

DEVELOPING METHODOLOGIES FOR MONITORING DEER IMPACTS IN THE 'WIDER COUNTRYSIDE': INITIAL SCOPING STUDY (RP35a)

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**Developing methodologies for monitoring deer impacts
in the 'wider countryside'**

Initial scoping study

Final revised report

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1. Background

In its Long Term Strategy, the Deer Commission for Scotland (DCS), has stated a commitment to identify areas where damage by deer is occurring, and to develop, through research, effective techniques for deer management (DCS, 2001). DCS is currently tackling deer damage to the natural heritage through a twin approach:

- the Priority Site process which aims to identify and resolve particularly significant 'hotspots', primarily on Natura sites designated under the European Commission's Species and Habitats Directives;
- through advising on collaborative deer management in the 'wider countryside', i.e., areas situated outwith designated protected sites such as Sites of Special Scientific Interest (SSSIs) and Natura sites.

There are strongly-held opposing views on whether or not the latter approach is adequate, focusing on deer causing damage to biodiversity targets and in the wider countryside: 'diffuse damage'. This is a debate receiving significant political and press attention, but for which there is currently insufficient objective data analysis. DCS flagged up this issue for ongoing review in recent formal advice to SEERAD on deer legislation. The issue has also been raised at the formal interagency liaison group and at the Deer Research Co-ordination Committee where the need to undertake objective data analysis received full support. However, it should be recognised that the term 'damage' is subjective, and implies that deer primarily have negative impacts on diverse aspects of the natural heritage. There are also positive benefits of deer, for instance, in terms of supporting the livelihoods of those depending on nature tourism, stalking or the sale of venison for their incomes; and also with regard to the need for low levels of trampling to promote seedling establishment. Accordingly, this report considers both the positive and negative impacts of deer.

The new Nature Conservation (Scotland) Act 2004 gives added impetus to this work as the DCS, as a public body, has the duty "in exercising any functions, to further the conservation of biodiversity so far as is consistent with the proper exercise of those functions" (Section 1). This clearly implies that the DCS may have to consider the conservation of biodiversity in all parts of Scotland occupied by deer. Furthermore, the introduction of land management orders to conserve, restore or enhance SSSIs and "land which is contiguous to, or which SNH considers to be otherwise associated with, a site of special scientific interest" (Section 29), implies closer collaboration with Scottish Natural Heritage (SNH) in monitoring deer populations and their impacts in many areas, whether these are formally designated for conservation or not. Closer cooperation with other government agencies in such activities will also derive from the fact that land contiguous to certain SSSIs is under the jurisdiction of Forest Enterprise Scotland; and that grazing, browsing, and trampling impacts often derive from not only deer, but also domestic livestock, so that this is a concern of SEERAD and the Crofters' Commission. Particularly with regard to impacts in riparian zones and more broadly affecting the quality and quantity of water flows, closer cooperation with the Scottish Environment Protection Agency (SEPA) is likely to increase in importance, towards the implementation of the Water Environment and Water Services Act (Scotland) 2003. All of this environmental legislation is likely to focus much more attention on the management of whole river catchments and the role of large herbivores, including deer, in affecting habitat quality across catchments.

DCS may also need to pay increasing attention to landscape and other aspects of public enjoyment of the countryside. The UK and Scottish governments appear to be moving closer to support for a European Landscape Directive. Even if this does not lead eventually to new statutory powers to protect landscape, there could be an increased need for public bodies, such as DCS, to take account of enhanced public expectation of improved landscape protection and enhancement. This will include a need to recognise that the natural beauty of large areas of Scotland is increasingly

recognised as a key element in making Scotland a ‘world class tourism destination’ (Scottish Executive 2002).

With regard to public access, the Land Reform (Scotland) Act 2003, expected to become operational in late 2004, may have implications for the DCS. The access component of this legislation provides for a statutory right of access to most land and water, with the intention of increasing public opportunities for the enjoyment of Scotland’s countryside although this is unlikely to create any difficulties in relation to stalking or culling operations

Finally, it has to be stressed that all species of deer are “wild animals” and, while individual landowners enjoy the rights to stalk and cull such animals, they only become the property of landowners, or their agents, after being killed. Deer populations are an intrinsic part of the natural heritage of Scotland, clearly recognised as a community or public asset. The management of these populations, especially where impacts, both positive and negative, are concerned, raises issues of stewardship and of whether the concerns of the wider public – as opposed to more narrow private aspirations – are being met.

1.1. Objectives

This report reviews existing information on:

a) how public interest objectives are defined in the wider countryside;

b) potentially suitable datasets for assessing deer impacts;

in order to provide an assessment on how existing information at a) and b) above could be used to produce a robust methodology for assessing whether local but diffuse impacts by deer in the wider countryside are occurring.

2. Deer species and populations in Scotland

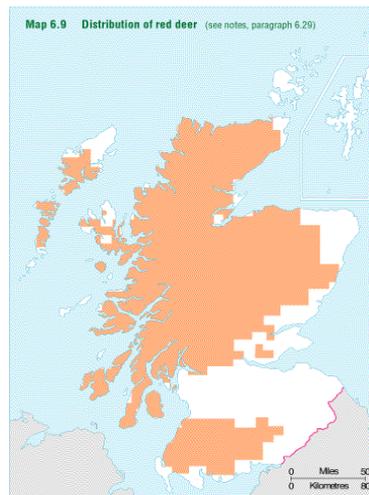
Two native species of deer, and two or three non-native species, currently live wild in Scotland. The total population of deer in Britain is around one million. While precise estimates of populations cannot be given because all free ranging species of deer are difficult to count, especially in woodland areas, most species are increasing in their range (Mayle 1999). These increases are due to a variety of factors, including increases in areas of woodland habitat which provides favourable shelter and food and consequently increased fecundity. Milder winters and reduced grazing competition from sheep are considered additional factors in increasing the range of deer species..

Concern has been expressed over many years at the potential negative impacts of an increased population of deer. However there are examples whereby initiatives by government and non-government organisations (e.g., by Scottish National Heritage (SNH), the Royal Society for the Protection of Birds [RSPB] and the National Trust for Scotland [NTS]) have been successful in reducing deer populations and have led to enhancement of Natura habitats. Potential issues which could mitigate against achieving habitat enhancement include (1) where natural winter feeding areas have been removed from the deer range, usually by fencing for forestry, and adequate compensatory culls have not been carried out, (2) a reluctance to carry out culls, because of a perceived reduction in stalking potential, (3) perceived lack of staff resources to undertake culling operations and (4) concerns for neighbouring landowners sharing the same deer range.

2.1. Red Deer

Red deer are native to Scotland and have been present for around 10,000 years since post-glacial times. In the 18th century as a result of anthropogenic activities, numbers of red deer declined significantly, surviving in only a few Highland locations. As interest increased in the stalking of red deer as a sport in the 19th century, deer forests were created and numbers increased (Staines *et al.*, 1995). In 2000, the DCS estimated a population of around 350,000 (DCS, 2000); Hunt (2003) suggested that this was an underestimate, and that the total number may be 454,000, including 100,000 woodland deer, but provided no evidence in support of this suggestion. Although there is general agreement that their range are increasing, it is extremely difficult to give an accurate indication of the current red deer population in Scotland. This is for a number of reasons, including the limited resources of DCS for population counts, and the increasing numbers of red deer occupying woodlands which makes obtaining accurate counts much more difficult. There is also the discrepancy that arises through variations in both methods used in counts – i.e. on the ground or from a helicopter – and the individuals involved with such counts. In general, counts from helicopters are higher than those on the ground in the same area (Milner *et al.* 2002, Rao 2004). Red deer now inhabit most of mainland Scotland except some east coastal fringes. They also occur in the inner Hebrides (Skye, Arran, Mull, Islay, Jura) and the Outer Hebrides (Lewis, Harris and Uist) (Scottish Office, 1998).

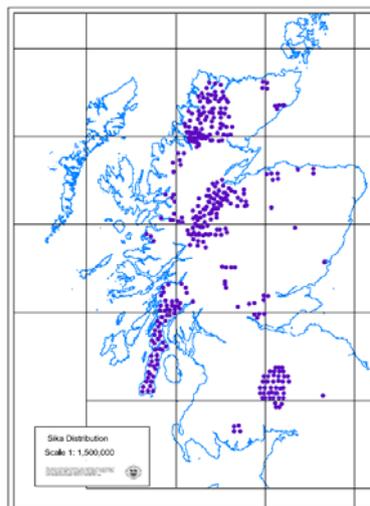
Figure 1. Red deer distribution in Scotland (Scottish Office, 1998)



2.2. Sika Deer

Unlike red deer, this species is not native and was introduced in the 1800s from Japan as an addition to estates and deer parks (Mayle 1999). They are primarily a woodland species and within this habitat they can become highly productive reaching high densities (Hunt 2003). Sika deer are able to hybridise with red deer producing fertile offspring, which some people view as a long-term threat to native red deer populations. Sikas are now widely distributed throughout the north and central Highlands, Argyll and the Borders and have been locally recorded in parts of central Scotland (Deer Commission for Scotland).

Figure 2. Sika deer distribution in Scotland (Deer Commission for Scotland)

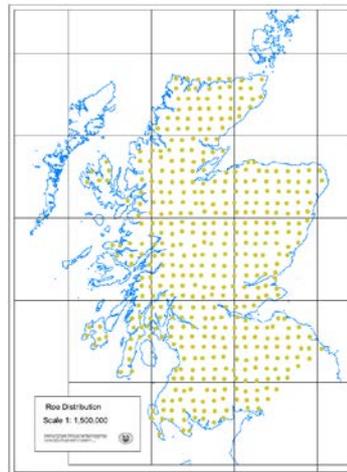


2.3. Roe Deer

Roe deer are native to Scotland and mostly inhabit woodlands, although they will also occupy wetland areas, moorland and the outskirts of urban areas. Roe deer are difficult to count and, according to Hunt (2003) “no systematic counting attempts are made”. In 2000, the DCS estimated

a population of between 200,000 and 400,000 roe deer in Scotland (DCS, 2000). However, as with all population estimates, opinions vary as to the accuracy of this figure. In favourable habitats, roe deer can be highly productive (Ratcliffe and Mayle 1992). Roe deer are widely distributed throughout mainland Scotland and are present on Islay and Skye (Figure 3).

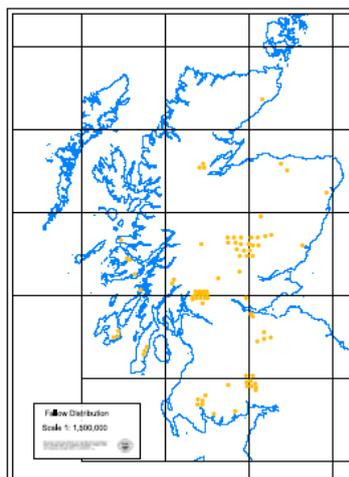
Figure 3. Roe deer distribution in Scotland (Deer Commission for Scotland)



2.4. Fallow Deer

A non-native species thought to have been introduced from France, fallow deer now inhabit several areas of Scotland, living mostly in woodland areas (Figure 4). The population is estimated at 8,000-10,000 (DCS 2000).

Figure 4. Fallow deer distribution in Scotland (Deer Commission for Scotland)



2.5. Muntjac Deer

This non-native species is currently widespread through southern and central England, with an estimated population of around 50,000. Muntjac can occupy a range of habitats including suburban areas and in favourable habitats, such as woodlands, can reach high densities. Although they have

spread into parts of northern England, it is not known whether they are currently occupying areas in Scotland. As muntjac is not listed under the Deer (Scotland) Act 1996, they are not covered by this legislation..

3. Potential impacts of deer: positive and negative

There are a number of different interests on which deer can have potentially important impacts, both direct, e.g., through browsing, grazing, and trampling, and indirect, e.g., through the erection of deer fencing and through soil erosion where vegetation has been removed. In some situations, such as those involving road safety, the simple presence of deer on or near the road can be an important factor.

When considering the diffuse impacts of deer, it is important to consider how the animals distribute themselves within an area. Herbivores tend to distribute their movements unevenly across a landscape, depending particularly on their foraging behaviour (Milne *et al.* 1998). Consequently, the extent to which resources, such as food, shelter and water, act to draw herbivores will be reflected in the way in which landscape heterogeneity drives the distribution of herbivore populations and their impacts on the resources (Palmer *et al.* 2003).

A determination of the impacts occurring within a given area can only be partially objective; it will always be, to some extent, subjective. The perceived importance of any impacts very much depends on the management objectives for a particular estate or piece of agricultural, forest, or upland land. For instance, managers responsible for areas of woodland regeneration (concerned with timber production and/or biodiversity), will have a differing view on what are acceptable or sustainable levels of impact from those responsible for areas focused on deer stalking. Similarly, managers who wish to maintain areas as heathland habitats will wish to minimise colonisation by trees, and high grazing levels can be effective in this; but those interested in the restoration of the same areas to montane scrub would wish to have low grazing levels. In any situation, a range of complex ecological processes, economic pressures, and social, cultural, and political values must be integrated into the decision-making process (Tremblay *et al.* 2004).

Natural heritage and biodiversity

As discussed in more detail in section 4 in relation to specific species, habitats, and parts of Scotland, the impacts of deer on soils and vegetation include browsing, grazing, trampling bark stripping, and dung deposition, each of which can potentially have significant and specific negative impacts in diverse habitats (Hunt 2003). Loss of heather has been recorded locally (Francis *et al.* 1991) and where supplementary feeding leads to high densities of deer. Lower plants (mosses and lichens), though largely ungrazed, can be adversely affected by trampling and loss of shelter due to heavy browsing of the plants among which they grow (JNCC 2004a). In forests, grazing and changes in vegetation can also have detrimental effects for some vertebrate and invertebrate fauna (Gill, 2000, Milne *et al.* 1998). However, certain species, such as carrion feeders and dung beetles – many of which are rare – benefit from higher populations of deer (Gill 2000); dung deposition can also lead to the introduction of species, provide nutrients, and affect herbivore foraging (Milne *et al.* 1998). Some annual species, such as alpine gentian (*Gentiana nivalis*), require trampling and grazing to create regeneration niches (Miller, 1993). Grazing in damp woodlands and scrub in West Scotland is important in maintaining clearing for the chequered skipper butterfly (*Carterocephalus*

palaemon) (Ravenscroft, 1994). In other words, the impacts of deer populations vary greatly depending on the element(s) of the natural heritage being considered.

Native woodland

Deer can influence the variety of wildlife in woodlands by altering habitat structure and plant species diversity and, at high densities and, particularly in the presence of livestock, can prevent regeneration and destroy the shrub layer (Palmer *et al.* 2004). However, when deer are present in low densities they can have a positive impact as their browsing helps to control dense shrubs, and their selective feeding patterns create a mosaic of vegetation which can enhance biodiversity (Mayle 1999, Palmer *et al.*, 2004). In addition, appropriate levels of trampling are beneficial in promoting seedling establishment, especially of small-seeded species such as birch (Milne *et al.*, 1998), and light use could be desirable for the regeneration of oakwoods (Mitchell and Kirby, 1990).

Commercial forestry

Deer can affect both the quality and quantity of timber produced from commercial forests through the browsing of young trees, stripping bark from older trees and fraying saplings with their antlers (Armstrong *et al.*, 2003a). At the same time, the erection of fencing to keep deer (and other species) out of plantations and commercial forests can both concentrate grazing outside the enclosure and lead to the development of excessively uniform canopy and field layer structures, providing sub-optimal habitats for many woodland species (Peterken, 1993). This may work against the breeding success of grouse species, which may experience increased mortality when they fly into the fences (Baines and Summers 1997).

Landscape, recreation and tourism

Recreation and tourism generate hundreds of millions of pounds a year and are the most important sources of employment in Scotland's mountain areas (Price *et al.*, 2002). A silhouetted stag on the skyline, a herd of red deer running across the moors, and open heather moors are among the sights that visitors come to see.

Tourism is also important to the economy of lowland areas. These are likely to see significant changes in coming years as the government increases its efforts to encourage more active lifestyles, with greater participation in healthy exercise and all forms of outdoor recreation. Gaining greater access to the countryside around towns and cities, especially through the provision of new walking, cycling and riding routes, along with statutory rights of access to field margins and all paths and tracks, is now a cornerstone of public policy for the countryside and has implications for deer management. One positive aspect of increased public use of the countryside can be where the frequent presence of people discourages deer from using certain areas. For example, this could be valuable where the reduced density of deer during all or part of the year is sufficient to reduce grazing pressure on young trees and shrubs, enabling them to develop into new woodland.

In the lowlands, the increasing presence of roe deer, combined with an apparent reduction in interest in stalking in such areas, could create difficulties with new woodland establishment. Efforts to stop the browsing of planted broadleaves by roe deer could lead to deer fencing being erected around most new woodlands, unless individual tree guards are used. Fences provide obstacles to access, with regard both to climbing over them and to ease of movement through the dense vegetation in enclosures. Such obstacles to access could produce conflict with local community groups and

outdoor recreation interests who resent the ‘parcelling up’ of the local landscape, with freedom of access curtailed or confined to corridor routes.

Agriculture, orchards and gardens

At low densities, deer grazing on cereals and grasslands tend to do little damage to the final crop, and often they feed on the weeds and herbs rather than on the crops themselves. However, at higher densities, negative impacts can occur through both grazing and trampling (Mayle, 1999). Many crofters and farmers have to fence in byelands and gardens to protect crops. The DCS authorises out of season and night shooting to protect agriculture; Hunt (2003) suggests that the proportion of the total cull of red deer shot for this purpose is now less than from 1976-90, when it averaged 12% of the total cull. Deer also trespass into orchards and gardens: locations where the DCS has no jurisdiction.

Stalking, culling and deer welfare

While total income from stalking in the Scottish uplands is significantly lower than for non-consumptive outdoor recreation, stalking continues to be important in the economy and culture of the uplands (Price *et al.*, 2000). A fundamental problem, however, is that the costs associated with the maintenance of a sporting estate, in virtually all parts of Scotland, are significantly greater than the income from sporting lets and sales of venison. Where the primary land use objective is timber production, as on Forestry Commission land, the costs associated with culling deer and maintaining large amounts of deer fencing may outweigh the revenue resulting from stalking and culling (suggested by Hunt 2003). The Ramblers’ Association Scotland (2004) has called for the removal of ring fences around Forestry Commission land, combined with culling and alterations to the forest structure, so that deer populations are in balance with the habitat over wider areas.

However, when deer increase above optimum densities, their habitats may no longer be able to support such populations and as a result deer can suffer poor health, reduced fecundity and increased mortality. Such impacts are not only relevant from an animal welfare viewpoint, but also detrimental to those who depend on high-quality animals as a source of income through the sale of venison or through stalking. Many shooting clients are willing to pay more for high-quality stags (Bullock 2001).

Soil erosion

It has been suggested that heavy grazing and trampling by deer and other herbivores have accelerated soil erosion in the uplands but the evidence is inadequate (Taylor 1995; Milne *et al.*, 1998), and the proportion due to deer is not possible to estimate. However, it should be noted that fencing across lines of habitual diurnal movement on steep slopes can lead to increased local soil erosion and is therefore undesirable (Milne *et al.*, 1998)

Public safety

The greatest threat to public safety from deer is through road traffic accidents and collisions.

3.1. Deer and livestock

Around two million sheep currently graze in upland Scotland and, in the past, the sheep population was considerably higher than today (Warren 2002). Sources of information on numbers of wild herbivores (deer, rabbits, hares) and livestock (cattle, sheep, feral goats) are discussed by Milne *et al.* (1998). As discussed below, grazing by livestock as well as deer is viewed as a major issue in many biodiversity action plans. For both deer and livestock, it is not the overall numbers of animals present in an area that is fundamental to determining the potential impacts but, more importantly, the distributions of the animals within a given area. These change in space and time for both ‘natural’ reasons (e.g., movements between grazing areas depending on forage availability or snow lie) and management reasons (e.g., herding of sheep from hill to inbye land); and also in response to disturbance, e.g., by recreational users. In areas from which sheep have been removed, both deer numbers and range have increased to replace them (Mclean 2001). Generally speaking, deer will move into land where competition for grazing is reduced, moving in from other estates in order to exploit the improved conditions (Rose 2004). On heather moorland, this may affect the vegetation because deer eat more mature heather than sheep (Grant *et al.*, 1987).

While the overlap between deer and sheep habitat is perhaps most significant, there are also areas where deer and cattle habitat overlap. Cattle are thought to provide biodiversity benefits in woodlands when grazed at low density, benefiting tree regeneration and leading to a greater variety of vegetation types and associated invertebrate and bird assemblages (Armstrong *et al.*, 2003b). A survey of cattle-grazed woodlands in the UK found sheep at 54% of the sites grazed by cattle in Scotland, and roe deer at 75%, red deer at 58%, sika deer at 12% and fallow deer at 5% (Armstrong *et al.*, 2003b). The co-location of different species was one factor in the finding that models of sapling density vs. herbivore pressure had low predictive power. It was concluded that “The lack of suitable controls meant that it was impossible to differentiate between the impacts of cattle and other large herbivores”.

The issue of whether deer or livestock are responsible – or in what proportion – for a variety of diffuse impacts across Scotland is a contentious one, which requires more research (Milne *et al.*, 1998) and long-term monitoring. In particular, there has been far more research a) on the impacts of livestock (sometimes mixed with deer) than on the impacts of deer *per se*, and b) on the impacts of deer in woodlands than in other habitats, so that the evidence-based understanding of these impacts in woodlands is greater than in other habitats. For both deer and livestock management, an additional issue requiring careful consideration is the differing views of different elements of the public, NGO, and private sectors and how to set informed management objectives that will achieve jointly-defined goals.

4. The definition of public interest objectives in the wider countryside

Public interest objectives include maintaining, enhancing, and promoting the enjoyment of landscapes and biodiversity; protecting wildlife and other aspects of the natural heritage, protecting and enhancing woodlands and commercial forests; promoting the safety of citizens (e.g., car drivers and passengers); optimising the volume and pattern of river flows by increasing water retention values in river catchments, e.g., through habitat improvements; and minimising the risk of erosion and natural hazards such as floods. It should also be recognized that the ‘wider countryside’ is not uniform. This section considers how public interest objectives relating to deer are defined in UK, Scottish and local biodiversity action plans and strategies; the Natural Heritage Futures and Natural Care programmes of Scottish Natural Heritage (SNH); Scottish forestry; and in relation to vehicle accidents.

This section principally contains material that relates to biodiversity objectives. These have been defined through comprehensive consultations and investigations over many years, especially since the impetus given to this area of work with the international commitments secured at the United Nations Conference on Environment and Development (Earth Summit) in Rio de Janeiro in 1992. Other natural heritage objectives, especially those relating to landscape and the public enjoyment and study of nature, are far less well defined and possibly never will be, given that such objectives are not as easily quantified as many aspects of biodiversity protection and enhancement. Also, far fewer resources have been devoted to the system by which nationally important landscapes are defined in Scotland (NSAs), than the equivalent national nature conservation designation system (SSSIs). Consequently, little can currently be concluded from an examination of the purposes and objectives of NSAs that can be specifically related to deer management and its impacts. An exception is the impact of vehicular hill tracks created to aid deer management. Such tracks have been a major concern in a number of NSAs and more generally in the countryside.

Although landscape objectives in relation to deer management are generally not well defined, there are many situations where they coincide with biodiversity aims. Many of the Biodiversity Action Plans mentioned below refer to pressures on species or habitats from herbivores. In some situations, a reduction in grazing pressure especially where it leads to the recovery of tall herb and bog communities, or shrub and woodland vegetation, will be seen to satisfy both biodiversity and landscape objectives.

A further factor to consider is that the most significant statutory designation which integrates biodiversity, landscape, recreation and local community interests in Scotland is the relatively new National Parks legislation for Scotland whereas, by contrast, the legislative framework for nature conservation or biodiversity was passed in 1949.

4.1. Biodiversity Action Plans

4.1.1. UK Biodiversity Action Plan

The UK Biodiversity Action Plan (BAP), launched in 1994 (Anon, 1994), was the product of a consultation between the government and over 300 organisations from throughout the UK, over the key issues raised in the 1992 United Nations Convention on Biological Diversity. The UK BAP describes the UK's biological resources and assigns a detailed plan for the protection of key resources. There are three types of action plans: 391 Species Action Plans (SAPs), 45 Habitat Action Plans (HAPs), and 162 Local Biodiversity Action Plans (LBAPs). These plans set priorities for both nationally and locally important wildlife and habitats, each including actions and targets with reporting on the targets undertaken every 3-5 years. The UK BAP website (www.ukbap.org) is the source of all data and information in the following two sections on SAPs and HAPs, which are illustrative, rather than exhaustive, in their coverage.

4.1.2. Species Action Plans

In a number of SAPs, deer are cited as a factor associated with causing loss of, or decline in, species numbers through direct or indirect effects. An example can be taken from the SAP for capercaillie (*Tetrao urogallus*), a localised breeding species confined to Scottish native pinewoods. It became extinct in the UK during the mid-18th century and was reintroduced in the mid-19th century.

Numbers have declined rapidly throughout its range in Northern Europe over recent decades, with the current UK population now estimated at 2,200 birds in winter. Under current factors causing loss or decline, collision with deer fences is cited, as is over-grazing by both deer and sheep which reduce the vigour of ground vegetation. It is proposed that one aim to manage and safeguard important sites is to promote reduced grazing by deer and sheep in order to encourage regeneration of native pinewood and blaeberry understorey, and to allow removal of fences.

Grazing by deer, and management activities associated with them, are also mentioned in other SAPs:

- black grouse (*Tetrao tetrix*): collisions with deer fences;
- juniper (*Juniperus communis*): excessive grazing preventing establishment of young bushes;
- twinflower (*Linnaea borealis*): unrestricted grazing by deer, sheep or cattle affecting pinewood habitat;
- *Alectoria ochroleuca*, a yellow-green fruticose lichen growing on the ground on the Cairngorm plateau, usually amongst prostrate heather (*Calluna vulgaris*): grazing by red deer, and also recreational (mainly skiing) disturbance;
- *Hammerschmidtia ferruginea* (a hoverfly), which mainly lives in aspen woodlands: effects on regeneration of woodlands through overgrazing by deer;
- narrow-headed ant (*Formica exsecta*): intensive management of moorland for game birds and red deer.

There are also other species where grazing by deer is considered a possible threat, but more research is needed: e.g., Northern Prongwort (*Herbertus borealis*), Silky swan-neck moss (*Campylopus setifolius*).

4.1.3. Habitat Action Plans

The impacts of grazing by deer and sheep are mentioned in a number of HAPs. Many of these habitats support a number of species which themselves are identified as rare or endangered and, in many cases, have their own SAPs. Of particular relevance is the native pinewoods HAP, which concerns native mixed forests dominated by pine, thought to have covered over 1.5 million ha in the Scottish Highlands about 4,000 years ago. Now they occupy around 1% of this former range, some 16,000 hectares, spread over 77 separate areas across the Highlands. One of the primary factors influencing native pinewoods as wildlife habitats is the poor natural regeneration and reduced diversity due to browsing by deer and sheep. A proposed action to aid site protection and management is the advisory approach to co-ordinate advice, training and financial assistance on the management of deer in areas where they are a major constraint upon the diversity or regeneration of pinewoods.

Grazing by deer (and often other herbivores) is also mentioned in other HAPs:

- upland oakwood: overgrazing by deer and sheep;
- upland mixed ashwoods: overgrazing by sheep, deer and rabbits in the western and northern uplands, leading to change in the woodland structure, ground flora impoverishment and difficulties for regeneration;
- wet woodland: inappropriate grazing levels and poaching of the soil by sheep, cattle and deer leading to a change in the woodland structure, ground flora impoverishment and difficulties for regeneration:

- acid grassland: inappropriate grazing regimes by sheep, cattle, ponies and deer; typically excessive grazing levels at the wrong time of the year, which causes the habitat to become degraded;
- blanket bog: heavy grazing by sheep, red deer, cattle and horses, especially if accompanied by supplementary feeding, burning, fencing and drainage, has a significant impact on vegetation;
- upland heathland (heather moorland): loss and prevention of regeneration through heavy grazing by sheep as well as red deer and cattle.

In most cases, the proposed action, with lead partners including DCS as well as other agencies including SNH, is to:

- provide advice to land managers on management regimes appropriate to the geographical distribution and ecological variation found in the habitat;
- promote the management of deer and other grazing animals in areas where they are (or might become) major limitations on the regeneration and spread of the habitat.

For upland heathland and blanket bog, the proposed action is to “develop by 2005 regional strategies to reduce red deer numbers in Scotland to levels where [the habitat] is maintained in favourable condition”. For all of these habitats, a key issue is that grazing by not only deer, but also – and in some cases predominantly – domestic livestock is also identified as an issue of concern.

4.1.4. Local Biodiversity Action Plans

Local Biodiversity Action Plans (LBAPs) have been created as a way of encouraging effective local action on the national priorities identified in the UK BAP, as well as for the species and habitats which are particularly valued in local areas of Scotland. The LBAP scheme is based on the principle that everyone has a stake in their local environment and the quality of life it supports - from national government agencies to local community groups, from environmental organisations to local businesses, and from farmers to school children (www.scotland.gov.uk/biodiversity).

All Scottish LBAP Officers with rural remits were contacted by e-mail to request information on the extent to which their LBAP considered impacts from deer. Responses were either in the form of brief statements or the provision of entire LBAPs, which were then searched. This information, which represents the LBAPs which cover most of Scotland’s area, is summarised in Table 1.

Table 1. Coverage of impacts of deer in LBAPs

LBAP	Are Deer Impacts Addressed?
Argyll and Bute	No
Ayrshire	Yes
Cairngorms	Yes
Caithness	Yes
Clackmannanshire	No
Dumfries and Galloway	Yes
East Dumbartonshire	Probably in the future
East Lothian	No
Lochaber	Yes
Northeast Scotland	No
North Lanarkshire	No
Renfrewshire	Possibly in the future

Ross and Cromarty	Yes
Skye and Lochalsh	Yes
Sutherland	Yes
Tayside	Yes
Western Isles	Yes
Wester Ross	Yes
West Lothian	Possibly in the future

Ayrshire

The Ayrshire LBAP refers to deer damage in montane habitat, native woodland and conifer plantation. However no specific actions or targets are set in relation to the threat. Specific reference is made to coordinated cull programmes for red and roe deer. Neighbouring landowners/managers must work together in order for their control measures to be cost-effective. All stalkers must report their cull figures to the DCS, and the Forestry Commission is increasingly strong in demanding that quality Deer Management Plans (DMPs) are put in place.

The LBAP team have not considered collating information across Ayrshire to determine the scale of damage (or culling) that is presently taking place. However, East Ayrshire Woodlands is working to encourage Scottish Coal, a major landowner in upland southeast Ayrshire, to put effective controls in place. This is anticipated to help promote natural regeneration of trees in undisturbed parts of opencast mine areas and improve neighbouring semi-montane habitats.

Cairngorms

The Farmland and Grassland chapter of the LBAP states that main issue affecting calcareous grassland is overgrazing from sheep, rabbits and deer. Actions include concentrating on reducing red deer numbers where their impacts are significant at the earliest opportunity.

The Acid Grasslands chapter states that the main issue is overgrazing, and that removing deer (rather than sheep and cattle) from acid grassland sites may result in a return to floristically and mycologically diverse grasslands. Actions include concentrating efforts on reducing red deer numbers where their impacts on acid grassland are severe.

In the Montane, Heath and Bog chapter, under inappropriate management issues, both the over grazing and under grazing of deer and sheep are mentioned. Relevant actions include support for the formation, development and work programmes of local Deer Management Groups (DMGs), to reduce impacts of high grazing levels of deer. It is also noted that deer are regarded as a local issue in relation to trampling the nests of dotterels and unrestricted grazing (also by sheep and cattle) is affecting the habitat of twinflower.

The Woodland chapter states that, in many areas, high densities of deer pose one of the greatest threats to existing woodland and to future woodland regeneration and expansion. Actions include support for DMGs on a catchment level; setting and revising site-specific cull targets based on objectives for the site; and the (monitored) response of woodland and non-woodland vegetation.

Caithness

The Forest and Woodland chapter of the LBAP notes that the majority of semi-natural woodlands are isolated and in poor condition through logging for firewood, inappropriate heather burning and heavy grazing by deer, rabbits and domestic stock. Woodland regeneration is constrained by the need for stock or deer fencing, although some restoration and expansion has occurred through fencing or planting programmes in the last 10-15 years. Bird strikes on deer fences are less of an issue than further south, but fences create an unnatural woodland edge and structure. Reduction in grazing pressure by more effective deer control and shepherding is an alternative. One biodiversity objective is therefore to control deer and rabbits to encourage the natural regeneration of semi-natural woodland from existing seed sources.

The Bog, Moor and Hill chapter notes that high deer and sheep numbers and a decline in shepherding have resulted in increases in rough grassland, dominated by indigestible plants such as tussock grass and purple moor grass, at the expense of heather moorland. This overgrazing also exacerbates localised wind erosion and runoff. Almost none of the ground has been allowed to develop into birch woodland, so the county remains bare of trees to an unnatural degree. One biodiversity objective is therefore to ensure deer and sheep grazing is kept to an appropriate level by the retention of stalkers to manage the deer population and through effective shepherding.

Clackmannanshire

Impacts from deer are not seen as a significant issue.

Dumfries and Galloway

The Native Woodland Local HAP identifies over-grazing by sheep and deer as a main threat to Upland Oakwoods. The related actions are to 1) formulate integrated strategies for management of deer and feral goats and 2) research further the relationship between grazing of woodlands and biodiversity value with a view to advise about management on appropriate levels of grazing and control of grazing where necessary.

The Montane Local HAP notes that overgrazing by sheep, goats and deer has caused the loss of much alpine and sub-alpine dwarf-shrub heath, scrub, herb-rich vegetation and moss-heath by conversion to grazing-tolerant grasses. The related actions are to 1) identify the grazing regimes used to manage the best examples of montane habitat and thus to develop a strategy to identify priority areas which might respond to a reduction in grazing pressure; 2) encourage landowners to actively manage deer populations in montane areas.

The Upland Heathland Local HAP notes that inappropriate management of sheep and red deer and heavy grazing are incompatible with maintaining upland heath cover and diversity and marked losses are sometimes exacerbated by excessive burning. However, there is no action specifically mentioning deer.

The Acid Grassland Local HAP notes that one main cause of change is inappropriate grazing regimes (sheep, cattle, deer), typically excessive grazing at the wrong time of year. However, there is no action specifically mentioning deer.

East Dumbartonshire

There is nothing specifically in the LBAP as it is a summary and does not specify detail. However, it is expected to have to decrease the number of roe deer as part of woodland management by as much as 70%, depending on area.

East Lothian

No action is taken within this LBAP area in regard to the potential impacts caused by deer, and no deer control measures are operated by the East Lothian Council on any of its sites. Any deer control measures will be undertaken on private estates outwith LBAP concern.

Lochaber

The Woodland chapter of the draft LBAP notes that red and roe deer seek food and shelter in ash and hazel woods on fairly steep slopes and isolated fragmented remnants of birch woods, and that this results in very little regeneration. Grazing by sheep is also noted as a factor. Conversely, it is recognised that some ground flora depends on a certain amount of grazing, and some ground disturbance by cattle or deer can help tree regeneration.

In the Mountain and Moorland chapter, promoting an integrated approach to deer and sheep management is a specific objective. It is noted that high numbers of red deer and sheep in recent decades have led to plant impoverishment and have prevented vegetation erosion from recovering in some hill and moorland habitats. A proposed future action is to instigate a review process regarding the reduction of deer numbers.

In the Built Environment chapter, in relation to new developments, it is noted that when non-native grass seed and plenty of fertiliser are used, grazing animals such as sheep or deer are attracted to the roadside to eat the sweeter grass, which could reduce the overall development of species diversity and lead to road accidents.

North Lanarkshire

Although deer have had impacts on some woodlands, these have not been sufficient to stop regeneration of woodlands on otherwise undisturbed sites, so this issue is not identified in the LBAP. Away from the urban areas, grazing of domestic livestock has been highlighted as more of an issue and deer are not on the LBAP agenda.

Renfrewshire

Impacts from deer have not been raised as an issue and therefore have not been incorporated into the LBAP. However there is an action plan for broadleaved and mixed woodland and, as work progresses in this area, whether deer impacts are an issue or not will be assessed.

Ross and Cromarty

The Forest and Woodland chapter of the LBAP notes that the natural regeneration of semi-natural woodland is currently limited by grazing and browsing by red and roe deer, sheep and rabbits, as well as by neighbouring land uses such as farming, grouse shooting or deer stalking. The reduction of grazing by sheep and deer may now be more feasible through CAP changes and the work of DMGs, and could be attempted in some parts of the area in an effort to restore this missing habitat.

The Bog, Moor and Hill chapter notes that inappropriate grazing by sheep and deer has a major influence on hill vegetation. Some sensitive species have been confined to inaccessible locations such as cliffs by overgrazing, which prevents the regeneration of woodland and montane scrub.

Future actions include 1) encouraging land managers to reduce deer or sheep numbers to levels that permit the survival and expansion of grazing-sensitive species while enhancing the welfare and quality of the remaining, smaller deer population; 2) promoting the use of deer fencing where appropriate (using high visibility fencing to avoid collisions from species such as grouse where necessary).

Skye and Lochalsh

The Mountain and Moorland chapter of the LBAP notes that large numbers of red deer and sheep, particularly in recent decades, have led to impoverishment of moorland and upland habitats and loss of the amount and condition of native woodland in these areas. A future action is to encourage land managers to reduce grazing pressure in some areas, through reduction in deer or sheep numbers and the use of deer fencing where appropriate (using high visibility fencing to minimise risk of collisions from species such as grouse where appropriate).

The Built Environment chapter notes that new roads or developments have been built with little or no regard for the potential impacts on local habitats or species, and that where non-native grass seed is used, grazing animals such as sheep or deer are attracted to the roadside to eat the sweeter grass. A future action is to consider green bridges over roads in areas of high deer mortality, with appropriate fencing.

Sutherland

The River, Loch and Wetland chapter of the LBAP notes that some wetland and waterside vegetation has been lost due to land drainage, flood defence, bank protection works, cultivation, forestry or heavy grazing by cattle, sheep or deer. Overgrazed or heavily trampled river banks are susceptible to erosion during floods. No specific action is identified.

The Forest and Woodland chapter notes that over-grazing by deer, rabbits and domestic stock, bracken expansion and inappropriate felling and burning have left many semi natural woodlands isolated and in poor condition. A reduction in grazing pressure by more effective deer control and shepherding will benefit many woodlands outwith specific schemes.

The Mountain and Moor chapter notes that high deer and sheep numbers, and a decline in shepherding, have resulted in overgrazing which has led to increases in rough grassland at the expense of heather moorland. This may cause localised erosion and run-off. One identified objective is to reduce the numbers of sheep and deer in certain areas where overgrazing has been identified as a problem. One action is to support the production and implementation of DMPs.

Tayside

In the Farmland chapter of the LBAP, deer are mentioned as causing problems in some areas through overgrazing and are cited as a major threat to Alpine Fleabane and Alpine Gentian.

The montane habitats section of the Upland chapter states that grazing pressure from deer should be reduced, and that surveys on designated sites show that some montane habitats are deteriorating due to trampling and grazing by deer and sheep. Deer are cited as a main threat to Golden Plover, Dotterel and Ptarmigan as a result of trampling; and as a threat to Alpine Sowthistle, Alpine Fleabane, Alpine Gentian and Alpine forget-me-not, as a result of grazing. Objectives in this section

include the reduction of grazing and trampling by deer and sheep. Rapid habitat assessments should be undertaken to give an indication of the quality of montane habitats. The upland heath section of the Upland chapter also notes that red deer numbers are increasing in Tayside, leading to some localized heavy grazing within the traditional red deer range. For both montane and upland heath, habitats, one action is to develop and implement DMPs in all sub-areas of DMGs, following DCS guidelines.

The Woodlands chapter mentions deer as a cause for decline of the narrow headed wood ant, as a result of their indirect impacts caused by intensified management of moorland for deer and grouse. They are also cited as impeding the development of native pine woods through grazing pressure.

Western Isles

The Western Isles LBAP includes a Native Woodlands HAP which identifies browsing and fraying by deer as a factor affecting the habitat, causing direct damage to regeneration and mature trees. The associated action is to develop long, medium, and short-term plans for controlling the deer population on the islands.

Wester Ross

The Mountain, Moorland and Grassland chapter of the LBAP notes that, in some areas, large numbers of deer and sheep have led to overgrazing of some moorland and upland habitats. One action is to promote the inclusion of biodiversity within estate management plans and DMPs, recognizing that a key issue for achieving the right balance between grazing of livestock is the use of incentive or regulation where appropriate.

The Built Environment chapter notes that verges sown with 'sweet' grasses attract deer to the roadside and cause accidents. Where verges are to be sown, care should be taken to select a locally appropriate grass and wild flower mix.

West Lothian

The woodland Action Plan sub-group of the LBAP partnership has taken on the subject of impacts from deer. The highways service is recording deer kills as well as badgers in order to gain a better understanding of road safety. The impacts caused by deer are not a matter addressed in the current LBAP, but are raised as an issue in the revised version which is under development.

Summary

LBAPs consider a wide range of issues relating to public interest objectives in the wider countryside with regard to deer. Most frequent are those relating to levels of grazing that are perceived as too high to permit regeneration, mainly of tree species. In upland habitats, inappropriate levels of grazing are often mentioned not only as a source of decreased biodiversity (or its maintenance as lower levels) but also as a cause of increased erosion and runoff; thus potentially causing flooding and impaired water quality, which are also not in the public interest. In one case, this is also mentioned in relation to heavy grazing in riparian habitats. However, deer are generally only one of a number of species mentioned with regard to inappropriate levels of grazing, underlining the need not only for DMPs, but integrated plans developed by stakeholders across a wide region and which address the management of all grazing animals and, where appropriate, muirburn. One issue that

does relate primarily to deer fencing which, as noted in the SAPs for capercaillie and black grouse, can be an important cause of mortality – and also creates unnatural woodland edges and changes in structure. The other issues relate primarily to traffic safety along roads, and especially in new developments where seeding with non-native grasses is identified as an attractant to deer.

4.1.5. Scotland's Biodiversity Strategy and Implementation Plans

Scottish Biodiversity Strategy was published in May 2004. It represents Scotland's response to its obligations under the Convention on Biological Diversity, the European Union's 6th Environmental Action Programme and the UK BAP, together with the Scottish Government's aspiration to position biodiversity at the heart of our national identity and culture (Scottish Executive, 2004). The grazing of deer (and sheep) is recognised as one of the main causes of changes in biodiversity (p. 19), with particular mention of reduction in the regeneration of heather moorland and the decline of montane heath (p. 21).

The strategy has a 25-year time horizon, and initially will be implemented through actions developed by five working groups, which have developed draft implementation plans in the following areas: Urban; Rural; Marine; Local delivery; and Interpretation, communication and education. In addition to these five plans, a 'cross-cutting issues plan' has been developed to include actions which are relevant across all sectors. The three-year actions in these plans remain in draft form and are currently subject to a consultation process. Among the proposed actions which could be considered as potentially relevant to the theme of this report are:

Rural 2.7: Develop targeted information programmes for local communities and the wider public (visitors and off site) on the biodiversity values of uplands and how individual and community actions can contribute to or decrease the effectiveness of biodiversity conservation.

Rural 3.4: Reduce threats from key landscape/ecosystem-scale factors threatening biodiversity.

Rural 3.6: Improve regional coordination of LBAPs across local government boundaries with regard to shared habitats/species.

Rural 4.6: Strengthen deer management policies and practice to meet biodiversity conservation objectives.

Rural 5.9: Research to understand the nature of environmental change affecting biodiversity values in the uplands (especially grazing intensity by different species, restoration, climate change); and to develop methods for adaptive management to achieve biodiversity goals (including definition of appropriate levels of management).

Cross-cutting 5.8: Develop co-ordinated monitoring and data management strategies for biodiversity in Scotland as part of/ linked to wider initiatives such as MAGICScotland and NBN.

Many of these proposed actions are complementary to those identified in SAPs, HAPs, and LBAPs. Only one (Rural 4.6) specifically mentions deer, and essentially reiterates the duty on the DCS under the new Nature Conservation (Scotland) Act.

4.2. Natural Heritage Futures

The SNH Natural Heritage Futures programme (www.snh.gov.uk/futures/Data/index.htm) aims to promote the integrated management of the natural heritage of Scotland towards 2025, within the wider context of sustainable development. It considers priorities at both national and local scales. At the national level, it considers the natural heritage with regard to six themes: Coasts and Seas; Farmland; Forests and Woodlands; Fresh Waters; Hills and Moors; Settlements. Deer are mentioned in all but the first and last of these themes.

The Farmland document proposes a “new, more integrated approach to the management of deer and livestock so as to allow trees to become established without the need for excessive fencing”, in order to achieve the vision for 2025 for greater regeneration of trees on farmland as a result of lower numbers of deer and livestock.

The Forests and Woodlands document notes that sika deer have a greater propensity than red deer for damage, especially to tree crops, and that hybridisation may mean that this behaviour may pass into the general deer population. The vision for 2025 is that “Deer are an integral part of the forest resource. In most areas, populations are maintained at a level where fencing is rarely required to secure tree regeneration. Population dynamics of red deer are widely understood, and landowners work cooperative to manage local deer populations. Woodland stalking of both roe and red deer is widely practised and supplements open hill stalks on many estates. The management of sika populations continues to tax everyone involved...” (p. 22). The principal action to achieve these long-term objectives is to “promote reduction in deer numbers where necessary through co-ordinated culling programmes though working with deer management groups” (p. 34).

The Freshwaters document states that deer browsing is a factor in the loss of wetland and waterside vegetation and, in the vision for 2025, proposes that deer and sheep grazing would be much reduced in riparian zones. In upland areas, high levels of grazing by sheep and red deer are mentioned as a factor in more rapid run-off and increased soil erosion, leading in turn to gradual soil loss and increased sedimentation of important freshwater habitats, such as fish spawning grounds. The associated action is to reduce browsing pressure in riparian areas through promoting more careful management of deer populations.

The Hills and Moors document notes that adverse effects from grazing by red deer in some areas include damage to open habitats such as heather moorland, blanket bog and alpine heaths, and prevention of the regeneration of native woodland; and that its restoration still largely depends on fencing which adversely affects landscape, access and biodiversity, particularly by preventing the development of natural transitions from woodland to open ground. Considering hunting as a low-intensity and sustainable land use on hill ground, deer have to be managed effectively in ways to ensure a sustainable harvest and a balance in animal populations and habitat condition (p. 20). The associated actions are more effective deer control for woodland management, with a presumption against the use of fencing (p. 32); and the implementation of “comprehensive Deer Management Plans which take full account of the natural heritage” (pp. 30, 33).

Within the Natural Heritage Futures programme, the natural heritage is also considered in relation to 21 regions, each defined by its individuality in terms of factors including geology, wildlife and land use. Deer are mentioned in all the documents for all but two of these regions: Shetland, and Wigtown Machars and Solway Coast. In summary, these documents largely cover issues also covered in BAPs at various levels. The primary difference is that they take a long-term perspective,

looking forward to 2025, with a strong emphasis on integrated approaches that consider deer and livestock together. An additional issue of relevance for this report is the concern regarding hybridisation between sika and red deer, with potentially severe implications in forests and woodlands.

4.3. Natural Care

The aim of the SNH Natural Care programme is to secure the positive management of designated sites while helping to safeguard biodiversity across the countryside by ensuring that available resources are targeted as effectively as possible (www.snh.gov.uk). Such designated sites include SSSIs and Natura sites, of which there are two types: candidate Special Areas of Conservation (SACs) and Special Protection Areas (SPAs). With respect to impacts of deer, SACs are the primary concern, though certain SPAs, designated for the protection of specified bird species, may also be of relevance if grazing affects their habitat. As of January 29th 2004, there were 235 candidate SACs in Scotland, covering 921,206 ha (www.jncc.gov.uk). It is worth noting that 42% of SACs and 27% of SPAs are in mountain areas, respectively accounting for 12% and 6.1% of the total area protected under these designations (Robinson, 2002). The condition of all designated sites is assessed on a regular basis by SNH (see section 5.2).

The Natural Care initiative is based on the voluntary entry of landowners into management schemes which set out standard management requirements and offer standard payments in return. Schemes are tailored on a local basis rather than developed at a national level, so that payment rates are appropriate for the local land use and economic conditions. The Peatlands Management Schemes in Caithness and Sutherland and on Lewis are both Natural Care Schemes; the net areas under agreement are 98,626 ha and 49,337 ha respectively. Payments are made to cover sporting land use including deer management and muirburn. The Clunie Forest Moorland Scheme also makes payments available for deer management.

4.4. Commercial forestry

As mentioned in section 3, deer can have both positive and negative impacts on woodland vegetation and can simplify the vertical structure by selectively feeding on herbs, shrubs and young trees. While deer clearly affect regeneration in woodlands, opinions vary as to both the extent and the severity of the issue. Pressures due to grazing and browsing can prevent the planting of amenity woodlands without protection through deer fencing or individual tree guards.

The impacts of deer in commercial forests can affect both the quantity and quality of timber produced. Both red and sika deer are capable of damaging trees for the majority of the plantation cycle, which is typically 40-55 years in Scotland. The smaller roe deer are usually only classed as a problem when the trees are young. Overall, foresters view red deer as the species causing most concern, but recently the impacts caused by roe deer are becoming increasingly noticeable (Hunt 2003). As stated by Ward . (2004), “when considering deer management in multiple-use forests, one of a forester’s aims may be to minimise the costs of deer damage”. Although there is little comprehensive data available quantifying the financial cost of deer to forestry, some figures are available, e.g., from Galloway, where damage to forestry from browsing and bark stripping was estimated to be £2m pa (Allison 2000). For 2003-4, Forest Enterprise Scotland spent £5.92 million on deer management, including fencing. Income from stalking lets and venison was £1.06 million. The net cost was thus £4.85 million – 14% of the organisation’s timber sales (Hunt 2003)

Within both forestry and woodland settings, management should aim to maintain healthy deer populations in balance with their environments. Management of deer problems requires a combination of three approaches (Mayle 1999):

- design and management of the habitat, especially woodlands;
- physical protection of vulnerable areas or individual trees;
- humane culling of deer over reasonably large areas in order to reduce and maintain numbers at an acceptable level.

Armstrong et al. (2003a) provide an overview of current knowledge with regard to management actions for protecting trees from deer. To be effective, these must be implemented cooperatively between neighbouring landowners.

4.5. Deer Collisions

Road traffic accidents involving deer can present a major problem. However, there are no reliable statistics to enable the scale of the problem to be quantified. A survey commissioned by the Highways Agency estimated that around 30,000 and 50,000 deer are killed annually through collisions with traffic in the United Kingdom. The annual number of deer-related road traffic accidents in Scotland is unknown; however, there is a growing concern in respect to both the public safety aspects and deer welfare. The Highways Agency and the Scottish Executive, together with the Woodland Trust, the National Forest Company, and the Deer Study and Resource are funding research aimed at developing a stratified national system for recording information on deer related road traffic incidents occurring throughout Great Britain (www.deercollisions.co.uk).

Through this research, a comprehensive database will be built up, enabling the analysis of key factors associated with the occurrence of deer collisions. This could aid in the identification and eventually the prediction of deer accident hotspots, helping to minimise the threats of deer associated road traffic accidents. This research could also be used to help identify areas where high densities of deer are occurring.

5. Potentially useful methodologies and data sets for assessing the impacts of deer

This section considers potentially suitable methodologies and data sets which could be utilised by the DCS for monitoring the diffuse impacts of deer. Unfortunately, the compilation of information for this section proved difficult, because the limited period of work not only coincided with the relatively short field season, but also included Scottish Biodiversity Week. As many key people were therefore unavailable, the section cannot be regarded as a comprehensive overview.

A further set of issues relates to the evaluation of impacts of deer, and in particular deer fencing, on landscapes. For this purpose, the methodology of landscape and visual impact assessment used by Scottish Natural Heritage (Landscape Institute and Institute of Environmental Assessment 2002) is recommended. These issues will not be discussed further below.

It is worth noting that the definition of the severity of diffuse impacts is somewhat subjective, as this is affected by the management objectives of a particular agency or estate. The action resulting from diffuse impacts could involve the public, private, or non-governmental sector or any mixture; consideration is required as to how the various stakeholders could integrate their objectives whilst avoiding conflicts. A key question is the balance between enforcement or enhancement in any policy designed to develop and implement integrated land management.

5.1. Macaulay Habitat Impact Assessment

Impact assessment data has been collected since 1997, with the earliest data from the Mar Lodge Estate in 1995. It can be used to inform land managers of the current impacts on specific habitats from grazing and trampling, which is crucial in order to enable them to make suitable decisions with regard to the sustainable use of the habitat. Although the methodology is built upon the SNH Habitat Impact Assessment (Macdonald et al. 1998), the sampling approach that has been developed by Nolan *et al.* (2002) combines field sampling techniques with modelling of predicted impacts. The outcome is the development of a technique aimed to provide a fast, cost-effective and accurate method of impact assessment.

Methodology

The methodology is based upon a stratified approach, utilising the Land Cover of Scotland 1988 datasets (MLURI, 1993), which provides a vegetation map of Scotland and is used as a base for sampling.

- 1) For a given survey area, the initial stratification is at the level of estate and the management units within the given estate.
- 2) Sample areas for field assessment, 0.25 km² in area, are randomly selected by a GIS-based computer model covering combinations of land cover and management units.
- 3) Field assessment is undertaken by surveyors detailing impacts as light, light-moderate, moderate, moderate-heavy and heavy.
- 4) A fully coloured comprehensive map is produced, showing both the results of the field assessments and modelled predicted impacts together with the delineation of management units within the survey area. The data are compiled in GIS format and stored in Excel tables.

Results

This assessment method has been used at Mar Lodge in order to provide information on the status of previously identified sensitive areas. In 1995/1996, an initial habitat assessment was carried out on the estate and potentially sensitive areas were identified. In 2001, these areas were re-surveyed and the data collected were compared to the 1995/1996 information by the Macaulay Institute (Rao, 2004). This comparison allowed the NTS to identify changes that were occurring on the estate. However, it should be noted that, while this methodology results in the classification of grazing impact, it does not help managers decide what level to aim for. At Mar Lodge, the NTS has made the provisional decision to try to reduce grazing to 'moderate', but this is based on the precautionary principle, rather than scientific research.

Comparable surveys have been conducted for 12 DMGs and, where impact assessments have been carried out in collaboration with SNH, it is possible to approach SNH to gain access to the data. However, where the assessments have been carried out without the involvement of SNH, approaches would have to be made to the relevant DMG. These data are potentially useful to the DCS for monitoring the diffuse impacts of deer in the wider countryside provided that they can gain access to all data collected. However, most of the surveys for DMGs have been one-off. To identify trends in grazing and trampling impacts requires two or more assessments. As there is a lag in the response of the vegetation to reduced grazing, a number of years are required between surveys (Rao, 2004).

5.2. SNH Site condition monitoring

Site condition monitoring (SCM) covers all the notified features (particular habitats, species etc) on all sites designated for nature conservation – SSSIs, and Natura 2000 sites (SPAs and SACs) – and is used as the basis for monitoring sites under the Natural Care programme. It is undertaken on a six-year cycle; results from part of the first cycle, presently underway, are due to be reported in spring 2005. Because of the quantity of work involved, monitoring of the various types of habitat is at different stages of completion and the methods have developed since the start of this first cycle as ideas and resource availability have evolved.

The methods have also had to take account of a ‘need to gain agreement’ with the other UK conservation agencies – English Nature, Countryside Council for Wales, and DoE Northern Ireland Heritage and Environment Service – under the auspices of the Joint Nature Conservation Committee (JNCC).

5.2.1. Uplands

Methodology

SCM is being undertaken as a two-phase process beginning with desk-based assessments, using existing information for all sites not already surveyed by SNH staff. This is complemented by detailed field assessment of a sample of sites, to provide calibration of the desk-based assessments and provide an objective sample that can be used to provide a statistical estimate of condition at the national scale. The field assessment methodology is based on a standardisation of feature identification derived from vegetation maps and generic tables of attributes and targets for each generic feature type (JNCC, 2004a).

Given the extent of the features covered within upland habitats, JNCC has streamlined the habitats into 28 generic feature types. The scale on which the assessments are carried out varies depending on the notified feature to be monitored; for example, grassland swards generally show greater variation in species composition at smaller spatial scales, and less variation at larger spatial scales, than do dwarf-shrub heaths. Thus the sample sizes vary as follows:

- acid grassland, calcareous grassland, and moss, dwarf-herb and grass-dominated snow-beds: 1 m²;
- all other feature types, with the exception of montane willow scrub and limestone pavement: 4 m²;
- montane willow scrub: 16 m².

Several approaches can be adopted for monitoring, each with advantages and disadvantages. Possible approaches include random sampling, systematic sampling along transects or on a grid basis, and targeted sampling where damaging activities are known to be concentrated. Whichever method is followed, it is recommended that monitoring is based on a series of re-locatable sample points in each feature, which should be selected prior to the fieldwork to avoid bias. Sample locations, with accurate grid references, can be easily selected using GIS if vegetation maps have been digitised, and can be located in the field using GPS handsets.

At each sample point, a number of attributes need to be assessed, covering diverse elements such as extent, species composition, frequency, cover, and disturbance. Each attribute has a specific target, or range of targets, against which the sample point can be scored to pass or fail. The targets are mostly specified in terms of broad, standardised quantities, such as 10%, 25%, or 50%, which can be

easily and reliably estimated in the field. For reporting, it is necessary to make a judgement on condition for the whole feature at a site level. One set of assessed attributes concerns the removal or destruction of plant parts by grazing, browsing and/or trampling. However, “it is really only for dwarf-shrub species, and in particular *Calluna*, that there is any research information to help set a precise target (e.g. see Palmer 1997)” (p. 26). Thus, for some features (habitats), the target is quite generic (e.g., Alpine dwarf-shrub heath: “less than 10% of the ground cover should be disturbed bare ground”), while for others it is more specific (e.g., Acid grassland (upland): “(1) The percentage of vegetation cover made up of *Juncus squarrosus* and/or *Rhytidiadelphus squarrosus* should be less than 33%. (2) At least 25% of the live leaves and/or flowering shoots of vascular plants should be more than 5 cm above the ground surface, and at least 25% should be less than 5 cm above the ground surface.” Such differences reflect variations in knowledge regarding the various habitats; in the field, they can lead to significant differences in the time taken for assessment and in the comparability of results. Differences may also arise from the time of assessment. JNCC makes recommendations regarding the most suitable periods for undertaking assessments of condition for each feature type. For many upland habitats, these are over the summer. However, certain aspects of plant cover vary considerably during the growing season.

Results

Due to the variety of habitats and the extent of ground to be covered, the survey for upland Scotland has started late and, for various reasons, the methods have been reduced. A total of 215 SSSIs and 82 SACs are designated in upland areas and together cover an extensive area. The desk-based assessment will eventually consider 118 SSSIs and 45 SACs. As there is considerable overlap between SSSIs and SACs, 121 geographical sites are involved. This part of the assessment will involve the assessment of 449 notified features, covering a total designated area of c. 6662 km². From these, 23 sites have been selected by stratified random sampling for detailed field assessment. These sites are scattered throughout Scotland, and have a total area of around 1459 km², with 149 notified features being assessed directly. Within each feature, 37 random locations have been identified at which the presence of the appropriate feature will be checked; if found to be present, a site condition assessment will be made. SNH have yet to decide whether this precise approach will be repeated in future monitoring cycles.

The analysis of collected data is incomplete, but the process will be completed ready for reporting in 2005. For each feature, a report will be produced on whether it meets the conditions targets or not and an overall report will be based on assessment of targets at each sample location. The data will be indirectly compatible with GIS, as data will be available for both the sample locations and feature boundaries (with the exception of some highly fragmented habitats); therefore it would be possible to display the condition information for each site using GIS.

In general, access to data sets should not be a problem as this information will be freely available after the report is published. However, accessing information from individual holdings could be problematic, requiring DCS to negotiate with individual landowners.

5.2.2. Woodlands

Methodology

The guidance (JNCC 2004b) emphasizes that change is continual in woodland habitats, and that targets should be “customised to the woodland feature and site being considered [so that] local

knowledge and distinctiveness can be brought to bear on the objective-setting process.” In general, the assessment should be based on “a structured walk around the site with a series of observation stops along the way.” It is based on five attributes: habitat extent, structure and natural processes, regeneration potential, composition (trees and shrubs); and indicators of local distinctiveness (including ground flora). With respect to potential regeneration and the condition of ground flora, the person assessing the site can make comments on whether the apparent cause is deer, sheep, or other herbivores. However, the primary emphasis is on condition rather than cause.

It should be noted that, if the assessment identifies concerns, this acts as a trigger for further work: for instance, an additional survey to establish the extent deterioration and causes of impacts. With respect to impacts from deer, there is not yet an agreed methodology.

Results

Approximately 80% of broadleaved sites, and 70% of coniferous sites, have been surveyed. This round of assessment will be completed this year, ready for reporting in 2005. The resulting data are stored in the SCM database, and can be cross-referenced to an Oracle database of site location (not a GIS). The data are currently not widely available, as landowners must be informed of the assessments before they are made public. It is envisaged that they will only be made publicly available in summary form (e.g., for SNH areas and sub-areas), so that specific locations cannot be identified. However, even if site-specific data are not available to the general public, they may be available to public bodies such as DCS.

5.3 Environmentally Sensitive Areas

Many features of the countryside, such as hedges, ditches, heather moorland, and river valley grasslands, have been created by traditional farming methods over hundreds of years. However, changes in farming practices, with a shift towards more intensive methods, have resulted in a loss of wildlife habitats and landscape features. The Environmentally Sensitive Area (ESA) designation is aimed at agricultural land which requires special protection in order to safeguard areas where the landscape, wildlife or historic interest is of national importance. The Scheme is voluntary and farmers and landowners receive annual payments for entering into management agreements. An ESA has one or more tiers of entry and, in most cases, the higher the tier, the more exacting the land management requirements (www.defra.gov.uk). Each ESA has a number of specified environmental objectives and associated performance indicators. The environmental monitoring program for each ESA is designed to provide information which will enable assessments to be made of the performance of the scheme in relation to the set objectives. Currently, ESAs cover around 15% of Scotland and data has been collected from permanent plots since 1989.

Methodology

For each ESA, there are stratified randomly sampled Ordnance Survey squares for each feature of interest. Chosen sample plots are marked, as the monitoring requires permanent fixed plots. The size of plots varies depending on the type of habitat being monitored:

- woodlands: 2x 1m x 50m;
- grasslands, wetlands: 2m x 2m;
- watersides: 10m x 1m;
- heather: 2m x 2m and 20m x 20m.

Results

The data collected are held in both GIS and electronic formats. Although compatible with formats required by DCS, the data is confidential to the client (SEERAD) until the final report is published in 2005.

5.4. Forestry Commission

5.4.1. National Inventory of Woodlands and Trees

Methodology

Damage by deer is not monitored specifically in the National Inventory of Woodlands and Trees (NIWT), but there is a section on mammal damage. This recognises two types of damage:

- bark stripping: three categories for recording information about damage – damage%, location, severity – each with three classes;
- browsing: two categories – damage% and severity – each with three classes.

The NIWT randomly samples about 1% of woodland area of the UK, based on a map of all woodlands over 2 ha in area. The last inventory ‘1998’ took place from 1995-2000, following previous inventories on a cycle of about 15-20 years. In future, the NIWT will take place on a shorter scale, on a continual rolling basis.

Results

The sample points for the 1998 NIWT are recorded in a GIS. However, since their location was not recorded with a GPS, they could not be reliably relocated. Data on specific sample points can not be disclosed for reasons of confidentiality linked to obtaining access for sampling. However, data on mammal damage are available for sub-regional areas (e.g., forest districts, DMG areas, national parks). In future, the methodology will change from the sampling of woodland blocks to a grid approach.

5.4.2. Nearest Neighbour Methods for Quantifying Wildlife Damage to Trees in Woodland

A Practice Note issued by the Forestry Authority (Pepper 1998) provides forest managers with a Nearest Neighbour Method for assessing wildlife damage in forests that is “accurate [,] consistent, simple and quick”. Points throughout the area to be assessed are systematically selected, and then a pre-determined number of trees around each point are examined for damage. However, “what is meant by *damage* must be clearly defined in the light of the forest manager’s requirements before carrying out a forest damage assessment”.

5.4.3. Deer Management in and adjacent to woodland areas

Landowners applying for the Reduction in Deer Numbers Stewardship Grant (S2) and the Scottish Forestry Grant Scheme (SFGS) have to provide information concerning indicators of woodland deer densities to inform their DMP (Forestry Commission 2003). There are three categories of deer density:

- low density (1-8/100 ha);
- medium density (8-15/100 ha)

- high density (>15/100 ha).

These are defined according to three types of evidence: tracks, dung, and browsing of vegetation.

The latter categories are:

- low density: natural regeneration of broad-leaved trees taking place with no or little damage to current year's incremental growth;
- broad-leaved sapling present but showing significant damage;
- no seedlings growing above dominant vegetation height. Often well-defined browse lines on established shrubs and plants.

It is also noted that "It is important to quantify and describe accurately, past and current deer damage within the woodlands and associated habitats"; reference is given to the relevant DCS best practice guides.

5.5. Comparison of methodologies and datasets

The status of data sets which could be evaluated by the date of production of this draft report is shown in Table 2. Although a complete inventory of existing methodologies and datasets could not be made, some preliminary conclusions can be drawn. The first is that these data sets are based on different methodologies developed for specific, but varying purposes. The Forest Commission's NIWT and the JNCC Common Standards Monitoring for woodlands are primarily concerned with the condition of habitats, and do not necessarily identify whether deer are a (potential) cause. Of those that do specifically consider deer, some use ordinal scales of lesser (e.g., DMP browsing indicators) or greater (e.g., Macaulay Habitat Impact Assessment) complexity; others use quantitative data, considering particular thresholds (e.g., JNCC Common Standards Monitoring for uplands). Consequently, the resulting assessments are not directly comparable, although they may provide useful contexts for comparison. Even within one broad methodology, such as the JNCC Common Standards Monitoring for uplands, different types of criteria are used for different habitats. Only the JNCC methodology is related to management objectives.

Table 2: Summary of dataset relating to monitoring of deer impacts

Data set	Area covered	Format of data	Scale	Useful	Available	Key contact person
Macaulay impact assessment	Used in 12 DMG areas (8600 km ²)	GIS maps, Excel spreadsheet and database	0.25 km ² sample squares	Yes	In part	A. Nolan (Macaulay Institute)
Site Condition Monitoring - upland	Designated sites (SSSI + Natura)	Indirectly compatible with GIS	variable	Limited: designated sites only	In part	A. MacDonald (SNH)
Site Condition Monitoring - woodland	Designated sites (SSSI + Natura)	Linked to Oracle database	variable	Limited: designated sites only	In part	J. Bryce (SNH)
ESA monitoring (permanent plots)	Approx 15% of Scotland	GIS and electronic format	variable	Potentially	In part	A. Nolan (Macaulay Institute)
Forestry Commission NIWT	Approx 1% of Scotland	GIS and electronic format	random sample	Limited: only summary data	In part	A. Hamilton (Forestry Commission)

If the DCS wishes to have available a robust methodology for assessing whether local but diffuse impacts by deer in the wider countryside is occurring, elements of these methodologies may be useful and one, possibly with appropriate modifications, may be suitable. If a qualitative or ordinal approach is used, training will have to be given to those involved in monitoring to ensure standardization over time and space. However, a ‘one size fits all’ approach will not be appropriate, given the range of habitats where deer cause diffuse impacts, from the diverse habitats of the uplands through different types of native and planted forests, across agricultural and crofting land and to gardens on the edges of cities. As discussed below, attention will also have to be given to the extent to which deer, as opposed to other herbivores, are responsible for particular impacts, as discussed further below.

Whatever methodology is chosen or modified, it will be worth bearing in mind the following criteria for a good indicator (Statistics New Zealand, n.d):

- policy relevant: monitors the key outcomes of policy and legislation; informs of progress towards policy goals; measures processes that cause pressure on the environment; provides information to a level appropriate for aiding policy decision making;
- measurable: changes on an appropriate geographic and/or temporal scale; representative of the system being assessed; shows reliability over time; has predictive capabilities;
- analytically valid: developed within a consistent analytical framework, with clearly defined, verifiable and scientifically acceptable (credible and robust) data, collected using standard methodologies with known accuracy and precision; (statistical integrity);
- environmentally informative: helpful in relating causes, effects and responses; responsive to environmental change and allows trend analysis or provides a baseline for future trends;
- cost effective: requires limited numbers of parameters to be established; uses existing data and information wherever possible; simple to monitor;

- simple and easily understood: simple to interpret, accessible and publicly appealing; clearly informs about the extent of the issue(s) it represents.

6. Assessment and conclusions

All large herbivores – not only deer, but also sheep, goats, and cattle – cause impacts to species, habitats, and soils in Scotland’s wider countryside – from the uplands to the edges of cities – through browsing, grazing, and trampling. When herbivores other than deer are known to be present in a particular area, only some negative impacts can unequivocally be attributed to deer, such as thrashing and fraying of saplings with antlers, and damage to trees at heights which no other species could reach. As noted in a DCS Best Practice Guidance, different deer species (especially red and sika, and to a lesser extent fallow) have similar impacts, and “the damage to plants from sheep is almost identical to that from deer, and circumstantial evidence is the best way to identify it” (DCS n.d.).

Browsing, grazing and trampling all cause changes in the distribution, health or regeneration potential of species and thus in the sustainability of populations and habitats; and changes in ground cover can influence levels of soil erosion and downstream water quality. Furthermore, it is not simple to assign specific impacts to the activities of herbivores at specific times, and the distribution and densities of herbivores change over space and time; impacts may persist over significant periods even when populations or densities are reduced. In other words, the assessment of the impacts of deer on biodiversity and other aspects of the public interest is complex and uncertain. This is even more true when one moves from direct impacts to indirect impacts on the public interest, such as changes in the landscape and to habitats through the use of fencing, increased soil erosion, water quality, and risks of vehicle accidents. It should also be noted that not all direct impacts are negative; certain levels of herbivore activity are necessary to maintain a suitable habitat for the persistence, regeneration, or reproduction of various species.

To address these complex and uncertain issues requires cooperation between diverse stakeholders with regard to research, monitoring, and management relating not only to deer, but also the other species with which they often share habitat for at least part of the year: particularly sheep but also, in some cases, cattle. This is implicit in the Nature Conservation (Scotland) Act 2004, and more explicit in certain proposed actions in the Rural and Cross-cutting Implementation Plans for the Scottish Biodiversity Strategy, various actions in LBAPs, and the long-term visions of Natural Heritage Futures. The types of cooperation need to vary according to the habitat and other local circumstances (e.g., key stakeholders, patterns of landholdings, ranges of deer herds). The stakeholders that need to be involved in research, monitoring and management include:

- estate and forest managers, farmers, and crofters;
- foresters, shepherds, and stalkers;
- national agencies such as DCS, SNH, Forestry Commission, Forest Enterprise, SEPA, SEERAD and other parts of the Scottish Executive (e.g., in relation to road safety);
- local government and agencies, including LBAP officers;
- research organisations;
- voluntary organisations representing environmental and recreation interests;
- representatives of local communities.

These groups are involved in the Deer Management Round Table. These categories are, of course, not exclusive, and some cooperation already exists both at the local scale, e.g., through DMGs and

LBAP partner groups, and nationally, e.g., through the Association of Deer Management Groups and Scotland's Moorland Forum. However, in general, the principal attention of these groups is in the uplands and on red deer; there is greater need for joint working in forests and, more generally, in lower-altitude environments, particularly farmland, where roe deer may have significant impacts on the copses and woodlands that are such important elements of the biodiversity of lowland cultural landscapes. DMGs often have a restricted group of stakeholders, with little representation from local communities or voluntary organisations that are not themselves land managers in the area

This scoping study suggests that, while considerable knowledge and expert opinion exists considering the impacts of deer on aspects of the public interest in the wider countryside, considerable research is needed, particularly on the relative impacts of different species of deer and other herbivores, especially in lower-altitude environments, and on trends in these impacts. Building on the report by Milne *et al.* (1998), which considered the impacts of all vertebrate herbivores, but only in the uplands, a comprehensive synthesis of all existing knowledge and information (not only from the UK but also for comparable habitats and species in other countries) would be a valuable starting point in order to identify what is known (and on what grounds; e.g., research, monitoring, expert opinion), what needs to be known, and why. Specifically, the findings should be linked to recent and forthcoming policy imperatives in Scotland.

With regard to monitoring, the existing methodologies are a valuable beginning, but there is greater need for sharing of data and information, according to the principles of openness and transparency enshrined in the Freedom of Information (Scotland) Act 2002 for public bodies, and to ensure that the results of monitoring programmes are directly useful for management. In order to identify trends, assessments using standardised methodologies will need to be repeated. A key issue will be to establish the extent to which impacts can be attributed to deer, rather than other herbivores. Finally, given the diversity of habitats and the considerable variation in management objectives at the local level, a number of robust methodologies for monitoring diffuse impacts will have to be developed, with appropriate consultation. These should consider impacts on not only species and habitats, but also broader public interest issues, such as landscape and recreation. They will need to be analytically valid and cost-effective, and provide accessible, reliable, and useful information to enable all stakeholders to make well-informed decisions.

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