

Introduced reindeer on South Georgia – a management dilemma

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Biological Conservation 47 (1989) 1–11 © 1989 Elsevier Science Publishers Ltd, England.

Abstract: Introduced mammals have had a major impact on the biota of islands in the Southern Ocean. Management plans for some islands include control measures for both introduced herbivores and carnivores that are justified on scientific grounds. In contrast, any active management of reindeer on South Georgia does not have a scientific justification since the survival of native species and communities are not at present threatened. Instead, the management option which is eventually chosen from those which are technically appropriate will be based on a value judgement by the management authority.

Key words: reindeer, feral, introduction, population ecology, impact on native species.

Rangifer, 9 (2): 59–65

Leader-Williams, N., Walton, D. W. H. & Prince, P. A. 1989. Innførte reinsdyr på Syd-Georgia – et forvaltningsproblem.

Sammendrag: Innførte pattedyr har hatt en vesentlig innvirkning på de biologiske forhold på øyer i Sydhavet. Forvaltningsplaner for enkelte øyer omfatter kontrollmålinger av både innførte gressetere og kjøttetere rettfærdiggjort av vitenskapelige grunner. I motsetning til dette, har en aktiv forvaltning av reinsdyr på Syd-Georgia ingen vitenskapelig begrunnelse, siden overlevelsen av lokale arter og samfunn ennå ikke er truet. Et eventuelt valg av forvaltningsmodell fra de som teknisk sett er hensiktsmessige, vil måtte baseres på en vurdering gjort av den forvaltende myndighet.

Rangifer, 9 (2): 59–65

(Tidligere publisert i: *Biological Conservation*, 47 (1989): 1–11)

Introduction

Decision-making in wildlife management often causes controversy, especially where this involves culling large mammals (e.g. Laws *et al.*, 1975; Lister-Kaye, 1980). Experiences of such controversy, largely derived from Africa, have led to clearer thinking about the decision-making process, separating out those

elements that are based on scientifically established necessity from those which involve value judgements (Caughley, 1981; Bell, 1983). Such clear distinctions have not yet been extended to all other areas. In the Antarctic region, for instance, there has been controversy between botanists and zoologists

over the removal of introduced herbivores on subantarctic islands in the light of the perceived importance of the protection of native vegetation (Campbell & Rudge, 1978; Wardle *et al.*, 1978).

Southern cool temperate and subantarctic islands are being increasingly recognised as areas of outstanding scientific interest and great natural beauty (Clark & Dingwall, 1985; Smith & Smith, 1987; Walton, 1987). The simplicity of terrestrial ecosystems and biota on southern islands makes them vulnerable to change and easily destroyed. Mammals that were accidentally or deliberately introduced to these islands, and ranging in size from rodents to cattle, have been important agents of change (Holdgate & Wace, 1961; Bonner, 1984; Leader-Williams, 1985, 1988). Calls for management policies to control the effects of introduced mammals have been made in recent years (Jouventin *et al.*, 1984; Walton, 1987). On South Georgia, grazing by three herds of introduced reindeer has caused major changes in both vegetation cover and species composition (Leader-Williams *et al.*, 1987). This paper aims (1) to examine whether or not there is scientific case for active management of the reindeer, in the context of conservation of the native flora and fauna on South Georgia, and of introduced animals on other subantarctic islands; and (2) to discuss the options available for management of reindeer.

Active management undertaken and planned on southern islands

The primary recommendation in a recent report on conservation in these southern islands (Walton, 1987), to the six national authorities concerned, was 'that the severity of the impact of introduced plants and animals on these sensitive island ecosystems be urgently assessed, that appropriate control measures be instituted as soon as possible to minimize damage and that the ecosystems be monitored to assess recovery'. Active management policies have already been implemented (a) by New Zealand, for sheep on Campbell Island (a fence was erected across the island in 1970 and all sheep to the north of it were shot); and for cattle on Campbell Island (all cattle were shot in 1986) (Muerk, 1982; Anon, 1983); (b) by Australia for rab-

bits on Macquarie Island (myxomatosis was introduced in 1978 together with its vector, the rabbit flea, and has resulted in a reduction, but not eradication, of the rabbit population) as the first stage of a programme to eliminate cats by reducing the availability of alternative prey (Brothers *et al.*, 1982); (c) by South Africa for cats on Marion Island (feline panleucopaemia virus was introduced in 1977 and attempts are being made to eradicate the remaining cats by shooting) (van Rensburg *et al.*, 1987).

In most cases where management has been undertaken, there has been some scientific justification for the management action. In particular, the cats on Marion Island were a recent introduction and were still irrupting. Though they have made a serious impact on the native avifauna, they have not apparently caused the extinction of any native species or subspecies. The scientific case for controlling rabbits (and cats) on Macquarie Island and sheep on Campbell Island was less strong, for each introduction was well established and extinctions of endemic bird subspecies from predation had already occurred on Macquarie (Taylor, 1979). However, these introductions were widespread across each island and very few representative areas for undisturbed native biota remained.

Further eradication plans have been adopted by New Zealand for goats on Auckland Islands (Anon, 1987). A long-standing French plan to restrict cattle, which have already severely damaged over half of the natural vegetation, to a small area of Ile Amsterdam (Jouventin *et al.*, 1984) has never been implemented, and no action or plan of action has been adopted for other French islands. There is adequate conservation legislation for the British islands, modelled on the Agreed Measures in the Antarctic Treaty, but no formal management plans have so far been formulated or adopted.

Reindeer on South Georgia

Reindeer were introduced to South Georgia as a sporting amenity by Norwegian whalers in 1911 and 1925. Each introduction was made to geographically separate areas of the island and no interchange between herds has occurred because of the presence of large glaciers at sea level. Each introduction irrupted

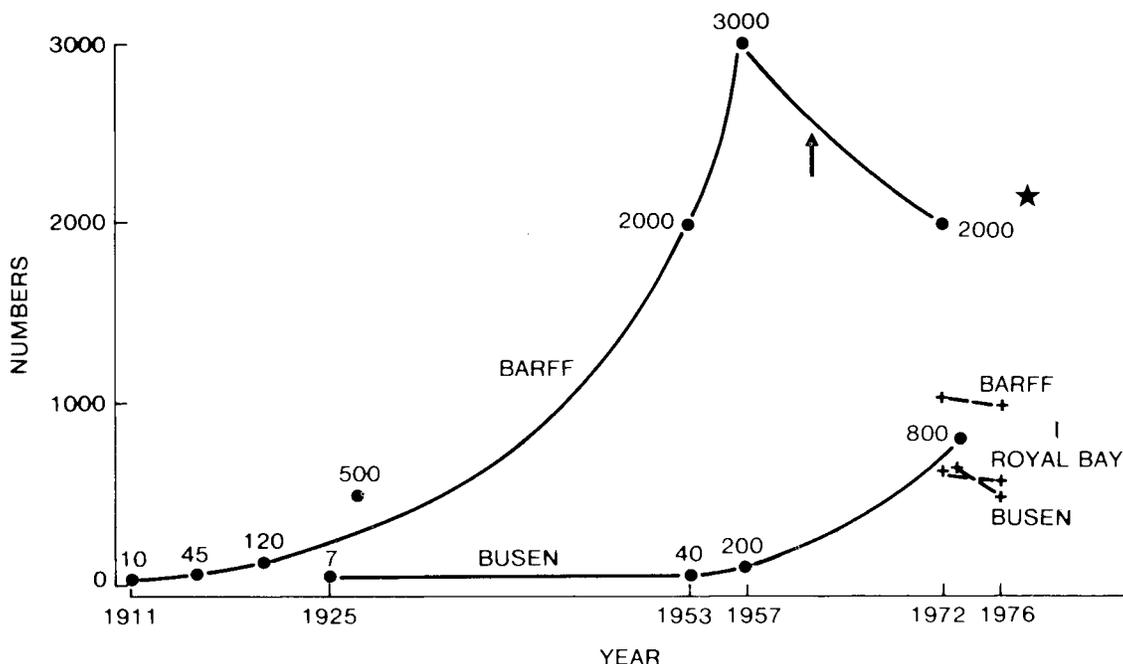


Fig. 1. Size estimates and the assumed increase and decrease of the Barff, Busen and Royal Bay herds (See Leader-Williams, 1980, for details of counts). —, total animals; ----, adults and yearlings.

(Fig. 1) and herds have reached peak numbers and declined. Part of the Barff herd emigrated around a glacier in the period 1961–65 to occupy the Royal Bay area (Fig. 2).

Despite being introduced, reindeer on South Georgia are protected under an ordinance to conserve wild animals and birds and may only be shot on issue of a permit. Up to 1965 the whalers shot small numbers of reindeer each year for fresh meat but this in no way constituted active management. A considerable number of reindeer were shot in the 1970s as part of an extensive study of their demography (Leader-Williams, 1988). The shooting of an unknown number since 1982 together with a lack of recent counts now makes it difficult to assess present herd sizes.

In contrast to reindeer and caribou in the Northern Hemisphere (Speiss, 1979; Ingold, 1980), the herds on South Georgia have no cultural or economic significance for man. Their chief interest in recent years has lain in the effects which their introduction have created in the native vegetation and in the contrasts between the irruptions of this introduction and those on arctic islands (Leader-Williams, 1988). However, in view of current interest in the conservation of southern is-

lands (Walton, 1987), their presence on the island poses a difficult management dilemma that should be resolved.

Is there a scientific case for management of reindeer?

The scientific case for eradicating introduced species varies in different situations and depends on the likelihood of preventing extinctions of endemic species and of retaining representative areas of undisturbed native plant and animal communities. In contrast to the control of cats on Marion Island, to a lesser extent, of sheep on Campbell Island, there is no scientific justification for control of reindeer on South Georgia for the following reasons:

- (1) The present range of the three herds occupies 313 km², which comprises only 20% of the snow-free area of South Georgia. The reindeer, therefore, have only a localised distribution and numerous biological 'archipelagos' exist around the island which have not been affected by grazing (even though many of them have been affected by the widely distributed introductions of the brown rat (Pye & Bonner, 1980)). However, the three herds graze

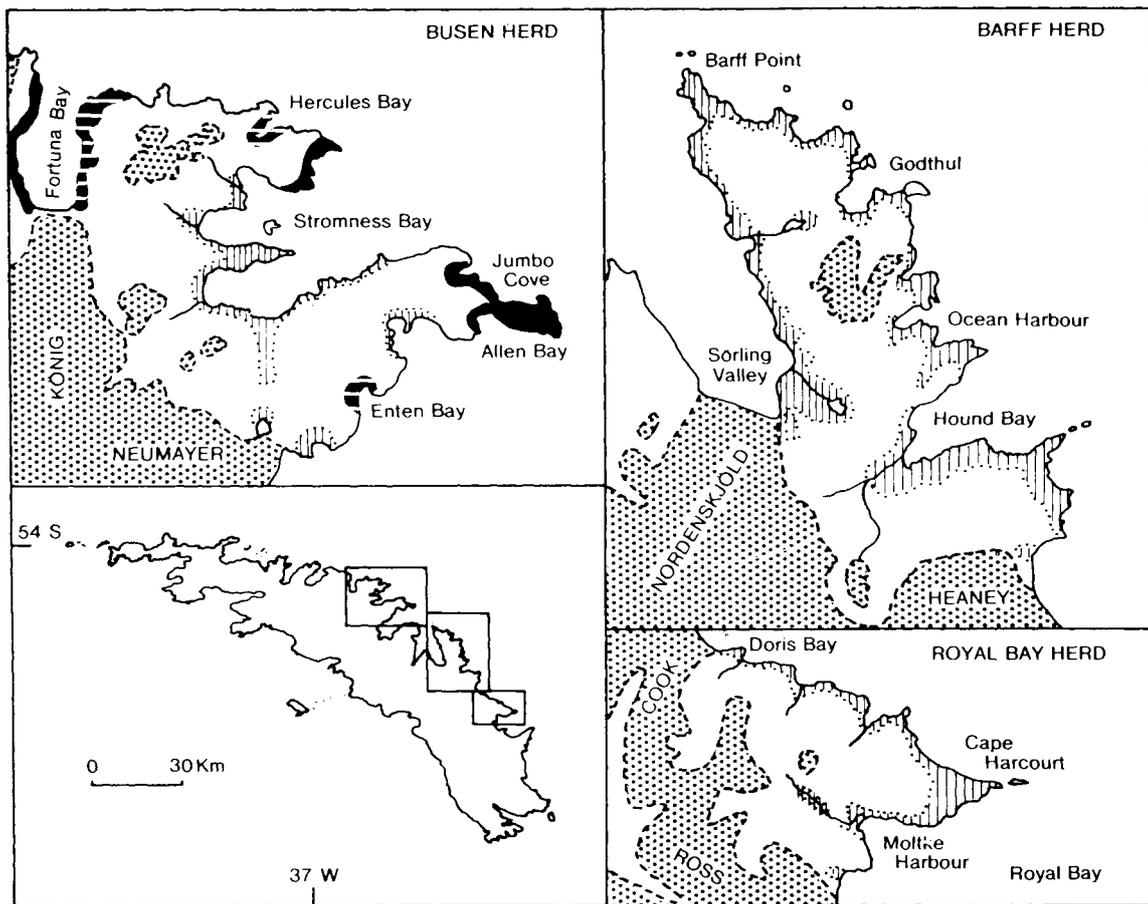


Fig. 2. Diagrammatic representation of the areas available to reindeer on South Georgia; the time of occupation of each area - Barff (1911), Busen (1925), Royal Bay (1961-65). ▨, areas grazed prior to 1976; ▩, areas recently occupied (McCann, 1987); ■, areas still ungrazed; □, non-vegetated ground or sparsely vegetated fellfield; ▧, permanent snow and ice.

the most floristically rich and extensively vegetated areas of South Georgia: many of the unaffected areas, especially on the southern side of the island, contain only a more limited range of plant species (Greene, 1964).

- (2) The reindeer have not caused any extinctions of native plant species in the areas they occupy. Reindeer have, however, caused moderate to severe overgrazing of the climax tussock grassland dominated by *Parodiocloa flabellata* (previously *Poa flabellata*), of macrolichens and of the dwarf-shrub community dominated by *Acaena magellanica*. This grazing has also encouraged the incorporation of the grazing-tolerant *Poa annua* into native plant communities. This species is now suffi-

ciently abundant and widespread to occur as a primary coloniser on recently deglaciated moraines. Enclosure experiments suggest that the dominant native species can recover when protected from grazing but that species diversity in these re-established communities may in some cases be different from that of the previously ungrazed stands (Leader-Williams *et al.*, 1987).

- (3) Brown rats survive best in the tussock grassland where they feed extensively on *P. flabellata* and invertebrates (Pye & Bonner, 1980). They have eradicated many of the smaller tussock-burrowing petrels and continue to predate white-chinned petrel chicks as well as threatening other burrowing species breeding in

adjacent habitats. Extensive and even moderate grazing of tussocks by reindeer is likely to have a positive effect in reducing rat food supplies and shelter. This in turn restricts any future major widespread range expansion by rats in areas occupied by reindeer.

- (4) Each of the herds has already irrupted and their numbers cannot therefore be contained by the active management, as in the case of cats on Marion Island. Any management attempted now would have the aim of re-establishing the balance in favour of native species at the expense of introduced species (Caughley, 1981).

Ironically, it might instead be argued that there is a different type of scientific case for not managing the reindeer. The irruption of reindeer has been studied in detail and the impact that their introduction has created is of undoubted scientific interest (Leader-Williams, 1988).

Options for management

Of importance in considering the future reindeer on South Georgia is the likelihood of further spread of reindeer around the land. Reindeer apparently will not cross or swim around any of the major glaciers to reach new areas. However, all the glaciers of South Georgia are ablating and retreating with the current warming trend occurring in the present interglacial period. The Cook and Heaney Glaciers to the south of the Barff Peninsula had retreated sufficiently for reindeer to emigrate round their snouts to the Royal Bay area in 1961-65. At present, however, the Nordenskjöld Glacier to the west of the Barff Peninsula and the Ross Glacier to the south of Royal Bay, and the Neumayer and Fortuna Glaciers that bound the Busen area, are large sea-entering glaciers that provide effective barriers to movement (Fig. 2). The possibility that these may retreat sufficiently in future to permit the spread of reindeer to other new areas must be borne in mind. In addition, a recent small-scale spread of reindeer has occurred from the Busen herd (McCann, 1987). When studied in 1976 several steep hill passes appeared to act as barriers to this herd,

restricting them to certain lowland areas on the Busen Peninsula. The herd has since spread through the passes to reach formerly ungrazed areas. Any small-scale irruptions in these newly occupied areas could be considered separately from decisions to be made about the future of the herds as a whole.

Control measures, if proposed for any animal, must be pragmatic. Eradication of the widespread brown rats, however scientifically desirable, is not a feasible proposition at the present time. Reindeer, on the other hand, are large animals that could be eradicated by shooting. Even though the topography of the island is rugged, the habitats all comprise open subantarctic tundra that offers a well-organised eradication campaign a good chance of success. Therefore, the range of management options at present available, and proposed are:

- (i) *Do nothing.* At present this course of action has been passively followed. It could be adopted as an active decision by the management authority in recognition of:
 - (a) the scientific interest that the introduction has created, and of its value to studies of population dynamics of large animals;
 - (b) the possible controlling effect on rat numbers and distribution, therefore indirectly maintaining existing burrowing petrel populations;
 - (c) as a reservoir population of Norwegian reindeer that are likely to remain free of radioactive pollution;
 - (d) the purely aesthetic value that the addition of reindeer have made to the fauna of South Georgia.
- (ii) *Prevent any further spread of reindeer to new areas and contain any new irruptions.* This course of action could be adopted with a view to retaining the presently localised distribution of reindeer on South Georgia and preventing damage by grazing to biotically important areas bordering their present range. Such a policy could be adopted in one of two forms:
 - (a) only to take action if reindeer spread to new areas outside their present glacier boundaries;

- (b) to take localised action now in the Busen herd to contain any irruptions that may occur in recently occupied areas (Fig. 2). This option could be achieved by shooting reindeer now occupying these areas and erecting fences across the mountain passes giving access to the new areas.
- (iii) *Eradicate reindeer in one or more areas by shooting.* This course of action could be adopted for reindeer from one herd (Busen), two herds (Barff and Royal Bay) or for all three herds in recognition of:
 - (a) the effects of reindeer on native plant communities, in lowering their productivity and in facilitating the spread of the introduced *Poa annua*;
 - (b) the likelihood of the recovery of the former abundance of most affected species in native plant communities when grazing pressure is removed;

It should be noted that a cull, as frequently carried out amongst natural populations when an imbalance is perceived between habitat and herbivore, is not presented as an appropriate option for introduced reindeer (Conroy, 1988). Clearly, a culling regime could be devised with up-to-date information on herd numbers, and fecundity and mortality rates. This might be appropriate only if there were profitable commercial returns to be gained in marketing the meat, but this seems unlikely with the relatively small and remote population of reindeer on South Georgia. Once entered into, however, continuous culling effort would need to be maintained (Caughley, 1983) if an objective was to minimise the effects of the introduced species. If a culling regime were to cease, this would simply recreate the conditions for an irruption in which there is a discrepancy between the numbers of animals present and the ecological carrying capacity of the habitat.

Conclusion - the choice of option

The role of the biologist in decisions involving management of wildlife populations is to provide a statement of the options available, their technical feasibility and the predicted outcome if they are adopted. In contrast, if

there is no scientific necessity for management, the decision as to which course of action should be adopted involves an aesthetic choice or a value judgement that is based on personal preference (Caughley, 1981; Bell, 1983). The choice of option for reindeer rests with the authority responsible for South Georgia and must be taken in the context of an overall future management plan for the island. Evidence to date suggests that no native plant species have been exterminated within the grazing range, and that the grazing pressure and consequent destruction of tussocks may have a controlling effect on rat populations, at least ensuring that any existing, burrow-nesting bird populations continue to survive. Thus the herbivore impact is different from that of introduced carnivores which are widespread on other southern islands, and where predation has caused the extinction of native or endemic species or subspecies.

The choice of which option to adopt for reindeer is not clear-cut. The population itself now has considerable scientific value. This must be weighted against the disruption, destruction and alteration of significant areas of the native plant communities and the protective effect reindeer may have on burrowing petrel populations. Reindeer control does not appear to be a priority issue on scientific grounds. There are strong scientific grounds to merit further investigations on the unexpected interactions between the two introduced mammals - reindeer and rats - and the native bird populations. Whatever option is eventually chosen should, however, be treated as a form of experiment, and the consequences of the action monitored in order to improve our knowledge of management practices (MacNab, 1983).

Acknowledgements

We are grateful to Drs. A. C. Clarke, J. P. Croxall, R. M. Laws and R. I. Lewis Smith, and to W. N. Bonner for much constructive criticism of the manuscript. The senior author gratefully acknowledges financial support from the Falkland Islands Dependencies Fund during the synthesis of reindeer data.

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