The introduction and naturalisation of birds

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Problems and management of naturalised introduced Canada geese *Branta canadensis* in Britain

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The increase in population size and geographic range of the Canada goose in Britain since the 1950s has resulted in many conflicts with human interests. The types of problems caused fall into five broad categories, related to the Canada goose's population ecology and distribution. These are: agricultural damage, amenity site impacts, effects on water bodies, possible competition with native birds, and the bird strike hazard to aircraft. This paper briefly outlines the problems and discusses the management options available in relation to current knowledge of Canada goose population biology.

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Introduction

Canada geese were introduced in the late 17th century to several country estates in England. Although they were well established by 1785 (Blurton-Jones 1956), there was little increase in numbers or geographical range until 1953-1957, when translocation schemes by the then Wildfowl Trust and the Wildfowlers' Association of Great Britain and Ireland resulted in over 700 birds being moved to new sites throughout England (Ogilvie 1969). Since these relocations, numbers have grown steadily at an annual rate of between 5% and 8%. The rate of increase has been greater in some favourable habitats such as gravel pits (19.5% p.a.) and reservoirs (20% p.a.) (Giles 1992), and the creation of such habitats has clearly contributed to the species' increase (Giles 1992). In addition, changes in land management, such as the improvement of marginal pasture and recent increases in winter-sown cereal production, may have contributed to the increase in Canada goose numbers by providing high quality food supplies (Wright & Giles 1988), particularly during the late winter (Parkin & McMeeking 1985). If maintained, the current growth rate of 8% p.a. will lead to a doubling of the 1991 population of 63,500 birds by the year 2000 (Delany 1992).

Canada geese are most abundant in the Midlands and south-east England, with relatively small populations in Scotland, Wales and Northern Ireland (Delany 1992). This distribution partly reflects the slow spread of the population from the sites to which birds were moved in the 1950s, and partly the availability of lowland lakes, reservoirs, gravel pits and urban water bodies which are particularly favoured habitats (Delany 1992). Canada geese are also found on upland reservoirs, however, and are increasingly colonising moorland areas (Garnett 1980). As well as increasing their range within the country, Canada geese are also increasing their density in already occupied areas. Delany (1992) found that population density had increased from 44 Canada geese per occupied 10km x 10km square in 1976, to 111 birds per occupied square in 1991.

The increase in size and range of the Canada goose population in the UK has led to growing conflicts with man. This paper outlines these conflicts and the biological processes that underlie them, and assesses how knowledge of the birds' population dynamics and behaviour can be used to identify management options that can be integrated into strategies to solve particular problems.

Conflicts between man and Canada geese

Agricultural damage

On farmland, Canada geese are regarded as a significant localised pest (Simpson 1991). They may remain at good feeding sites for prolonged periods, leading to cumulative damage to grazing pasture and crops, especially where these are close to water bodies (Traill-Stevenson 1987). Damage may be caused to crops such as cereals, oilseed rape and root crops by overgrazing (White-Robinson 1984; Traill-Stevenson 1987; Simpson 1991). Spring pasture can also be adversely affected by large numbers of Canada geese grazing, fouling and trampling their feeding areas (Giles & Street 1990). There is little

information concerning the direct impact on yield, and the associated financial cost, of crop damage by Canada geese in Great Britain (see Allan, Kirby & Feare 1995 for a summary of evidence of damage in North America). One indication of the increasing concern felt by farmers and landowners is the number of licences for control of Canada geese in England issued by the Ministry of Agriculture, Fisheries and Food. This has increased from 35 in 1988 to 111 in 1993 (*ibid.*), illustrating the increasing impact the species is having in rural areas.

Damage to amenity sites

In urban areas, especially in the south-east, where the Canada goose population has undergone the largest increase (Delany 1992), fouling and damage by trampling and overgrazing to rural parks, golf courses and city parks is reported to be serious (Hughes & Watson 1986; London Ecology Unit 1995). A single Canada goose produces 0.8 kg of droppings each day (Giles 1992). Paths may become slippery and dangerous and the birds' droppings may carry human pathogens making the site both unsightly and unhygienic (London Ecology Unit 1995; CSL unpubl.). Cleaning of paths and the reinstatement of damaged vegetation was estimated to cost £40 per bird per year in one London park (P. Clarke, pers. comm., quoted in Allan, Kirby & Feare 1995).

Impact on water quality

Canada geese may contribute to the eutrophication of water-bodies (Conover & Chasko 1985; Mott & Timbrook 1986; Manny, Johnson & Wetzel 1994). Only 25-30% of the food value of the vegetable matter Canada geese eat is absorbed (Giles 1992). Increased nutrient loadings may trigger algal blooms which are particularly problematic on waters used for public recreation. Blue-green algal toxins are extremely hazardous to fish, domestic animals and humans (National Rivers Authority 1990). The geese are also reported to damage reed beds (Wall 1984), and vegetation such as willows *Salix* spp., resulting in bank erosion.

Possible competition with other waterfowl

Canada geese may compete with native waterfowl for nest-sites, feeding and roosting areas. Palmer (1976) remarked on their intolerance to other species during the breeding season. Anecdotal reports suggest that Canada geese may drive away ducks *Anas* spp. and mute swans *Cygnus olor* by sheer weight of numbers (Giles 1992), and may compete with wigeon *Anas penelope* for grazing (Hughes & Watson 1986). In a study of one mixed population of waterfowl in England direct aggressive interaction between Canada geese and other waterfowl during winter was rare (CSL unpubl.). Further research is needed before the true impact of Canada geese on other species can be determined.

Threat to air safety

Canada geese have been involved in several bird strikes, both in Britain (Milsom 1990) and in America (Fairaizl 1992). Their large size and tendency to form flocks makes them a particular threat to aircraft and the growth of populations close to major airfields gives increasing cause for concern (Allan & Feare 1995).

While all of these conflicts are well known, the extent or cost of damage has rarely been assessed. Work is in progress in Britain to determine the extent of damage in public parks (London Ecology Unit 1995), the potential health risk posed by Canada goose droppings (CSL unpubl.), and the extent to which Canada Geese compete with other waterfowl (CSL unpubl.).

These and other assessments of the seriousness of damage caused by Canada geese are clearly important in determining whether management action is justified. Once a management programme becomes necessary, the selection of the most appropriate techniques for a particular site must take into account both their long term effectiveness and humaneness. These aspects require an understanding both of the nature of the problem and of the biology and population dynamics of the geese if the strategy is to be successful.

The management of Canada geese in relation to their population dynamics

The management strategies available to control Canada goose populations fall into three categories: increasing mortality of full grown birds, reducing the output of young, and modifying behaviour. The tactics selected to manage Canada geese must take into account their protected status and the ecology and behaviour of the particular population concerned. In Britain, the Canada goose is protected under the Wildlife and Countryside Act 1981. During the shooting season (September 1-January 31, or February 20 on the foreshore) Canada geese may legally be shot. Control methods involving

destruction of birds in the close season or removal/ destruction of eggs, or using any technique otherwise prohibited by the Wildlife and Countryside Act, must be carried out under government licence issued by the Department of the Environment or the appropriate Agriculture Ministry or Department. Licences may be issued to control Canada geese for the prevention of serious damage to livestock, foodstuffs for livestock, crops, vegetables, fruit, growing timber or fisheries, the preservation of public health or public or air safety, the prevention of spread of disease, and the conservation of wild birds. The Wildlife and Countryside Act does not identify damage to property as a justification for the issue of licences and such licences cannot, therefore, be issued to help prevent damage to amenity land although, in some cases, there may be an associated health or safety risk.

Ideally, the tactics available for managing Canada goose populations or behaviour should be employed as part of an Integrated Management Strategy (IMS). Some knowledge of the population dynamics of the birds involved is needed as this enables techniques to be selected on the basis of the maximum likelihood of success in achieving objectives in a given situation. Unfortunately, our understanding of the relevant aspects of Canada goose population dynamics and behaviour is still incomplete and we outline below available techniques (previously discussed by Feare (1991); Giles (1992); Allan, Kirby & Feare (1995)) in the light of currently available biological information.

Increasing mortality of full grown birds

Short term increases in the mortality of fully grown birds are usually achieved by shooting or rounding up flightless birds during moult and culling them.

Shooting in the open season is an option for removing small numbers during the autumn and winter. The proportion of Canada geese in the total goose bag in Britain has risen from 11% in 1980-81 to 36% in 1987-88 (Harradine 1991). Estimates vary, but up to 16% of the total UK population may be shot by hunters each year (Giles & Street 1990). Giles & Street (1990) also thought that once a local flock had reached a size of more than 200 birds, shooting was largely ineffective in population control and studies of shooting pressure have shown how difficult it is to increase mortality (e.g. Imber & Williams 1968 (New Zealand); Chapman, Henny & Wright 1969 (USA)). This difficulty arises in part from the birds' increased wariness in response to shooting: at one CSL study site in Yorkshire, pheasant shooting and opportunistic shooting of Canada geese (only 5-20 geese, out of a flock of about 400) caused the geese to become extremely shy, making observation of marked birds very difficult, but when the shooting season ended, the birds became less wary again (pers. obs.).

In addition, increased shooting pressure may lead to displacement of flocks to other areas. This may make further control more difficult, especially if the birds are driven to urban areas where shooting may not be possible due to public opposition and concerns for public safety (London Ecology Unit 1995). Further constraints on the use of shooting as a control technique are imposed by the scaring effect it may have on other bird species. During the close season licences are, therefore, normally granted to allow shooting in order to reinforce other scaring measures, rather than to reduce populations.

Culling during the moult in the first two weeks of July is perhaps the most efficient, humane (Giles 1992) and practical way of achieving a rapid reduction in local numbers and an immediate cessation of damage. Rounding-up the flightless birds requires considerable manpower and expertise, and these operations can generate public opposition. The efficacy of culls of moulting birds in reducing numbers and damage in the long term is not known. The fidelity of Canada geese, particularly females, to their breeding site (Lessells 1985), and the resulting slow recolonisation of a breeding area when a breeding flock has been removed (Palmer 1976), suggest that it may take some considerable time before a site is re-occupied. At one East Midland estate, it was reported that a cull of breeding birds was effective when combined with annual egg control (Downing 1991) but no further details are available.

The restriction of movements of Canada geese within a number of largely discrete local sub-populations (Watola *et al.* in prep.) further suggests that rates of re-colonisation might be low. Various authors (e.g. Blurton-Jones 1956; Ogilvie 1969, 1977; Thomas 1977; Parkin & McMeeking 1985; Hughes & Watson 1986; Walker 1986) have suggested that Canada geese in Britain exist in discrete regional populations, although Delany (1992) reported that the spread of birds had caused these regional populations to merge. Watola *et al.* (in prep.) have found that analysis of colour-ringed Canada geese dispersal in Yorkshire indicates that recognisable local sub-populations exist, and these are important in determining the

scale at which management techniques should be applied.

Further studies of the effects of culls on population dynamics and movements are needed, both when culls alone are employed and when they are used in conjunction with other techniques. Canada goose population growth is facilitated by the establishment of new colonies by pairs leaving their natal site (Hughes & Watson 1986, Allan, Kirby & Feare 1995). If the processes involved in rounding up birds encourages birds not captured to disperse, culls could stimulate the establishment of new colonies, thereby spreading the problem to other sites. Because of the existence of local sub-populations which may make use of several water bodies (Watola *et al.*, in prep.), co-ordinated culls may be necessary to alleviate problems in a given area (Giles 1992). This can pose particular difficulties where damage alleviation at one site can be achieved only by culling birds at a moult site, which may be on a neighbouring property.

Control of reproduction

In the absence of techniques for the chemical or immunological sterilisation of Canada geese, reproductive control may be achieved by shooting breeding adults at the nest (Feare 1991) or by preventing eggs from hatching. In Britain, both techniques require a licence under the Wildlife and Countryside Act, and the shooting of adults on the nest may be further constrained by public acceptability. Eggs may be simply removed from the nest, but the female may re-lay if the clutch is not complete. Re-laying can be prevented by hard-boiling, pricking holes in the shells (Gross 1951) or by coating eggs with liquid paraffin (Baker *et al.* 1993) to kill the embryo before returning them to the nest. Replacement of eggs with substitutes made of wood, plastic or pottery will also prevent relaying (Wright & Phillips 1991). These techniques require time for the location of all nests, but are attractive in that they appear acceptable to the public by being perceived as a more humane control method (Baker *et al.* 1993)

The long term effectiveness of egg control in reducing breeding populations is not known, but Barnard (1991) used a computer simulation to estimate that it would take six years to halve the numbers in a colony if 100% egg control were achieved. In practical terms, six years is a long time for landowners to wait for a reduction in damage and they may regard this kind of delay as unacceptable. A further difficulty may arise from the process of locating nests and treating the eggs; this disturbance may stimulate dispersal to areas where the birds are less accessible for control (Hughes & Watson 1986).

In recent trials (CSL unpubl.) it proved extremely difficult to achieve 100% egg control at large sites where birds nested in dense scrub. Furthermore, in the study region, only 90 pairs, out of a population of 1400 birds, bred each year, suggesting the existence of a large reservoir of non-breeding birds. These birds would thus be available to move in to fill vacated nesting territories, and sustain the population at a prime breeding site, even after prolonged egg control. Egg control may thus take considerably longer than six years to reduce numbers at sites such as these, and, for successful management, reductions in the production of young must be accompanied by other techniques, particularly those involving an increase in adult mortality.

Management of behaviour

Techniques for influencing the behaviour of geese include relocation, scaring, physical exclusion, habitat modification and the use of chemical repellents. Behavioural modification is most often employed when short term protection of vulnerable crops is required. For longer term control, these techniques should be used in combination with reductions in the number of full grown birds and reductions in breeding output. For example, in order to reduce the bird hazard caused to aircraft by Canada geese in Reno, Nevada the disruption of roosts and feeding areas, scaring with visual and sound devices, exclusion from roost sites, public education, relocation of goslings and the creation of a suburban goose refuge were all elements of an integrated pest management plan that were implemented by a task force (Fairaizl 1992).

In Britain, relocation is rarely employed as a management technique. It requires licensing under the Wildlife and Countryside Act, and generally serves only to move the problem elsewhere, if not actually providing a stimulus to renewed population growth, as shown by previous relocations in Britain (Ogilvie 1969), Sweden (Sjoberg & Sjoberg 1992) and the USA (Fairaizl 1992). The geese also tend to return to their site of origin (Hughes & Watson 1986), unless they have been pinioned. While relocations were taking place as recently as 1980 in Britain (Hughes and Watson 1986), it is thought unlikely that further licences will be issued for this purpose (London Ecology Unit 1995).

Scaring is generally unsuccessful in urban situations, or over long periods, as the geese become quickly habituated to the stimuli utilised, generally an acoustic or visual device (Conover & Chasko 1985; Feare 1991). Some methods, such as the use of screamer shells (Aguilera, Knight & Cummings 1991) are effective, but the geese will relocate to other sites and may increase the area of conflict (Giles 1992). The strong site fidelity of Canada geese (Raveling 1969; Schultz, Cooper & Zicus 1988) also means that constant vigilance by landowners and an extremely intensive scaring technique would be required at any site where the geese are causing long term damage.

Physical exclusion by fencing (Parkin & McMeeking 1986), tapes (Summers & Hillman 1990) or the use of plastic wire grids over water (Fairaizl 1992) can be successful, but is rarely attempted due to cost and impracticality at many sites. Predators such as foxes are known to predate a high proportion of nests that are not on islands (Giles & Wright 1987), so fencing or barrier tapes on islands that exclude Canada geese may be particularly useful at some sites, with birds forced to breed on the mainland being more susceptible to predation and disturbance (Johnson & Sibly 1991), and so having a lower breeding success. The placing of one or two strands of wire around shorelines as a means of excluding Canada geese from island breeding sites has been recommended (London Ecology Unit 1995). This method is successful at some sites, but not at others, and requires more study into its efficacy.

Habitat modification of the sites frequented by Canada geese has also been recommended (London Ecology Unit 1995). Reese, Kadlec & Smith (1987) studied the characteristics of artificial islands used by breeding Canada geese and found that low islands with short vegetation were preferred, with the nest sites close to the waterline. Modification of characteristics such as these might reduce attractiveness to Canada geese. Conover (1991) found that certain plants, such as English ivy *Hedera helix*, were actively avoided by Canada Geese, so the provision of unpalatable ground cover could reduce numbers at a site. The planting of more shrubs, to reduce the openness of a site, and trees to limit the angle of flight approach, could also reduce numbers at a site (Conover & Kania 1991; Conover 1992). Wherever any such modifications are proposed, however, consideration must be given to any likely effects on other waterfowl.

Mason & Clark (1992) have reviewed chemical bird repellents in depth. They concluded that the lack of progress in this field in the USA is partly due to the small economic impact of many bird pests, resulting in little commercial research. However, methyl anthranilite, a commercially available compound (Vogt 1992), has been proven to be safe, non-toxic to humans, biodegradable and repels Canada geese (Mason, Clark & Adams 1989; Cummings *et al.* 1991; Avery 1992; Askham 1992). This compound deserves further research in Britain on the basis of these properties. The major drawbacks are the short period of effectiveness of the chemical necessitating frequent re-applications and the need to target Canada geese, while not deterring other waterfowl species at a site. Cinnamamide has also been proved effective in deterring birds (Crocker *et al.* 1993; Gill *et al.* 1995), and its effectiveness against Canada geese also needs investigation.

Conclusions

The Canada goose is a highly successful introduced species, whose recent increase and spread appears largely related to human intervention and its adaptability to man-made environments. If numbers continue to increase, the conflicts between man and Canada geese are likely to become more severe and widespread. Such conflicts may have a high public profile, particularly when control methods involving the destruction of adult birds are employed. Concerns over damage have led the Ministry of Agriculture, Fisheries and Food and the Department of the Environment to fund research aimed at identifying the need for management and providing management guidelines based on a sound knowledge of the species' biology. The latter body has convened the Canada Goose Working Group to co-ordinate activities and direct funding. Integrated management strategies (Feare 1991; Giles 1992; Allan, Kirby & Feare 1995) are the most appropriate means of resolving particular local problems, but the techniques to be used, and the scale of the management needed, require further research.

The public perception of Canada geese as tame, amenable and even aesthetic assets to public areas and the countryside, may differ radically from that of local authorities or landowners. The public, and the conservation bodies that represent them, must be convinced of the need for management and of the efficacy and humaneness of methods used if future controversy is to be avoided. Education and guidance must thus be readily available (Canada Goose Working Group 1994), and any decisions taken based on sound long term research.

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