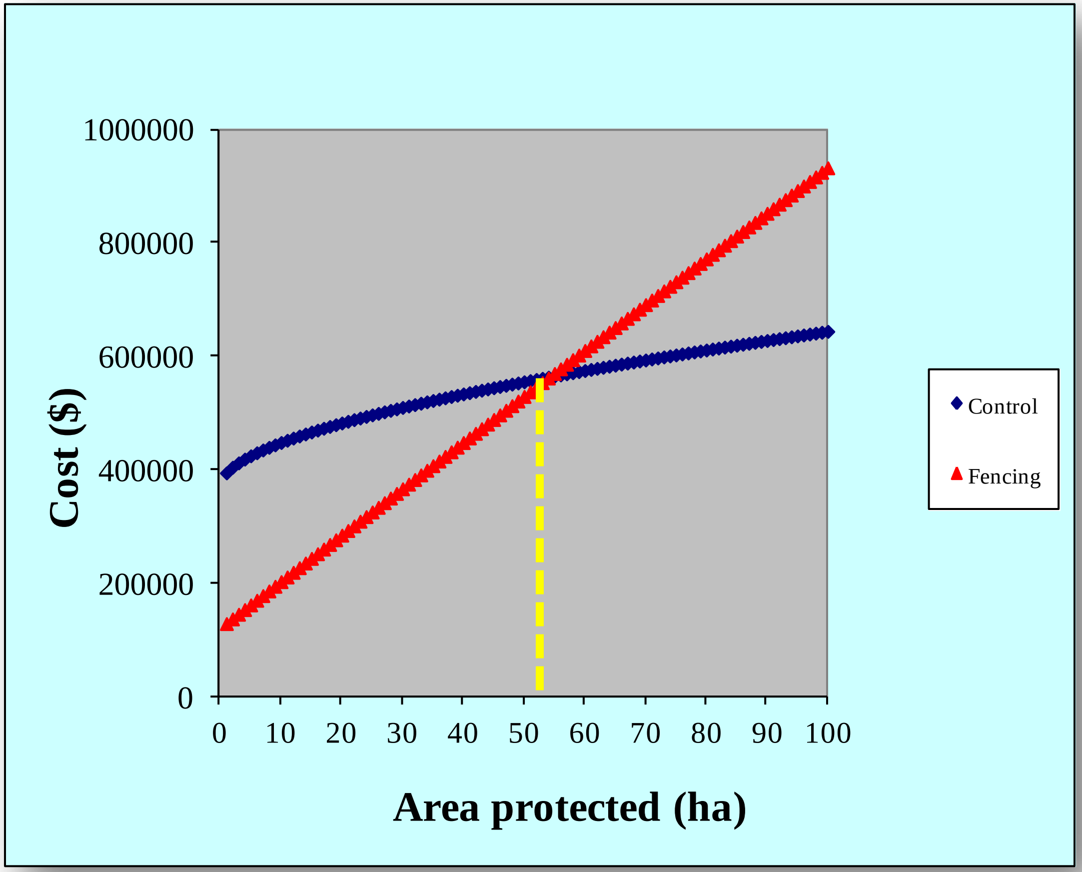
# Unadjusted total costs per ha



# With varying fence costs

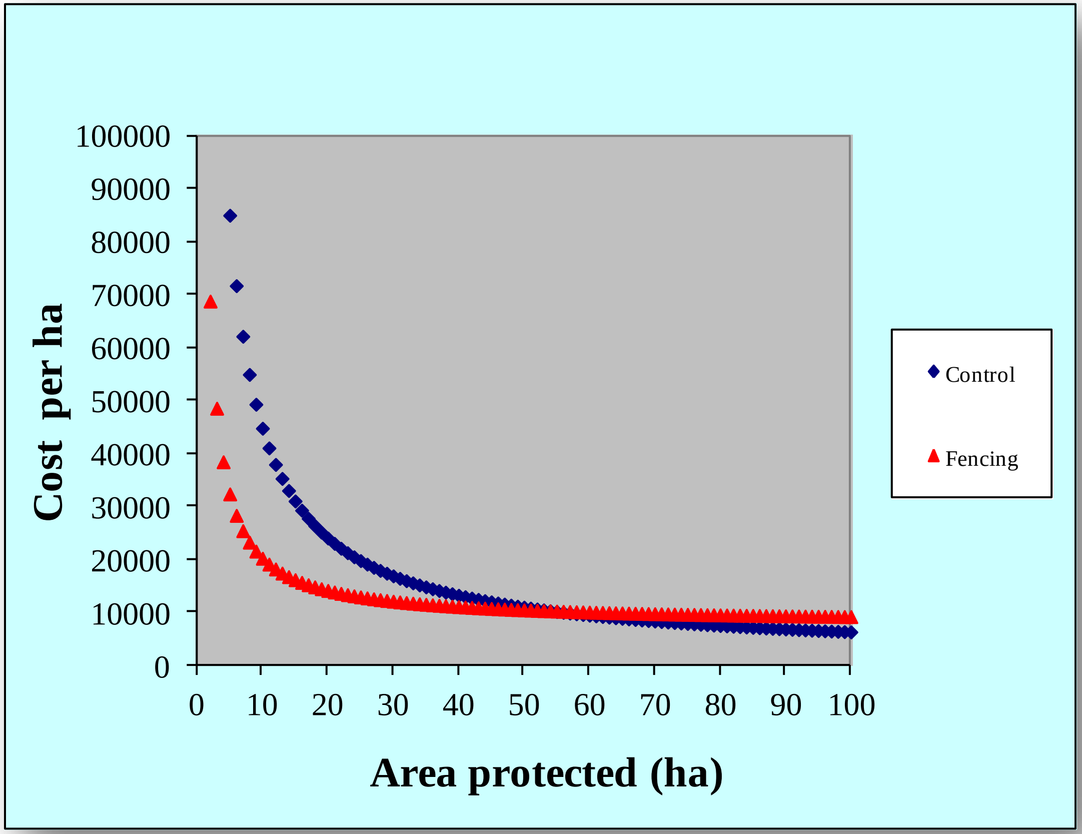


# NPV costs

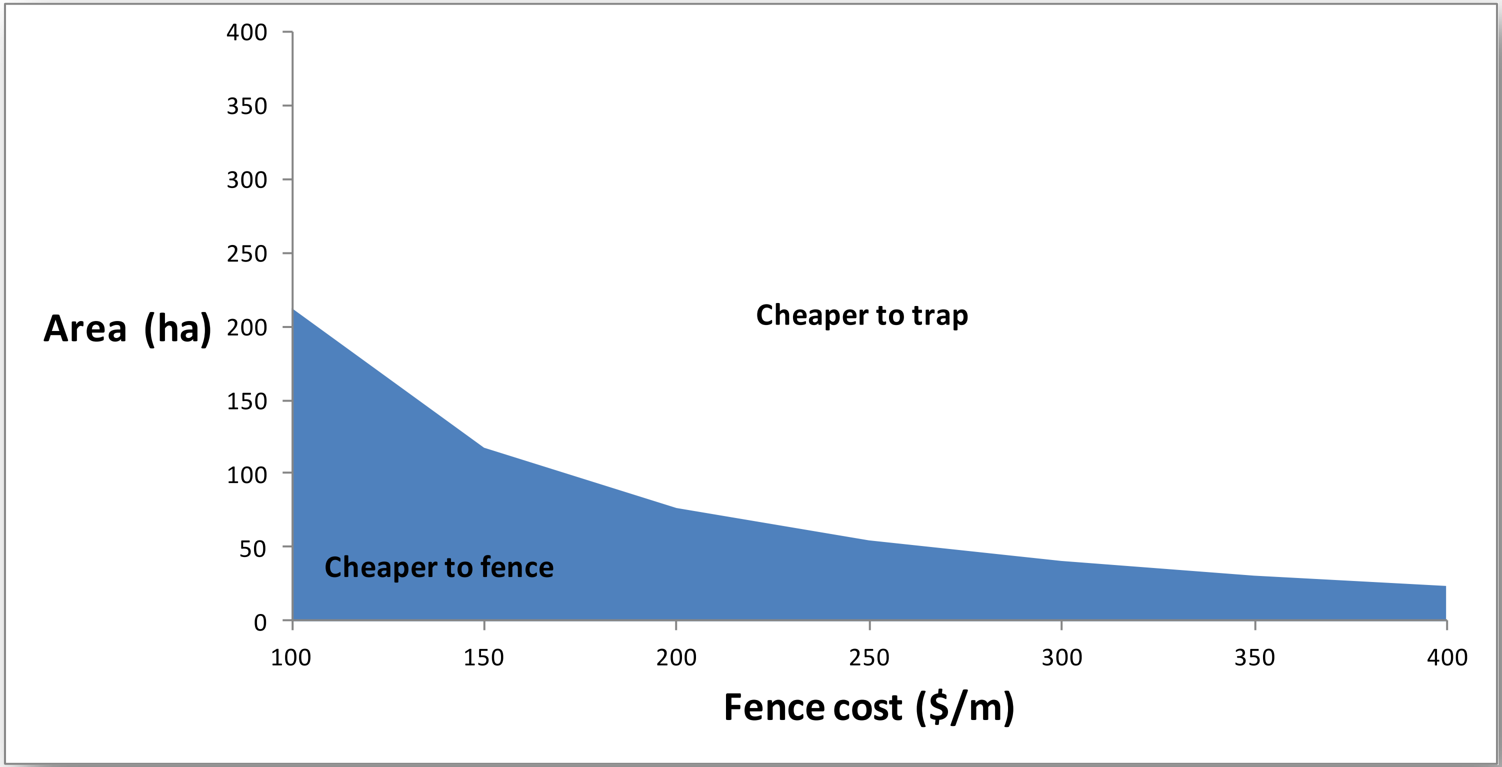


1000000
800000
600000
400000
200000
0
Cost ($)
0
10
20
30
40
50
60
70
80
90
100
Area protected (ha)
Control
Fencing

# NPV costs per ha



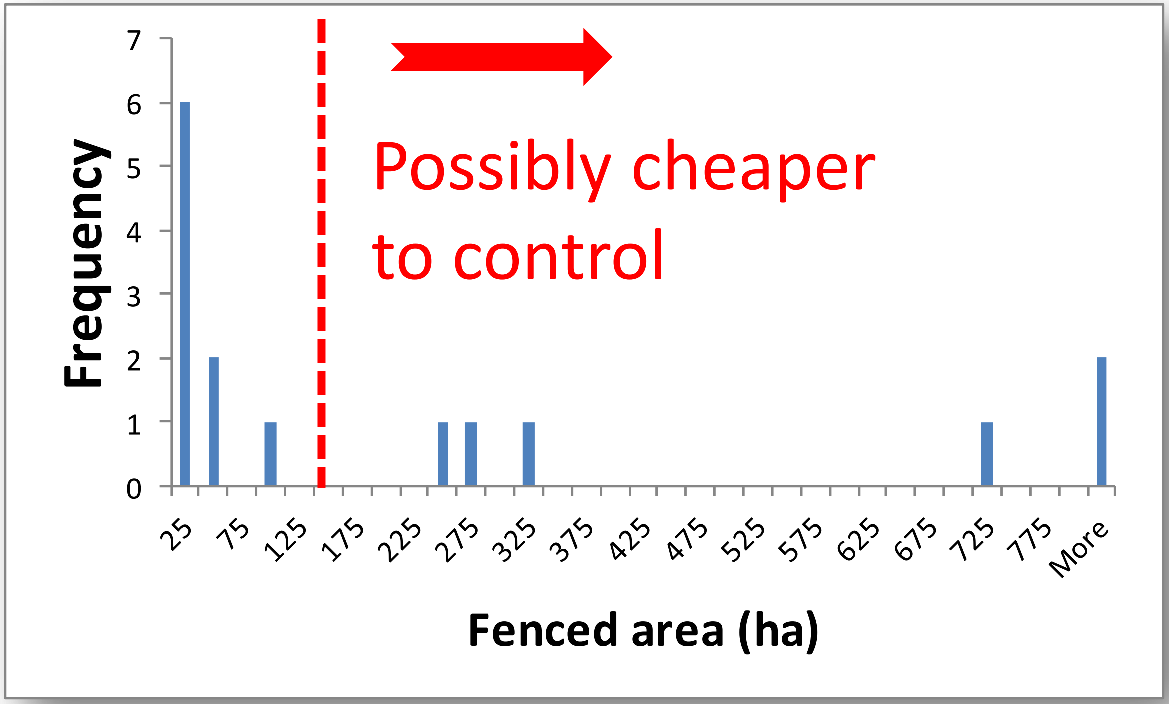
# With varying fence costs



# Which method is most cost-effective?

## Given parameter assumptions

- For unadjusted costs, cheaper to fence
  < approx. 150 ha
- For Net Present Value, cheaper to fence
  < approx. 50 ha




A tool to fit particular needs

# Some non-economic arguments

- Fences are fixed and inflexible
- Fences have visual impact
- Fences are often small and therefore of poor ecological integrity
- Fences are ecologically safest bet, especially for ecosystem restoration

- Control is more vulnerable to vagaries of staff morale, dedication and expertise
- Funders often less willing to fund wages
- Control sometimes involves goodwill of neighbours
- Control is less effective at suppressing pests
  - **what pest density is low enough for given conservation target?**

# Some non-economic arguments

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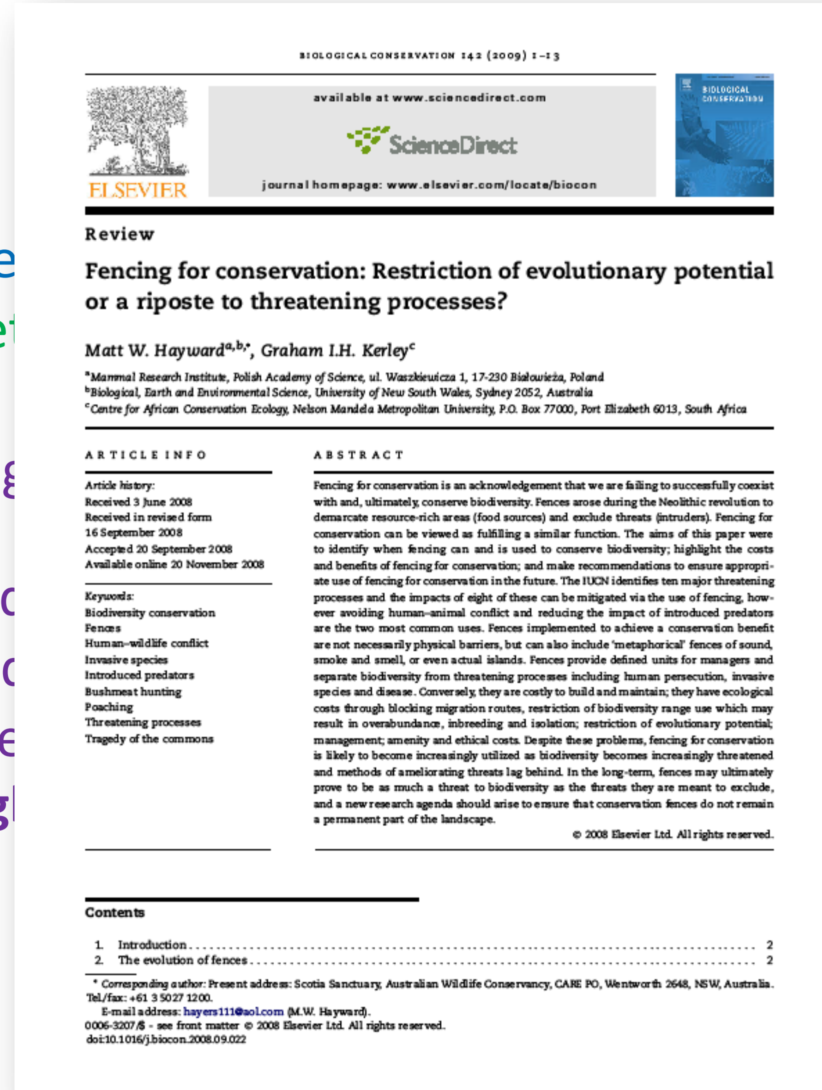

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Review

## Fencing for conservation: Restriction of evolutionary potential or a riposte to threatening processes?

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ABSTRACT

Fencing for conservation is an acknowledgement that we are failing to successfully coexist with and, ultimately, conserve biodiversity. Fences arose during the Neolithic revolution to demarcate resource-rich areas (food sources) and exclude threats (intruders). Fencing for conservation can be viewed as fulfilling a similar function. The aims of this paper were to identify when fencing can and is used to conserve biodiversity; highlight the costs and benefits of fencing for conservation; and make recommendations to ensure appropriate use of fencing for conservation in the future. The IUCN identifies ten major threatening processes and the impacts of eight of these can be mitigated via the use of fencing, however avoiding human–animal conflict and reducing the impact of introduced predators are the two most common uses. Fences implemented to achieve a conservation benefit are not necessarily physical barriers, but can also include 'metaphorical' fences of sound, smoke and smell, or even actual islands. Fences provide defined units for managers and separate biodiversity from threatening processes including human persecution, invasive species and disease. Conversely, they are costly to build and maintain; they have ecological costs through blocking migration routes, restriction of biodiversity range use which may result in overabundance, inbreeding and isolation; restriction of evolutionary potential; management; amenity and ethical costs. Despite these problems, fencing for conservation is likely to become increasingly utilized as biodiversity becomes increasingly threatened and methods of ameliorating threats lag behind. In the long-term, fences may ultimately prove to be as much a threat to biodiversity as the threats they are meant to exclude, and a new research agenda should arise to ensure that conservation fences do not remain a permanent part of the landscape.



Contents



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