Alien Invaders

The Threat Posed to British Wildlife by Introduced Mammals

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Introduction

One of the most controversial and challenging issues in conservation today is what should be done when an animal or plant species has a negative impact on a niche, habitat or ecosystem where it does not naturally occur. This article will explore the issue of invasive mammalian species; the causes of their misplacement, the threat to conservation that they pose and the challenges faced by those who want to mitigate their often serious impacts.



In addition to this, as it is impossible to avoid the strong and often emotive debates that surround this issue, this article will also attempt to illustrate how different species in different situations can lead to very different responses from people, and how human emotion often supersedes empirical evidence when it comes to deciding on the best conservation strategy to adopt.

Being in the Wrong Place at the Wrong Time

Since humans first began to move around the world around 8000 years ago they have been taking animals with them and introducing them into habitats and ecosystems where they did not previously occur (Webb, 1985). In some cases (approximately 10%), when these non-native species establish themselves in their new location, they become ecologically disruptive and are therefore referred to as 'invasive' (Buckle, *pers. comm.*). However, it is important to re-emphasise that, although referred to as 'invasive' species, these species have only become invasive following their introduction to a new environment by humans. In Britain there are thought to be twenty-three non-native mammalian species, many of which have been reported to have negative impacts on biodiversity (Brown, 1986). Some of the deliberate and accidental causes of species introduction are listed in Table 1 (Manchester and Bullock, 2000).

Table 1

Means of Introduction	Examples of Species Introduced
Accidental translocation	Mice and rats
Introduction for food, hunting or sport	Rabbits, wild boar, sheep and red fox
Release form commercial enterprise	Goats, sheep, mink and brush-tailed possum
Introduction for pest control	Stoats, mongooses, cats and red fox
Escaped domestic animals/pets	Cats and dogs
Introduced for visual appeal	Grey squirrel, ungulates and marsupials

Few people are aware but the rabbit was introduced to the UK by the Romans for food. Since then it has had a serious impact on the grassland habitats and species in the British countryside.

The American mink in Britain also serves as an excellent example of how a commercial enterprise can lead to the introduction of an invasive species to an ecosystem where it does not normally occur and of the devastating ecological impact that it can have.

The American Mink in Britain

The ***American mink*** (***mustela vison***) was initially brought to Britain to be farmed for its fur and it was from these farms that they were introduced to the British countryside following their accidental escape or on occasion deliberate release by animal rights activists campaigning against them being farmed. The mink has since thrived, both in riparian habitats and on islands such as the Outer Hebrides, where as strong swimmers and climbers they are perfectly adapted to prey upon rabbits, fish, ground-nesting birds and most significantly on water voles (Barreto *et al*., 1998; Chanin and Linn, 1980; Dunstone, 1993).

The mink has been so successful in Britain that its predation has had a dramatic impact on the water vole, in many rivers pushing it to the brink of extinction (ref). This impact has been shown to be significant by studies in which control of mink has seen the water vole population recover (Reynolds, 2003).

In addition to species with such clearly characterised mechanisms of introduction, or misplacement, it is important to note that there are also some more subtle anthropogenic effects that are responsible for species becoming invasive. Human impacts on an ecosystem, such as habitat destruction, climate change or alterations in community composition, can all change the behaviour of a species such that, although not necessarily in the wrong place, it is displaced from its niche or normal habitat and so becomes a pest or invasive species.

The Impacts of Invasive Species

It has been estimated that of the 941 vertebrate species in danger of extinction globally, 18% are endangered because of invasive species (MacDonald and Tattershall, 2001), and that invasive vertebrates represent the second most important cause of biodiversity loss globally, with only habitat destruction having a more significant impact (Buckle, *pers. comm.*).

Successful invasive species have a number of characteristics that allow them not only to establish in new locations, but also to thrive. They are usually highly adaptable generalist species with short life cycles ('r'-selected) and which often have an association with humans. The impacts of invasive species can be classified according to the level at which they effect their new environment (see Table 2).

Table 2

Level	Effects on…
1	Individuals
2	Genetics
3	Population Dynamics
4	Community composition
5	Ecosystem processes

Invasive species can exert these influences via a number of mechanisms including, predation of native species (level 1), introduction of disease and parasites (level 1), genetic corruption through hybridisation (level 2), competition for food and resources (level 3), increasing the

carrying capacity for predators (level 3), and alteration of plant communities and the species dependent on them (levels 4 and 5).

The North American grey squirrel in Britain serves as an excellent example of how an invasive mammal can have serious impacts on a wide array of native flora and fauna through competition for resources, predation and through the transmission of disease.

The Grey Squirrel in Britain

The North American ***grey squirrel*** (***Sciurus carolinensis***) was deliberately introduced to Britain during the 19th Century and since then has thrived in parks, gardens and woodlands. It has become so widespread, that it is accepted by many as a natural part of our wildlife, much enjoyed by many people and perhaps one of the most commonly seen British mammals. However, despite its obvious charm and appeal, it is clear that the spread of the grey squirrel across the British Isles has had a devastating impact on many native British species, which are poorly adapted to withstand its presence. These impacts include the destruction of woodland trees and plants (Pepper and Currie, 1998), predation of woodland birds (Hewson and Fuller, 2004) and, perhaps most importantly, direct contribution to the catastrophic decline of Britain's native red squirrel (Gurnell, 1994; Reynolds, 1985).

The grey squirrel out-competes the red in almost every phase of their life history (Gurnell et al., 2004) and is also thought to be a carrier of the parapox viral disease against which the red squirrel has little resistance (Rushton *et al*., 2000). The grey squirrel now occurs over almost all of England, with only the far north and a few more southerly areas as yet unoccupied, while the red squirrel on the other hand has seen its range squeezed into those areas unoccupied by the grey (Pepper and Patterson, 2001). John Gurnell of the Mammal Society believes that, if the grey squirrel had not been introduced to Britain, then the red squirrel would still be common in parks and woodlands (Gurnell, 1994).

Holding Back the Tide

The most effective way of preventing a mammal species from becoming invasive is clearly to prevent its misplacement occurring at all. Unfortunately, for many places it is simply too late and so the issue becomes one of what could or should be done to prevent irrevocable damage from being done.

To create a well planned and integrated management strategy it is important that the ecology of the species in its new environment and of the species on which it is having an impact are understood. It is also important to ensure that there is a clear understanding of what the adverse impact is to be mitigated and where the strategy is to be implemented. This information can then be used to decide which approach will be the most appropriate and the most effective. The management of invasive species is often poorly planned and this usually results in a strategy that

is ineffective. The options generally fall into three categories; non-lethal control, lethal control or eradication.

Non-lethal control can be achieved in a variety of ways, including habitat management to prevent exploitation food or harbourage, physical exclusion from areas where they are having an impact and more experimental approaches such as fertility control through vaccination. These strategies, which are discussed in more detail elsewhere (Courchamp *et al*., 2003), can be effective but they are often expensive, impractical and ineffective and so lethal population control becomes necessary.

Lethal control can be performed in a number of ways, including poisoning, trapping, shooting or biological control through the introduction of predators, disease or parasites. When implementing a lethal population control strategy it is essential that potential non-target impacts are identified. There are numerous examples of lethal control measures targeted at an invasive species having disastrous consequences for native species and becoming a conservation problem in there own right (see Table 3).

Table 3

Invasive Species	Location	Control Measure	Non-target Impact
Rabbit	Global	Introduction of myxomatosis	Rabbits killed where they are native, causing decline of predators dependent on them such as Iberian lynx.
Rat	Global	Rodenticide poisoning	Poisoning of native predators such as raptors feeding on rats.
Rabbit and Rat	Australia	Introduction of predators such as red fox or cat	Introduced predator becomes invasive and preys upon sensitive native species.
Mink	Britain	Spring trapping	Potential to kill native species such as otter, badger and pine marten.
Grey squirrel	N. Europe	Rodenticide poisoning	Potential poisoning of native red squirrel.
Cat, red fox and rabbit	Global	Any	In many situations the invasive species has become an integral part of the ecosystem making its removal detrimental.

With 80% (644) of global mammalian and bird introductions, the greatest impact of invasive mammals has been seen on islands, which typically have little diversification, simplified trophic webs and high levels of endemicity. It is estimated that mammalian introductions to islands have been responsible for 42% of island bird extinctions. Islands however, particularly small ones less than 5km^2 in size, have the greatest chance of an invasive species being successfully ***eradicated*** (Veitch and Clout, 2002) and there are several examples of introduced mammalian species, such as rats, being successfully removed from islands (for example Willcox, 2000; Zonfrillo, 2000).

Lundy Island, off the southwest coast of Britain, is a good example of a successful eradication of an invasive species and highlights the controversy of lethal control and the eradication of invasive species.

The Rats of Lundy Island

Lundy is a 500 ha island (below, centre) recognised as a Site of Special Scientific Interest (SSSI) due to its internationally important colonies of seabirds such as puffins (below, right). In 2002-2003, in light of evidence that introduced ***black*** (***Rattus rattus***) and ***brown rats*** (***Rattus norvegicus***) (below, left) were having a devastating impact on the island's bird populations, a collaborative project between English Nature, the RSPB and the National Trust (who own the island) was set up to eradicate the rats on the island (Appleton *et al*., 2002).

Several animal welfare organisations, such as Animal Aid, began campaigns to stop the eradication on the grounds that it was unnecessary and that the black rat, which is rare in Britain, were of conservation importance in their own right. Following a protracted consultation, during which such factors as the feasibility of the project, the legal requirement for the birds to be protected and the potential for non-target impacts were considered, the decision was eventually made to proceed. In 2004 the eradication was pronounced complete, but only time will tell whether the bird populations will recover and whether rats can be kept from re-colonising the island again in the future.

A Moral Minefield

It is impossible to avoid the fact that the issue of invasive species, particularly invasive mammals, is inextricably entwined with human value judgements and moral dilemmas. Thus, while eradication clearly represents the most effective strategy to mitigate the negative impacts of an invasive species, it is a solution that is often impractical and which does not always have the support of the general public. Public opinion, and hence the opinion of politicians and decision makers, is less dependent upon scientific evidence or legal requirements than it is influenced by other factors, such as the nature of the species in question, the history of the invasive species and animal welfare issues.

These influences are highlighted by examples, such as the rats on Lundy, where there has been strong lobbying from welfare organisations and the public to prevent the eradication of an invasive species. These objections are not always the result of the species being held in great affection by the public, but rather are founded on the belief that eradication is morally unacceptable and the feeling that further human intervention will only compound the effects of our previous mistakes. This point of view, that the ecosystem should be left to reach a new balance with the introduced species included, does have its merits, but it overlooks the fact that native biodiversity is at risk as a result of the invasive species' continued presence. The decision to cull an invasive species thus becomes a moral judgement of which species has the greater right to be

there – a decision that is extremely difficult to make and one which, when mirrored in human society, it is unacceptable to even consider.

The issue is made even more complex when the invasive species *does* have the affection of the public and nowhere has this been more acutely felt than in the Outer Hebrides, where there are currently projects underway to eradicate introduced mink and hedgehogs.

Conclusion

It seems, as a result of practical and moral obstacles to complete eradication, that many conservation organisations are committed to un-ending, expensive and labour intensive programmes of invasive species control – trying to hold back the tide but knowing that they could be over-run at any time. Perhaps, to save the financial and physical resources being consumed by this problem, we should hold up our hands and accept that we cannot overcome the challenge of invasive species except on the smallest of islands. Perhaps we should accept that some of our native species will be lost and take consolation from the fact that we now have 23 new species, including grey squirrels, mink and rabbits, to replace them. It is likely that many people would find this solution even less acceptable than eradication.

References

- Angus, S. (1993) Hedgehogs in the Western Isles in 1991. *Hebridean Naturalist* **11**, 73–76.
- Appleton, D., Booker, H., Bullock, D. Cordrey, L., Sampson, B. and Cole, L. (2002) The Lundy Seabird Recovery Project. *English Nature Publications*
- Baker, S. J. (1990) Escaped exotic animals in Britain. *Mammal Review* **20**; 75-96.
- Barreto, G.R., Rushton, S.P., Strachan, R. & Macdonald, D.W. (1998) The role of habitat and mink predation in determining the status and distribution of water voles in England. *Animal Conservation* **1**; 129-137.
- Brown, K. C. (1986) Animals, plants and micro-organisms introduced to the British Isles. *Department of the Environment, London, UK.*
- Chanin, P. R. F. & Linn, I. (1980) The diet of the feral mink (Mustela vison) in southwest Britain. *Journal of Zoology* **192**; 205-223.
- Courchamp, F., Chapuis, J-L. and Pascal, M. (2003) Mammal invaders on islands: impacts, control and control impact. *Biological Review* **78**: 347-383.
- Dunstone, N. (1993) The Mink. T. & A.D. Poyser Ltd, London.
- Gurnell, J. (1994) The red squirrel. *Mammal Society Publications, UK.*
- Gurnell, J., Wauters, L. A., Lurz, P. W. W. and Tosi, G. (2004) Alien species and interspecific competition: effects of introduced eastern grey squirrels on red squirrel population dynamics. *Journal of Animal Ecology* **73**; 26-35.
- Hewson, C., Fuller, R., Mayle, B. and Smith, K. (2004) Possible impacts of grey squirrels on birds and other wildlife. *British Wildlife* **15**.
- IUCN (2000) IUCN Guidelines for the Prevention of Biodiversity Loss caused by Alien Invasive Species.
- http://iucn.org/themes/ssc/pubs/policy/invasivesEng.htm
- Jackson, D. B. & Green, R. E. (2000) The importance of the introduced hedgehog (*Erinaceus europaeus*) as a predator of the eggs of waders (Charadrii) on the machair in South Uist, Scotland. *Biological Conservation*, **93**, 333–348.
- MacDonald, D. W. and Tattershall, F. (2001) Britain's Mammals: the Challenge for Conservation. *Mammals Trust UK Publication*.
- Manchester, S. J. and Bullock, J. M. (2000) The impacts of non-native species on UK biodiversity and the effectiveness of control. *Journal of Applied Ecology* **37**; 845-864.
- Pepper, H. and Currie, F. (1998) Controlling grey squirrel damage to woodlands. Forestry *Commission Practice Note* **4**.
- Pepper, H. and Patterson, G. (2001) Red squirrel conservation. Forestry *Commission Practice Note* **5**.
- Reynolds, J. C. (1985) Details of the geographic replacement of the red squirrel (sciurius vulgaris) by the grey squirrel (sciurius carolinensis) in eastern England. *Journal of Animal Ecology* **54**; 149-162
- Reynolds, J. C. (2003) Mink control in conservation. *Game Conservancy Trust Review* **34**, 42-46.

- Rushton, S. P., Lurz, P. W. W., Gurnell, J. and Fuller, R. (2000) Modelling the spatial dynamics of parapox virus disease in red and grey squirrels: a possible cause of the decline in the red squirrel in the UK. *Journal of Applied Ecology* **37**; 997-1012.
- Strachan, R. & Jefferies, D. J. (1993) The Water Vole Arvicola terrestris in Britain 1989-90: Its Distribution and Changing Status. The Vincent Wildlife Trust, London.
- Uist Wader Project (2002) Three potential methods of reducing the non-native Uist hedgehog population to conserve breeding waders: animal welfare and conservation considerations. *Uist Wader Project report.*
- Veitch, C. R. and Clout, M. N. eds. (2002) Turning the Tide: The Eradication of Invasive Species. *Proceedings of the International Conference on Eradication of Island Invasives. Occasional Paper of the IUCN Species Survival Commission No. 27. The World Conservation Union (IUCN) 414 pp.*
- Watson, J. (2004) Hedgehog bounty rises to £20 a head. *Scotland on Sunday* http://news.scotsman.com/politics.cfm?id=265842004
- Webb, D. A. (1985) What are the criteria for presuming native status? *Watsonia* **15**; 231-236.
- Willcox, N. (2000) A rat-free future for island seabirds? *English Nature Enact* **8**: 4, 12-14.
- Zonfrillo, B. (2000) Ailsa Craig. Before and after the eradication of rats in 1991. Ayrshire Bird Report.