WOODLAND DEER MANAGEMENT

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FOREST HISTORY AND DEVELOPMENT

Five thousand years ago, when human communities were just beginning to inhabit the Borders, at least 80% of the land was covered with trees, the principal species being alder, ash, birch, elm, oak and pine. Only the hilltops were free from trees, although naturally on the upper slopes pine and birch predominated and the tree cover was sparser than in the valleys. In his efforts to settle down in the area, the trees were gradually removed by man to provide hand made tools, building materials and firewood etc enabling him to supply shelter and food to live. The increasing amount of cultivation and the introduction of sheep by monasteries around AD1200 accelerated the rate of deforestation and virtually all the woods in the Borders were eliminated with the exception of small copses round the river valleys, and it is estimated that approximately two percent of the land area in the Borders had tree cover at this time.

The low point for forestry in the Borders was in the middle of the 17th century, after which followed a gradual improvement until the start of the First World War. The leading landowners such as the Dukes of Buccleuch were keen enthusiastic foresters, and many new (exotic) species were introduced. David Douglas introduced Douglas fir and Sitka spruce into the Borders area around 1830 and in the 1850's John Jeffrey introduced Lodgepole pine.

These 19th century introductions revolutionised forestry in the Borders, for no other trees could be grown on the exposed and inhospitable sites left by the sheep grazing. After the end of the First World War, during which large quantities of timber were removed for the war effort, the **Forestry Commission** (FC) was established and in 1920 began new planting. The Forestry Commission is the Government Department responsible for forestry throughout Great Britain. Sitka spruce proved extremely well suited to the exposed and relatively infertile land that was available for afforestation. By the end of the Second World War, although some progress had been made, only 5% of the Borders covered commercial tree crops. However in the 1950's and 60's, the FC spearheaded an extensive planting programme and from 1965 to 1975 the newly formed private forest companies took advantage of a favourable fiscal climate, and planted large areas of land.

Sitka spruce is by far the most common species planted in the Borders comprising in excess of 75% of the total forested area. However, in the rush to create these new commercial forests throughout upland Britain, little thought was given to forest design and the knock on effects to forest protection, conservation of native flora and fauna or the communities which would have to live and work within or adjacent to such forests.

In 1991 there was a re-statement of forest policy in Great Britain and an emphasis on multi-objectivity led to changes in forest management objectives.

At present the four main objectives of the FC is to:

Protect Britain's forests and woodlands.
Expand Britain's forest area.
Enhance the economic value of our forest resources.
Conserve and improve the biodiversity, landscape and cultural heritage of our forests and woodlands.

All these objectives will require an inherent ability to control deer and other mammals within these forests/woodlands throughout the whole rotation. This will only be possible if the industry recognises the need for;

- A proper forest design based on soil type, which incorporates space and provides extra internal forest edge and native broadleaf species within and throughout the commercial forest. This space will allow for adequate management of the larger herbivore species which could be a threat to the forest investment because of the extinction of the larger predator species that were present in the natural forest. The combinations of native broadleaf's and conifers will eventually support a species rich ecosystem of food chains integrated throughout the whole forest. If invertebrate pest problems arise in the future there will then be an increased potential of the forest supporting a British species in the forest that may adapt and exert some control on the pest species.

- A recognition of the importance of employing trained full-time wildlife managers with an understanding of the entire flora and fauna within the forest, and who are capable of managing many different population types, indigenous and introduced, to achieve a complete protection plan.

Historically, the government has attempted to encourage private forest investors to create new commercial forests. They have done this through the provision of a forest grant system which would be paid to owners/investors who have created the type of forest the fulfilling the objectives set out at the time of planting. Through time the government's objectives have changed as explained above and the associated grant system has changed with it and all forest operations which are grant aided must be designed and managed to meet the new objectives stated above. It is the job of the Forest Authority (a division of the FC) to check on these plantations and observe if these objectives are being met before grant money is released.

The grant system which is operating at present is the Woodland Grant System (WGS) and it is aimed at providing an incentive for people to create and manage woodlands on areas all over Britain. The FC pays grants for establishing and managing woodlands but to qualify for grant you require to meet the standards of environmental protection and practices set out in their Guidelines.

There is another grant, the Woodland Improvement Grant (WIG) which is a single payment made to encourage a range of work in existing woodlands to achieve any one of three objectives. The main type of project which may be useful for a woodland stalker/deer controller would be Project 3 (WIG3) where grant is paid for work to assist woodland owners to manage their woods in ways which will implement the forestry aspects of "Biodiversity, The UK Action Plan". This could be utilised to subsidise

forest protection design improvements in an established woodland, if the main watercourses of that forest were too tightly planted. Otherwise, the design improvements would have to be linked to improving the forest habitat conservation reasons e.g. habitat improvement works for blackgame which also have forest protection design implications.

The most recent impact on forestry as a land use has involves the implementation of "Certification". The international forest products market is increasingly demanding assurance concerning the quality of forest management. One way was to provide this assurance through independent verification set against a published standard which defines appropriate and effective management. This process is now widely known as certification and there are certain sections that relates to the forest design/protection aspects:

- **3.3.2** Species Selection: The proportion of different types of species in new planting, or planned for the next rotation of an existing plantation are as follows:

  (1) Where at least two commercial species are adapted to the site;
  < 65% primary species
  > 20% secondary species
  > 10% open space
  >5% native broadleaves

  (2) Where only one commercial species is adapted to the site;
  < 75% primary species
  > 10% open space
  > 5% native broadleaves
  > 10% other areas actively managed for biodiversity.

- **3.4.2** The rate of felling is subject to the following conditions:

  (1) In plantations over 20 ha: no more than 25% is felled in any 5-year period unless all felling and restocking is based on an adequate Design Plan.
  (2) In plantations over 100 ha: the maximum coupe size is 20 ha except where site factors dictate otherwise. In this case, all felling and restocking are based on an adequate Design Plan.
  (3) In semi-natural woods over 10 ha: no more than 10% is felled in any 5-year period and a maximum coupe size never exceeds 10 ha.
  (4) In semi-natural woods under 10 ha: silvicultural systems which provide continuity of forest cover are used, unless habitat continuity is being achieved through proximity to nearby woodlands.

- **3.4.3** In semi-natural woodland and in plantations on ancient sites, clearfell/replant silvicultural systems are being replaced by lower impact systems.

- **3.4.4** In windfirm conifer plantations, continuous cover silvicultural systems are increasingly favoured, where they are suited to species present.

- **3.5.1** Conversion to non-forest land: Felling of part or all of an area within a compartment and restoration of the area to non-forest land is carried out only where all of the following criteria are satisfied:
  (1)The new land will be ecologically more valuable than the plantation or the removal of the plantation constitutes an improvement in the landscape or is required for cultural or archaeological issues.
  (2)The change is not highly unpopular.

- **5.1.1** Planting plans and restructuring are designed to minimise risk of damage from wind, fire, **pests** and diseases.

- **5.1.3** Where possible, management of wild mammals is undertaken in co-ordination with neighbours.

- **5.4.1** Fence alignments are designed to minimise impacts on public rights of way and wildlife.

- **5.4.2** Where appropriate, wildlife management and control is used in preference to fencing.

- **6.1.2** Identified special areas and features are safeguarded and, where possible, enhanced. Areas with valuable flora are protected from browsing.

- **6.2.1** Hunting, game rearing and shooting, stalking and fishing is carried out in accordance with the recommendations and codes of practice produced by relevant associations. (BDS, BASC, Game Conservancy, etc.).

- **6.3.1** A minimum of 15% of the forest area is managed with biodiversity as a major objective, by the following means:

  Summary of areas:

  Conservation features: Variable in percentage area of the forest. All features and areas of high value for biodiversity are conserved; will include non-forest habitats. e.g. water courses and bodies, wetlands, rides and glades etc.

  Long-term retentions: Areas for long-term retention have been identified (stable stands and clumps), and constitute a minimum of 1% of forest area.

  Natural reserves: areas of forest have been set aside where biodiversity is the prime objective. These are managed by minimum intervention unless alternative management has a higher conservation or biodiversity value.

The “conditions” linked to WGS grant approval and Certification should be recognised as a positive opportunity to widen the role of deerstalkers into wildlife managers and conservationists. The “conditions” should be viewed as a positive factor in commercial woodland protection which can be used to support the need for further design

improvements. In other words, it could be argued that a well placed deer control area can be viewed as an important woodland conservation area.

All wildlife managers/woodland deer stalkers have to be aware that it is extremely difficult to separate the man-hours and associated charges to individual aspects as he/she is multitasking all the time when present within the property. While stalking for deer, one is monitoring the present forest design and how it will change with time, observing other flora and fauna which may or may not require further attention and subsequent reporting etc. Indeed all aspects of forest protection have to be linked to the other forest objectives for conservation, landscaping, recreation and vice versa.

SILVICULTURE

Forest Protection requires the ability to recognise/identify the main tree species that are utilised within the forest industry. Deer show marked preferences for particular tree species and these are most apparent in mixed species stands, where the level of browsing, fraying and bark stripping damage on each species is usually distinctly different. Therefore, tree species selection will have obvious forest protection priority implications and wildlife managers/stalkers should be able to identify the tree species commonly utilised in any given forest. There are many illustrated books on the market that can be used to aid tree species identification.

Mitchell, A.F. (1985). *Conifers*: Forestry Commission Booklet No. 15. HMSO, London.

Mitchell, A.F. (1985). *Broadleaves*: Forestry Commission Booklet No. 20. HMSO, London

Mitchell, A. (1978). *A Field Guide to the Trees of Britain and Northern Europe*. Collins, London

CONIFERS

These will most probably include Sitka spruce, Norway spruce, Lodgepole pine, Scots pine, Douglas fir, Silver fir sp., Larix sp.,

NATIVE HARDWOODS

Due to the growing emphasis on obtaining environmental benefits from forests, the use of native hardwoods and shrubs has greatly increased. This usually takes the form of hardwood groups in mixture with non-native conifers to combine timber production with environmental and social benefits. There has been much research into the relationship between the species composition of semi-natural woodlands and the site which they are growing in. In short there is now information available to match soil/site types to recommended native hardwood species suited to these conditions. This ability to match hardwood species to soil/site type has significant forest protection implications and all possible effort must be made to utilise the present research information. A tree planted in it’s appropriate soil/site type will grow vigourously and reduce the time period where it is vulnerable to browsing/fraying damage. Hardwoods, which are not matched to soil type, will grow slowly and usually becomes moribund and therefore are a lot more susceptible to disease, insect and deer damage.

Wildlife managers/deerstalkers should have some input into the decision to make sure that all native hardwood planting takes regard to soil/site type at least and also preferably take due regard to provenance/genetic suitability as. If there is to be planting in association with designated deer control areas the soil/site type dictates the use of the following species:

Surface water gley;
Major tree species; Ash on better drained slopes, Alder on wetter flat areas
Minor tree species; Downy birch, Goat willow, Rowan, Bird cherry.
Major shrubs; Hazel, Hawthorn on slopes; and Grey sallow on wet/flat areas.
Brown earths;
Major tree species; Downy birch, Sessile oak.
Minor tree species; Pedunculate oak in east-central Scotland, Silver birch in east-central Scotland, Rowan
Major shrubs; Hazel, Hawthorn on better soils; Juniper in open/exposed situations.

In all cases, the sooner the trees are established the better and most forestry prescriptions are targeted to achieve this.

- Ground preparation should be directed to providing a drained, weed free site for the newly planted tree.
- Trees should be treated with care from the start, they should have a good root structure, and of reasonable girth/height.
- All plants should be dormant at the time of planting and if broadleaves have flushed before planting this will seriously reduce planting success.
- If tree species are being planted in distinct groups it is important that as much as possible individual species (conifer & native broadleaves) are planted with regard to soil/site type. In addition, if soils/sites allow, it is important to plant the more vulnerable species away from edges of compartments if deer are resident in adjacent stands, preferably close to roadsides for monitoring etc. However, priority should always be given to matching soil/site type and or linking with other habitat/protection/conservation design factors. Distinct groups should also be planted in decent sized groups firstly to create a viable habitat in the long-term but increased size reduces likely browsing/fraying impacts.
- Felling coupe size and shape can have important effects on forest protection potential. Normally the smaller the coupe the higher the edge to area ratio becomes and the more edge there is the more ability the deer have to feed on the edge of the coupe. This can have a significant effect on the resultant damage from browsing/fraying on the stand. Obviously the shape of the coupe will have similar edge to area effects with similar consequences.

PREDICTING FOREST STRUCTURE CHANGES

For reasons given above it is important to be able to forecast important/significant changes in forest structure and build this into the forest protection strategy. With the use of forest compartment records, tree species and yield class maps it is possible to predict significant changes in forest habitat suitability/carrying capacity for the resident species of deer and associated changes in forest crop vulnerability to browsing, fraying or bark stripping. This will enable wildlife managers/stalkers to predict potential problem areas and lead to a more efficient use of time.

FOREST PROTECTION

Tree species differ in vulnerability and each form of damage occurs within certain age size classes, knowledge of this enables prediction of possible losses so those appropriate measures of protection are taken. Deer cause problems by browsing, stripping bark and fraying trees with antlers.

BROWSING

The term browsing in the context of forest damage, refers to all forms of feeding damage other than bark stripping and therefore involves the removal of twigs, shoots, leaves, needles, buds or flowers, from either young trees or coppice stools. Small seedlings can be uprooted. The only reason deer browse on trees is for added nutritional value in their diet. Deer are selective and the parts taken will depend very much on the species of tree and time of year. Conifers are usually browsed in winter, often with increasing intensity as winter progresses, whereas broadleaf's are more usually damaged in summer.
Deer show a marked preference for particular tree species and the susceptibility of each of the common tree species to red and roe deer browsing in Scotland are summarised below.

.Deer Species	Most susceptible	Moderate susceptible	Least susceptible	Summer/Winter Browsing
Red deer	Rowan	Birch sp.	Scots pine	**S**
	Scots pine		Birch sp. Rowan	**W**
	Sitka spruce Scots pine		Lodgepole pine	
	Willow sp. Rowan	Birch sp. Alder	Scots pine	
Roe Deer	Oak sp. Rowan Willow Sp.	Alder Birch Aspen	Silver fir Norway spruce Scots pine	**S**
	Rowan	Oak sp. Willow sp. Norway spruce Silver fir Scots pine	Birch sp.	**W**
	Norway spruce Lodgepole pine	Scots pine	Sitka spruce	

This susceptibility table illustrates that there are many factors affecting browsing selection;

- Deer species involved i.e. bulk feeders e.g. red deer or selective feeders e.g. roe deer.
- Understorey vegetation/habitat which reflects underlying soil type. Weed control methods can reduce the availability of food plants and in Norway spruce stands it has been found to increase browsing damage by roe deer.
- Tree species mixture available for browsing.
- Season of year. Snow can exert a considerable influence on browsing by concealing seedlings and forcing deer to browse on trees when the availability of other vegetation is limited.
- Plants on coupe edges are more vulnerable due to proximity of shelter and deer feeling more secure when choosing a feeding area.

Most browsing by deer usually occurs at an intermediate level between ground and "full reach" resulting in smaller and larger trees being relatively protected. In Sitka spruce research has indicated that the most vulnerable height range for leader damage is between 40-55cm, 30-60cm for general damage and there is very little damage occurring above 85cm.

The incidence and intensity of browsing are widely accepted to be directly correlated with deer population density.

BARK STRIPPING

Red, sika and fallow deer are known to remove bark, usually in winter, when it is gnawed off with the aid of the lower incisors and eaten.
In spring and summer bark can be more easily removed and deer can then pull it away from the stem, sometimes leaving loose strands on the tree.
Bark is usually taken from the stem at a height of between 50-100cm, but bark stripping damage (ripping) can occur up to heights in excess of 2m depending on the species of tree and season.
Damage does not usually occur uniformly or randomly throughout a stand but it is normally clustered.
Differences in susceptibility between tree species are distinct and if anything, appear to be more consistent than those related to browsing.
Research has failed to conclusively link this activity to any one causing factor and various factors have shown to be involved e.g. nutrient deficiency, stress and boredom.

Most susceptible	Moderate susceptible	Least susceptible
Norway spruce Lodgepole pine	Larch sp. Silver fir sp. Birch sp.	Sitka spruce
Willow sp. Rowan	Alder	Scots pine
Lodgepole pine Scots pine Norway spruce	Douglas fir Silver fir	Sitka spruce

The susceptibility of a tree to bark stripping is closely related to age and size. Damage can begin when the stem becomes rigid and accessible and ends when the bark becomes too coarse and thick or difficult to remove. Periods of vulnerability varies considerably between species e.g. Norway and Sitka spruce have been reportedly damaged between 5-50 years (whole rotation). Douglas fir between 12 and 44 years, Scots and Lodgepole pine for between 5-16 years.

FRAYING

Fraying damage results from the removal of bark by the action of rubbing antlers or tusks up and down the stem. It is often associated with scent marking or velvet removal. The most common type of fraying in Britain is performed by roe bucks marking their territories but sika deer also have the habit of scoring tree trunks with their tines (bole scoring) and these make deeper and more serious wounds on the trunk.
Fraying can lead to serious crop damage and in widely spaced broad-leaved crops every unprotected tree may be damaged by roe deer. Red, sika and roe deer have all been reported to be selective among trees they choose to fray with the trees physical characteristics being more important than tree species.

- Roe deer prefer springy unbranched, sapling-sized stems for fraying and they will attack almost any species.
- Red deer select slightly larger trees than roe (50-250cm) with some species susceptible at greater sizes than others.
- Sika appear to prefer smooth-barked stems greater than 30cm diameter at breast height and since they select larger stems crops, will be vulnerable for a much greater proportion of the rotation.

Most fraying is performed in relation to mating behaviour and is therefore intended to display either condition or status to other rival males, to mark a territory, or to leave scent.
The fraying incidence of roe deer increases generally with population density and has two seasonal peaks, both at the onset of territory establishment in spring and during the rut. Fraying by red and sika deer occurs immediately before the rut in autumn.

OTHER FOREST PROTECTION MATTERS

As mentioned previously, the modern woodland wildlife manager/stalker should be aware of many other factors than just deer and their effects on their habitat. Due to the nature of their job, they are in general, more aware of a detailed knowledge of the plantation. Also, during the stalking season they regularly visit within the forest, more than any other employee and should be able to feed back any relevant information to other members of the forestry team. Forest protection matters which, may arise vary from broken fences, allowing domestic grazing animals or deer into the forest, to other forest pests which have to be dealt with by someone else in the team.

One important issue is the identification of insect related problems and in most cases the sooner this is reported and dealt with the less chance of serious forest crop damage occurring. There may be cases of localised complete defoliation of the crop trees, in conifers there may be removal of previous years foliage or removal of current years foliage, discoloration of foliage, death of young shoots etc.
It is useful to have a set procedure to follow when significant areas of damage are discovered so that a comprehensive description can be passed on to the relevant member of the team.

- Having found an **insect** or associated **damage**.

- **Identify** the species of tree, which is being fed upon.

- **Note** the part of the tree upon which it is feeding.

Some of the more important insect pest species are associated with restocks;

Pine Weevil; This is the only one of all the European forest insect pests against which routine treatments are taken on restocks. The adult pine weevil feeds on the green bark of young trees on a restock and frequently kills them. There are two periods of peak feeding activity (early spring, July/August) when wildlife managers/stalkers should be on the look out for the adult feeding on young trees (restocks) and report back to the relevant person if required.

Black Pine and Spruce Beetles; A pest of restock as above but damage is limited to feeding activity at the root collar and roots. A dead plant shows little sign of cause of death until pulled up gently to reveal frass, damaged tissue and the offending beetle.

There are many illustrated books on the market that can be used to aid tree species identification.

Bevan, D. (1987). *Forest Insects: A guide to insects feeding on trees in Britain:* Forestry Commission Handbook No. 1. HMSO, London.

ASSESSMENT OF TREE PROTECTION METHODS TABLE 3

Method	Advantages	Disadvantages
Tree guards	Cost effective for small areas: can protect trees from herbicide damage; can make trees easier to locate; do not present a barrier to public access; do not prevent positive herbivore impacts on ground vegetation. In addition, treeshelters can provide an early boost to growth.	Do not protect other elements of the woodland ecosystem; are costly for large areas; require regular inspection, maintenance and often eventual removal; are generally not reusable; taller guards can be unstable and cause damage to trees in windy situations; can be unsightly and attract vandalism
Fencing	Cost effective for large areas and high stocking densities; often less visually intrusive than individual tree protection; offers protection for natural regeneration and other woodland vegetation.	Expensive for small trees; reduces accessibility to woodland users; a breach can put whole planted area at risk; may prevent beneficial herbivore impacts. Some reduction of animal numbers may also be necessary when populations are high.
Electric fencing	Low capital cost; reusable	Generally reliable for domestic stock only; dependent on intensive checking and maintenance; requires reliable power source and earthing; breach or loss of power renders the whole fence line ineffective.
Chemical repellents	Useful emergency measure for immediate and over-winter protection of small trees.	Expensive for large areas and where repeat applications are necessary, current repellents offer limited duration of protection and do not protect growth occurring after treatment.
Deer - shooting	Limits deer damage whilst maintaining positive impacts; recognises deer as a part of forest biodiversity, as a recreational resource, as a tool for habitat management, and as a potential source of income.	Requires time, experience and long-term commitment to plan and implement; requires co-operation with neighbours if used in small woodlands; public safety considerations may limit potential to cull.
Grey squirrels - poisoning	The most effective method currently available, particular in terms of labour requirement.	Use of a hazardous mammalian toxin in the environment.
Grey squirrels - multi-capture traps	Easy to site and set; may be used even where red squirrels are resident.	High capital cost and labour requirement.
Rabbits - gassing	The most effective rabbit control.	Extremely hazardous to operators if prescribed methods not fully observed; requires properly trained and equipped personnel.
Rabbits - cage traps	Non-target species can be released unharmed; does not require access to burrow systems. Useful for removal of rabbits from within fenced areas.	Unsuitable for removing substantial numbers of rabbits.
Rabbits - box traps	Can catch substantial numbers of rabbits; useful for removal of rabbits within fenced areas and for maintaining good relations with neighbours.	High capital cost.

FOREST DESIGN

The forest soil, open to leaching and erosion by the natural elements and a continual removal of nutrition through centuries of grazing, has degraded in fertility and pH. Given these problems of poor soil fertility, low pH and exposure on the majority of sites forested in the southern uplands over the last three decades the commercial forest industry has developed a high dependency on certain conifers, particularly Sitka spruce. Having accepted that first rotation commercial forests inevitably create a large even aged spruce woodland, the forest industry can only succeed if wildlife managers can protect the commercial tree for the whole of the rotation when the crop is harvested and the return of investment realised. This in turn can only be achieved when forest protection is based on a sound forest design based on soil type, which incorporates space and provides extra internal forest edge and native site-specific broadleave species within and throughout the commercial forest. The space will allow for adequate management of the larger herbivore species, which could be a threat to the forest investment because of the extinction of the larger predator species that were present in the natural forest many years ago.

The combinations of native broadleaves and conifers will eventually support a species-rich ecosystem of food chains integrated throughout the whole forest. If invertebrate pest problems arise in the future there will then be an increased potential of the forest supporting a British species in the forest that may adapt and exert some control on the pest species.

The best time to consider forest protection design is at the afforestation planning stage before the proposal is put forward for WGS approval. When considering the location of future deer control areas several factors require to be considered:

Soil map/vegetation survey - If possible, a soil map should be made available before any plans are drawn up. Priority should be given to creating deer control areas on surface water gleys and brown earths both of which support the herbs/grasses most preferred by all species of deer. If soil maps are not readily available then the design has to be based on a vegetation survey which prioritises areas where there is a mixture of herbs like Meadowsweet, Marsh thistle, Creeping buttercup, Wild angelica, Common valerian, Sweet vernal grass which would indicate the presence of a surface water gley. A mixture of Sheep's fescue, Red fescue, Sweet vernal grass, Yorkshire fog, Yarrow and Bracken would indicate the presence of an acidic brown earth. It should be noted that bracken might spread to such an extent on the brown earth soil types that shooting opportunities and stalking options are greatly curtailed. In some cases the bracken would have to be removed from the more important control areas through spraying with chemicals which can prove to be a very costly operation.

Water courses - All the main watercourses should be identified as having a high degree of design importance not only for forest protection but also for conservation related reasons. They also offer the best chance to create a continuity of design within the forest complex. It is important to avoid the creation of wind tunnels along the watercourses and the design should build in sites where the conifer crop will be planted close to the watercourse to create a shelterbelt effect along the riparian zone.

Additional - Some deer control areas may be required outwith the watercourse zones and again these areas should be sited on the best soil types available and placement should strive to achieve an even displacement of these areas throughout the forest stand.

Although it is best to build in this design at the afforestation planning stage, these major design options are available up to the pre-thicket stage before the underlying vegetation is suppressed and can therefore no longer indicate underlying soil type. It should be noted that any delay (1-2 years) in respacing at this stage will have significant knock-on effects to associated labour costs for felling/removing conifers within the control area. In some cases, if the control areas are linked to watercourses which have been planted too closely at the afforestation phase, costs can be subsidised by up to 30% through a Woodland Improvement Grant 3 (WIG 3) application to the Forest Authority.
Once the crop has reached the close canopy phase, associated labour costs and windthrow problems will prevent any major forest design improvements taking place until the end of the rotation and restructuring takes place. If there are specific problems attaining the deer cull in certain areas within the forest it may be possible to create some control areas to last until the end of the rotation. In some forests where commercial conifer selection was related to soil/site type then Norway spruce may be planted on gley sites. In this case the deer will have maintained an open canopy and possibly restricted leader growth through browsing pressure. These areas are already favoured by deer and can be opened out without causing windthrow problems of the surrounding crop.
These areas and others like frost pockets can be identified through the use of tree species maps and aerial photographs, which are available for most forest stands. If maps/photos are not available then an informal survey of the area, following deer paths can sometimes lead to favoured areas within the commercial crop. These areas would be indicated by the presence of deer dung groups.

CONTROL AREA DESIGN

All designated control areas should be chosen with primary importance given to underlying soil type with preference given to surface water gleys and brown earths with the associated herbs/grasses described above.

Shelter from the prevailing wind is an important factor to consider, as deer will avoid draughty situations if possible. Therefore it is important to avoid opening up the control area to the prevailing wind, if possible, and the commercial conifer crop should be left untouched at the appropriate place to give shelter. Sitka spruce probably offers the best potential for providing shelter since it is not browsed so readily as other commercial conifers and it will maintain ground shelter throughout the whole rotation.

Design within the control area is then based around the **shooting position**. The shooting position is chosen to give the best view of the control area, preferably from ground level, and takes into account the direction of the prevailing wind, rising/setting sun and access from the forest roads/ride network. Access should also try to minimise/avoid any disturbance to resident deer lying up in the surrounding forest area.

Deer, especially sika, dislike wide-open spaces and their utilisation of any open control area will be limited to the edge area. If a control area is being created by removing an already existing conifer crop, some trees should be left to increase the feeling of security throughout the whole control area. If there is a choice of conifer species within the area then preference should be given to those species which deer prefer to browse/fray like Norway spruce and Lodgepole pine. If native hardwood trees are being planted to improve the “security” of the space then soil/site specific species should be utilised with priority on their inherent ability to withstand a limited amount of browsing/fraying e.g. Willow sp., Alder etc. The placement of any trees left or planted within the control area should be made with direct regard to the shooting position in order to create several wide shooting avenues throughout the area. It should be noted that the fact that trees are being left/planted within the control area a degree of upkeep/maintenance would be required on a regular basis to maintain culling opportunity.

If sika or red deer are resident within the forest area then thought should be given to carcass removal from the control areas to the road network.

The control areas should be linked to the access road network by brashed paths which are cleared of brash as to allow a silent approach to the shooting point.

SHOOTING PLATFORMS/HIGHSEATS

In some cases due to topography (convex slopes), vegetation growth, ground obstructions (prevalent on restock sites), safety requirements (backdrop) etc. the shooting point will have to be from a raised shooting platform. This may come in the form of a seat giving a shooting point 1 metre above ground through to a highseat many meters above ground level. It is important to realise that at all times, the lower the shooting platform can be made the better for various reasons i.e. production costs, maintenance costs, health and safety liability etc.

The placement of the shooting platform will be decided upon the considerations made when choosing the shooting point. As previously stated, priority is to create a shooting point on the ground if the topography of the site allows but a highseat can offer a change in shooting position if required for various reasons e.g. a safe backdrop, or access to control area dictates that ground shooting point is not ideal etc.

Since the use of a shooting platform/highseat implies the building/transport/locating of a man-made structure there are obvious cost implications involved which have to be considered. To be cost effective one must consider the length of time it will be in situ and if it is only for a short period it should be portable. This is especially important when working on the edge of restock sites which are only in use until the second rotation crop is successfully established and/or the restock edge is changed due to windblow or harvesting of the adjacent coupe.

Shooting platforms/highseats are also important for increasing culling efficiency if there is only a short time when a cull beast is in view and a shot can be taken. There are periods in the year when the social behaviour of the target species creates a peak of movement, which in turn increases culling opportunity. However, these movements are not necessarily on traditional feeding areas and are within the main forest blocks where only rides offer the opportunity for culling. Once traditional paths of movement are identified, shooting platforms/highseats can be sited to provide an instant stable shooting position and greatly increases culling efficiency.

The shooting platform/highseat should be made as comfortable as possible with priority given to seating and shelter from the elements.

The person/agent placing a highseat within a forest block becomes liable for any damage to persons/property. It is therefore imperative that the person responsible for the highseat can prove that **every reasonable care** was taken to prevent accidents occurring. This is an important point to consider when there are already precedents of trespassers climbing into highseats without permission, falling off the highseat, injuring themselves and successfully suing the person responsible for the highseat.

The important factor is to demonstrate that all reasonable care was taken to avoid such accidents happening.

Factors to consider include:

- All joints/ladder steps etc. should be individually wired to another support structure.

- If necessary the highseat should be made stable with the use of guyropes etc.

- All highseats should have a sign with clear words stating "No Access to Unauthorised Persons" and an **accompanying diagram** depicting no climbing of the access ladder.
- In some cases the complete or lower part of the access ladder could be removed and

hidden close by. It could also be possible to block off access to the ladder using a board that is chained and locked in front of the steps.

- In addition the person responsible may have to prove that the highseat is checked on a regular (twice yearly) basis using a record sheet which notes date when checked, satisfactory condition or not, any faults noted and when fixed. All these factors considered together would help to demonstrate that the responsible person has **taken all practical and reasonable precautions** to prevent an accident happening.

IS DEER POPULATION IN BALANCE WITH FOREST/HABITAT?

In most cases woodland deer management within a commercial forest scenario will have two main objectives:

- Being part of a forest management team, the long-term protection of the commercial tree crop from establishment to felling and eventual re-establishment (economic sustainability) is usually the main objective. One also has to remember that in 1991 there was a re-statement of forest policy in Great Britain and an emphasis on multi-objectivity led to changes in forest management objectives which included; Protect Britain's forests and woodlands; Enhance the economic value of our forest resources; Conserve and improve the biodiversity, landscape and cultural heritage of our forests and woodlands.

- Alongside this main economic objective a secondary objective of woodland deer management must be to conserve native deer as a species in their own right and maintain a healthy population. In some cases the limitation of the spread of exotic deer may be an objective.

If these are the two main objectives success/failure could be based on undertaking simple forest crop damage assessments and completing comprehensive cull records which indicate the health of the deer population. These records can also supply important information for population estimation at a later date if required.

DAMAGE ASSESSMENT FOR TREES IN WOODLAND

From the outset it is important that all involved with the assessment are informed of the type of damage being surveyed, what actually constitutes as damage and that they identify it consistently. If considering browsing, most surveys would only record damage if the current year's leader were browsed, since side-shoot browsing does not have the economic implications of leader browsing. It may also be useful to record more than one type of damage e.g. browsing and bark stripping and the agent responsible for inflicting the damage so that protection prescriptions are directed at the appropriate cause of any problem picked up. This in turn assumes an ability to identify the agent responsible by looking at a tree which has been damaged. The two tables in

Appendix?. Summarise

It is also important that different assessors should be able to utilise the same sampling method on any given area and obtain damage estimates, which are not significantly different from each other.

The stalker/manager must also be privy to the protection history of the stand since planting e.g. frost damage on leaders/whole tree, weevil damage and treatments, drought problems etc. as this gives a complete picture of how the stand has reached the present stage in development.

NEAREST NEIGHBOUR METHOD OF DAMAGE ASSESSMENT

Due to time/cost constraints it is important to utilise a method which is both accurate, consistent but also simple and quick. The Nearest Neighbour Method (NNM) is widely accepted as being suitable for assessing any type of tree damage and even more than one type of damage or tree species can be assessed at one time. The method may be utilised to monitor changes in damage levels, but ideally permanently marked plots would be more efficient to monitor trends as long as the plot identification system does not effect use by damaging mammal.
However it should be realised that this method of sampling is most appropriate when a single damage assessment is being made on a particular forest compartment and compartments of differing tree species and/or ages should be sampled and identified as separate entities.
The NNM involves the selection of a number of sample points evenly spread throughout the area and a pre-determined number of trees are sampled at each point. The trees sampled are identified objectively and independently of any damage, which has occurred.

- Systematic spacing of sampling points throughout the assessment area means that the results are not biased by any varying intensity of damage which may exist across the area.

- The sampling points are picked to lie upon a set of approx. parallel lies which are distance D apart and the sampling points are also spaced the same distance D along any of the given lines. The distance D is calculated using the formula :

$$D = \sqrt{\frac{Ax10{,}000}{n}}$$

D = distance between clusters in metres.
A = area of stand in hectares.
n = number of clusters to be assessed.

- Once distance D has been calculated, the first task is to locate the first sampling point. This can be achieved by choosing a convenient starting point, on the edge of the compartment and then measure distance D / 2 into the stand. This will be the first sampling point and the second sampling point is then located by choosing a convenient direction across the stand. If the rows of trees are visible then the direction should be chosen to follow a row. Further sampling points are located by moving distance D along the row until the edge of the stand is reached noting the distance from the last sampling point to the edge. The next line is found by walking distance D along the edge of the compartment. Then the sample point along this line is located by continuing to count to distance D from the last sample point. The sample points are located until the whole of the stand has been sampled.

- The trees in a sampling point should be selected in an objective way, which is independent of the damage present. S simple method is to choose the pre-determined number of trees situated closest to the chosen sample point. Or if the

stand is being assessed using tree rows it is acceptable to select trees occurring along the nearest row to the sample point.

- The accuracy of any damage assessment is obviously related to the total number trees that have been sampled. The assessor must decide on the level of accuracy required before sampling begins because this has a knock on effect on the total number of trees that will require to be sampled. The accuracy required depend on the expectation of damage level and the risks associated with obtaining an inaccurate estimate of damage and if the number of trees damaged is likely to be between 20-80% a higher degree of accuracy is required before accurate management decisions can be made. Accuracy will also depend on the age and value of the crop and the size of the stand being assessed. For instance a large compartment of a high value crop approaching the end of the rotation might require an accuracy of ±5%; but a small restock site being browsed may require an accuracy of ±10 or 15%.
- The NNM has an accuracy based on 95% confidence limits and to achieve an accuracy of ± ***x*** with this level of confidence, the number of trees that must be sampled N is found by using the formula:

$$N = \left\{\frac{100}{c}\right\}^2$$

N = total number of trees to be assessed
x = accuracy desired ± @ 95% confidence level.

- The number of trees sampled at each sample plot *c* is fixed at any value from 4 to 7 with the choice of size dependant on stand conditions. Normally a size of 5 trees is recommended i.e. *c* = 5

- The number of sampling points

$$n = \frac{N}{c}$$

n = number of sapling points
N = the total number of trees to be assessed
c = the chosen sample size.

However, at least 20 sampling points must be identified and if the actual number of sampling points assessed at a certain spacing is less than 20, the assessment should be finished by assessing the required number of additional sampling points selected at random throughout the stand.

- It is important to be aware that it is possible for bias to occur in the assessment. For instance during pacing out the distance between plots it can be tempting to change pace length so as to avoid/hit an area of damage. It is also important that the trees sampled at each plot are independent of damage.

- The percentage damage is determined from the recorded assessment figures:

$$Percentage\ damage = \frac{d}{a} \times 100$$

d= total number of damaged trees counted
a = total number of trees to be assessed.

- It is not possible to be sure that the accuracy achieved is the same as the target level of accuracy as actual accuracy achieved is determined by the inherent variability in the damage between clusters. Actual accuracy achieved is calculated as follows: (1) Square the number of trees damaged in each sample plot and add them together to find X (2) The actual achieved accuracy can now be calculated using:

$$Actual\ error = \frac{\pm 200 \sqrt{X - \left\{\frac{d^2}{n^1}\right\}}}{a} \%$$

d = total number of damaged trees counted
a= total number of trees assessed
n = number of sampling points assessed.

When the assessments and calculations are complete they could be plotted onto a map of the area. If there is an area of significantly intense damage in one region of the stand then these could be treated as a separate stand on their own right.
In mixed species crops sampling plots should consist of an equal number of trees of each species e.g. in a larch/sitka mixture with 5 trees per sample plot then5 larch and 5 sitka should be assessed at each sample plot.

It may also be necessary to work out the stocking density of the stand being sampled for damage as the lower the stocking density the lower the damage that can be tolerated. The three most common methods of assessing stocking density are as follows:

- Crops under 1.5 metres in height with no visible rows.

  Use a circle of 5.6 metres radius for 0.01 Ha plots. The simplest method is to anchor a 5.6 metre length of string at the plot centre and using its full extension to define the plot boundary within which all trees are counted.

- Crops over 1.5 metres in height with no visible rows.

  It is more difficult to use a circular plot in crops over 1.5 metres in height and therefore 10m by 10m plots are recommended.

- Crops with rows.

Measure the width of 4 rows of trees from the centre line of the first row to the centre line of the fourth row. Divide this distance into 100 to give a length in metres that has to be measured along a row to provide the other side of a 0.01Ha plot. Run a tape measure out along either of the central rows of trees for this distance and count all the trees in that row and in the row on either side.

CULL / LARDER RECORDS

Accurate cull records form an important part of information that give an insight into the health and fecundity of any woodland deer population. In addition a series of cull maps built up over a number of years can also produce interesting population information indicating possible areas where forest protection design could be improved.
An example of a typical larder sheet can be found at Appendix? recording certain facts which will provide the stalker/manager with useful information on which to base future management decisions i.e. if management is achieving it's objectives or if changes in management (cull targets) /protection design etc. are required.

Date: In retrospect this record may indicate when in the season social/feeding movement is at a high and therefore sightings and culling efficiency increases, assuming that the stalker can spend an equal amount of time on the property throughout the year. However, no one thing can be looked at in isolation. These records would have to be looked at over a period of years to eliminate effects of unusual weather patterns for any given year, consideration may be needed for the effects of any forestry operations that may be in the area etc.

Tag No.: Identification of a particular carcass to particular area can be useful in the ever demanding world requiring individual tracability from forest to Game Dealer and beyond.

Sex: Population control requires that an adequate proportion of females be culled from the population every season. It is important to set out individual culls for either sex and record this.

Age: It should be possible noting teeth eruption, staining and wear, to estimate the age of red, sika and fallow deer up to the age of 12 years. Over a period of years, jaws from deer shot on a particular estate/area will enable stalkers to build up a representative picture so that ageing from jaws can be more dependable.
In the case of roe deer the process of tooth eruption and replacement is completed towards the end of the first year of life thereafter only comparisons of teeth wear may indicate age. However, teeth wear has a tendency to reflect the geology and vegetation types being browsed as opposed to age. Classifying culled animals simply as young, 2 year-old, mature and old, may be sufficient for some purposes taking note of several factors;

- Noting the ridge at the muscle attachment point to the lower jawbone. From middle-age onwards there will be an increasingly noticeable thickening of the edge and a corresponding concavity on the outside.

- Pedicles tend to slope downwards on older bucks.

- The degree of ossification of the central nasal septum which is the division running down the inside of the nose between the nostrils. The greater the ossification the older the animal.

In some cases (for cohort analysis) it may be necessary to place the culled roe deer as accurately as possible into their year classes. There is some debate as to whether this can be achieved consistently/accurately despite considerable labour/effort.

- The ossification of the central nasal septum can be used to place the culled deer in a year class. REF: Prior, R. 1999. How old was he ?. In *The Stalking Magazine*, November 1999. Field Sports Publications Ltd.

- Counting the annual growth layers of dentine on a molar tooth. There is some debate as to whether the winters in GB are hard enough to cause these annual layers to be distinct enough to observe under the microscope.

Weight: Carcass weights are useful indicator of population health for any given estate/forest and comparisons over several years of recording can give some indication of possible trends in health of the population and thus trends in balance of population with the forest habitat at any particular stage of development. For instance as the forest crop goes from pre-thicket into the thicket phase, depending on the inherent forest design, there will be a marked reduction in food availability which could be reflected in change in average body weights. It can also reflect differences in seasonal weather from year to year and any trends should only be looked at over a period of 4-5 years.

Kidney Fat Index: This is a good indicator of individual fat reserves and breeding condition in females. Fat colour can also indicate if fat reserves are being drawn upon reflecting changes in food availability, feeding behaviour, social behaviour e.g. rutting started, deep snow etc.

Corpus Luteum / Foetii: Females only come into breeding condition if they reach a threshold body weight at the time of the rut. In the woodland deer context, the corpus luteum of females born earlier that year should also be checked because in some cases they will have reached the threshold body weight. There is some discussion within the profession as to whether this indicates a population well below carrying capacity or is reflecting a genetic trait of a particular family group for fawns/calves to come into season in their first year.
It is important to be able to measure recruitment into the population through breeding of resident females. Since the female cull begins before there is any significant sign of foetii, it is important to be able to check the females ovaries for the presence of corpus luteum This is especially important for roe does which will not produce recognisable foetii until well into the doe season due to **delayed implantation**. It is also important to be able to do this for species that commonly have multiple births, again for estimating recruitment and also as an indicator of population health.

Shot Placement: It is important to monitor that deer being culled are being culled as humanely as possible. If there was a rise in unsatisfactory shot placement/wounding, the cause for this should be sought out and rectified. It may reflect accuracy problems with

a particular rifle, unsatisfactory ability of a certain controller, etc. Obviously certain shot placements will have a follow through effect to the income received for that carcass form the game dealer and on checking records, this can be identified.

Forest Structure: This records the areas in the estate/forest that are being utilised to observe/cull deer. If significantly more deer are being culled on a particular forest structure/phase it either reflects a discrepancy in the amount of time being spent culling deer in a particular phase or a difference in population density between phases.

Control Area: Culls from highseats/boxes or on designated control areas should be recorded. This aids in improving culling efficiency over the years and can indicate the need for control space maintenance or future design developments for improving culling efficiency.

Part Time Help: Future woodland deer population control will depend on the utilisation of part-time recreational stalkers. Since a team is only as efficient as it's weakest link it is important to be able to monitor the ability/efficiency of all members of the team.

AM/PM: Knowledge of deer movement in morning/evening at particular times of the season can be useful for improving culling efficiency. Indeed in some cases the **actual time** of culling can lead to important discoveries for particular populations. For instance we discovered that in the AM it is late morning in September/October that the peak in sika movement occurs, thus controllers are not placed in highseats at first light but later in the morning so that they are more alert/comfortable etc. at time of peak movement.

In Season: In the woodland situation there are certain times when deer have to be culled out of season. For instance the presence of roe bucks cannot be tolerated on certain restock sites over a winter period when high browsing damage can occur. In the case of sika deer, our period of high culling efficiency occurs during September to November and later in March when both sexes are out of season. Therefor it may be necessary to apply to the DCS for out of season licences for these situations. Part of the conditions with the licence is to inform them as to how many deer were actually culled out of season during the period the licence allowed. This cull record eases calculation of this figure at the end of the period.

Comments: Behaviour before shot should be recorded if it is at all unusual as this has to be passed onto the game dealer by law, if the beast was culled using a spotlight then the DCS has to be informed when the night-shooting permit ceases, presence of endo-parasites, body condition, etc.

Target Cull: It is important that a target cull be set for all estates/properties so that stalkers/controllers can gauge their success throughout the season. Target culls should be set as objectively as possible taking into account a whole series of factors;

- If past cull records are available, body weight, fecundity cull trends should be taken into account to see if they reflect any changes in the balance between deer population and carrying capacity.

- The stage of forest development has to be accounted for. As the forest enters the thicket stage, food availability will be reduced significantly and the deer cull should be increased in an attempt to lower the population to reflect this reduction in carrying capacity. If not the unplaced animals of this population will have to migrate to a more suitable habitat and therefore may cause problems on adjacent estates/forests or body condition will decrease. Eventually when the crop has entered close canopy and the population is again in balance with the carrying capacity a lower target can be set to maintain population density at a lower level as it was at pre-thicket.

- Imminent forest operations which will ultimately create a short-term disturbance or create a change in crop vulnerability (e.g. restock, thinning) should be taken into account and if the resident deer population can be reduced before the commencement of operations the better.

- In some cases population models etc. could be utilised to set an objective cull.

In setting the cull controllers/managers have to take into account the overall effect that immigration/emigration is having on the population density and the bigger the management unit in relation to other adjacent units, the more control one can have on the resident population.
However there will be cases where adjacent estates can have a serious impact on management and associated cull targets. These impacts will be more significant for species like red/sika deer that have a wider ranging tendency than species like roe deer that have far more smaller/stronger territorial behaviour patterns.

- For instance if an adjacent estate/forest is entering the thicket stage with a poor inherent control design/policy there will be a significant increase in emigration from that area.

- Another case is where neighbouring estates have differing management objectives e.g. forest protection as opposed to sporting estate where there are significant differences in the perceived acceptable deer density. If the acceptable density figures are significantly different there will be continual supply of animals into the area with the lower density.

In these cases the target cull figure would be higher than on a normal situation

In some cases, once the target cull is set, it may be useful to make a cull progress sheet for each estate/forest which could indicate if the cull is on progress to achieve the set target or not. Enclosed

ESTIMATING DEER POPULATION SIZE

In some cases it may be deemed necessary to estimate the resident population size. This may be necessary for a number of reasons e.g. to find out if a population is increasing, stable or in decline; to identify the level of culling a certain population can sustain at a certain phase of forest structure.
Without an accurate assessment of population size and its rate of increase, it will not be possible to calculate a target cull that would maintain or reduce total numbers.
However the value of such information may be negligible if the management area is significantly effected by migration of deer to and from adjacent forests/estates. The land use may be other than commercial forestry e.g. open hill deer forest; objectives of deer control/management within different forests may differ e.g. forest protection or recreational stalking etc. If the resident population being estimated is significantly changed due to migration then the value of the time/costs involved to estimate population density has to be questioned.
Obviously one should attempt to negate the effect of migration to and from the population. Options include; erect/maintain a deer fence between alternate land uses, increase the total area to be estimated to include all areas where most of the movement occurs e.g. set up a deer management group covering a large area where the deer can potentially be managed as one unit and effects of migration are significantly reduced.

To be of value there must also be a commitment/realisation that the deer density survey will have to be reinvestigated at a later date to monitor.

OBJECTIVES OF SURVEY

It is crucial to have clear and definite objectives of what information is required from the survey. This process of objective setting will have significant effect on the census method to be utilised and the inherent sampling design. Things that need to be considered can include; size/extent of area to be surveyed, presence/size of differing forest phases e.g. pre-thicket, thicket etc., accuracy required and survey cost implications.
One important consideration to make is if an **index** of deer numbers as opposed to an **actual count** is acceptable/practicable. However this is usually only an option where there is little concern about the present/future population size or their effect on crops/habitats.
Objectives can also influence if **direct** as opposed to **indirect** methods of assessment are used. For instance if objectives require an assessment of age-class or sex-class ratios then direct methods will have to be used. However in the woodland scenario, direct observation is usually restricted and indirect methods are the best option to estimating deer populations

SAMPLING

Most of the census methods will require information (data) to be collected through sampling. The sample design will depend on the labour/equipment at disposal, accuracy required and the likelihood of introducing bias.
In the case of woodland surveys, there is a good chance that there will be an inherent variation across the study area and it is important to **stratify**. Since the census is aimed at calculating deer density/presence it is important to stratify the area of woodland into phases of development;

- Establishment/restock (0-1m),
- Pre-thicket (1-3m),
- Thicket (3-10m),
- Pole stage (10+m),
- Pre-felling (10+m),
- Open ground (No crop).

All these forest phases offer different levels of food, shelter and security to the resident deer population and will therefore influence their usage within the forest complex.

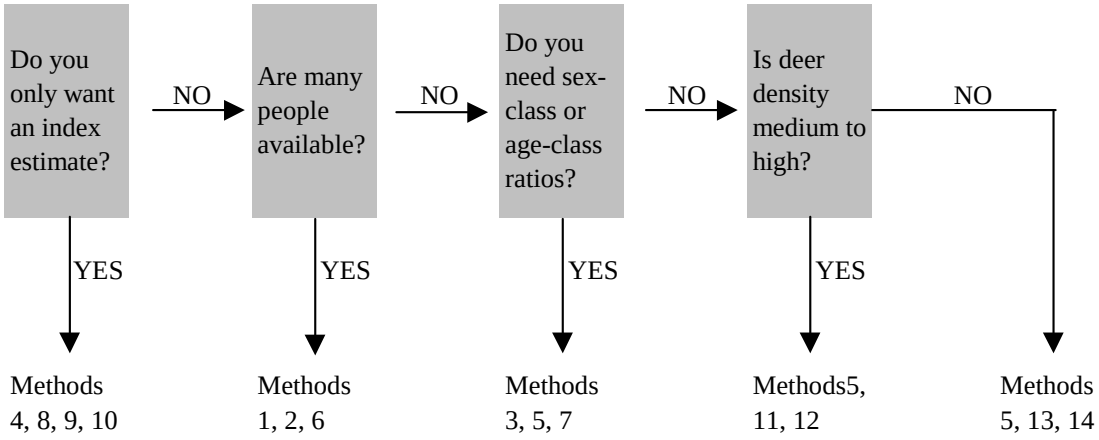
ESTIMATION METHODS

The estimation or census methods fall into three categories: direct methods, indirect method, and use of cull data.
The choice of method is dependent on various factors:

- Is index or actual population estimate required ?
- Is area to be sampled open or closed.
- Topography of survey area may be more suitable for some census methods than others.
- How much time before the survey information is required ?
- Seasonal and daily behaviour patterns of the deer may effect sex and age classes of deer to be found in a particular area.
- The amount of money, labour and equipment required for each census method.

The flowchart below identifies which method(s) are likely to be the most practicable for any given woodland situation and the following table illustrates the related performance and costs of each method.

CHOOSING CENSUS METHOD



Direct Methods

1. Drive Counts

Data recorded: Each observer and beater records numbers of animals seen sorted into species, sex, age-class, time seen and direction of travel.

Equipment required: Map of area showing observer positions and viewing area, record forms; radios and whistles for beaters.

Health & Safety considerations: Beaters may get lost in thick woodland. Bright clothing and list of participants to reduce this problem.

Advantages:

- Suitable for large or small areas.
- Suitable for woodlands.
- Species composition, sex- and age-class ratios can be estimated.
- Completed in 1 day.

Disadvantages:

- Requires good visibility on day.
- Deer can be very difficult to flush from cover (even with dogs) particularly mature/old and juveniles (1-3 weeks old) remain in cover.
- Accuracy can be effected by observer bias on age- sex-class identification.
- Only the minimum population is estimated.
- Seasonal behaviour, weather, and disturbance prior to and on the day can effect number of observations/results.
- Requires detailed planning
- Large numbers of beaters may be required and prone to getting lost in large thick woodland and hilly ground.

Performance as an estimate: fair
Performance as an index: fair
Inexpensive equipment costs: fair
Inexpensive labour requirements: very poor
Simple data analysis: good
Data collection period: 1-7 days

2. Static Census

Data recorded: Species, sex-class, age-class, time of observation and direction of travel of all animals observed.

Equipment required: Maps of area, indicating observer positions and viewing area, record forms and binoculars.

Health & Safety considerations: Observers should be dressed against prevailing weather conditions.

Advantages:

- Can be utilised in all habitat types.
- Species composition, sex- and age-class ratios can be estimated.
- Completed in one day

Disadvantages:

- Requires good visibility on day.
- Only minimum population can be estimated.
- Accuracy effected by observer bias on age and sex class definition.
- Results specific to one day and are effected by weather, seasonal behaviour, disturbance levels.
- Many observers required.
- Requires detailed organisation.

Performance as an estimate: fair
Performance as an index: good
Inexpensive equipment costs: good
Inexpensive labour requirements: very poor
Simple data analysis: good
Data collection period: 1-3 days

3. Vantage point counts

Data recorded: Species, sex- and age-class, and direction of movement of all animals.

Equipment required: Binoculars, telescope, map of area.

Health & Safety considerations: Dressed for weather conditions.

Advantages:

- Species composition, age- sex-class ratios can be estimated.
- Carrying out counts in the same area in differing seasons may indicate seasonal deer use.
- Only 1-2 observers required.

Disadvantages:

- Only suitable for hilly terrain.
- Requires good visibility.
- Results specific to count days reflecting weather, disturbance and seasonal behaviour of deer.
- Usually only a minimum population is estimated.
- Various habitat/forest phase types have to be surveyed separately.
- Area observed must be typical of the habitat being sampled or bias may be introduced.

Performance as an estimate: fair
Performance as an index: good
Inexpensive equipment costs: good
Inexpensive labour requirements: excellent
Simple data analysis: good
Data collection period: 1-3 days

4. Spotlight counts

Data recorded: Species, sex- and age-class of all animals seen Perpendicular distance to observed deer (if distance sampling).

Equipment required: Spotlight, vehicle with high observation point, 1-3 observers/assistants, map of area and record forms.

Health & Safety considerations: All risks linked with driving at night with sidelights only. Learn route previous to night run and record obvious hazards like low branches, potholes etc.

Advantages:

- Quick method.
- Low labour requirement.
- Low cost of equipment.

Disadvantages:

- Area being sampled requires good road/ride network.
- Requires good visibility on night.
- Only minimum population size can be estimated and accuracy probably poor.
- Difficult to work out age- and sex class.
- **If night shooting has gone on previously, animals will disappear quickly or before they are observed.**
- Result specific to seasonal behaviour, changes in climate and effect on feeding behaviour.

Performance as an estimate: poor
Performance as an index: fair
Inexpensive equipment costs: fair
Inexpensive labour requirements: good
Simple data analysis: fair
Data collection period: 1-7 days.

5. Thermal imaging: distance counting

Data recorded: Number, species, sex- and age-class of all animals in a group, and distance of the group from the transect line.

Equipment required: High-resolution thermal imager with built in rangefinder (for distance sampling). If a 4-WD vehicle is utilised, a roof hatch is recommended for viewing out of. A compass with a luminous dial is needed to take bearings, two way communications with driver/observer.

Health & Safety considerations: Care required if walking through woodlands at night All routes for walking/driving should be completed during daylight to monitor hazards Steep/unstable ground should be avoided if possible.

Advantages:

- Accuracy/reliability good.
- Species composition can be estimated.
- Sex- age-class ratios can be estimated if males are in velvet.
- Low labour requirement.
- Areas of high deer use can be identified.
- Nocturnal patterns of behaviour and habitat use can be observed.

Disadvantages:

- Woodland must have an extensive road/ride network i.e. greater than 2.5 km of road for every square km being sampled which is not associated with deer habitat use.
- Requires use of specialist computer software to analyse data and calc. Population density.
- Results specific to conditions, seasonal behaviour, disturbance effects on the night sampled.
- Observers require training in use of equipment, sampling methods and analysis.
- Availability of equipment is limited at present.
- There may be bias in results if deer are attracted to or avoiding the roads/rides.

Performance as an estimate: excellent
Performance as an index: excellent
Inexpensive equipment costs: poor
Inexpensive labour requirements: good
Simple data analysis: very poor
Data collection period: 3-5 days

6. Individual recognition (mark-resightings)

Data recorded: Individual deer identity (number/mark), dates seen, total number of deer seen on each occasion.

Equipment required: If deer are marked you nee clearly coloured collars or eartags; equipment and licence to catch/handle animals.

Health & Safety considerations: Risks of injury to staff whilst catching/handling live deer. If darts are used there are also risks with chemicals used.

Advantages:

- Can estimate precision.
- Sex- and age-class ratios can be estimated.

Disadvantages:

- Precision is based on validity of assumptions, and bias introduced if assumptions are not correct.
- Lot of labour required for observation and deer capture. Also catching and marking equipment costs
- Require licence to catch and mark adult deer.
- Detailed planning required for catching of deer, care needed for handling/marking of captured deer.
- Complex computer software required to analyse data.

Performance as an estimate: good
Performance as an index: good
Inexpensive equipment costs: very poor
Inexpensive labour requirements: very poor
Simple data analysis: poor
Data collection period: 3-24 months

7. Change-in-ratio counts

Data recorded: Number of animals by species, sex- and age-class.

Equipment required: Binoculars, telescopes

Health & Safety considerations: Lone working so have daily reporting procedures and/or mobile phones.

Advantages:

- Suitable for sampling large areas.
- Sex- and age-class ratios can be estimated.
- Low equipment costs

Disadvantages:

- Many observations required so it is actually more suited to open habitats.
- Good visibility required.
- Can be observer bias in sex and age classification.
- Precision can be effected by seasonal behaviour changes of deer.
- Two separate surveys required.

Performance as an estimate: fair
Performance as an index: good
Inexpensive equipment costs: fair
Inexpensive labour requirements: fair
Simple data analysis: fair
Data collection period: 6-9 months

Indirect methods

8. Impact levels

Data recorded: Deer species present, type of tree protection (if any), proportion of trees damaged, and impact scores for other vegetation.

Equipment required: Record forms, sampling quadrats for other vegetation.

Health & Safety considerations: Lone working risks

Advantages:

- Applicable on all habitats.
- Low labour requirement (1-2 people)
- Low equipment costs.

Disadvantages:

- Imprecise.
- Only an index of deer presence.
- Seasonal deer behaviour and associated changes in habitat impact/damage will cause bias and effects sampling date.
- May be difficult to separate effects of sheep, rabbits, hares etc. impacts from purely deer impacts on vegetation.

Performance as an estimate: very poor
Performance as an index: fair
Inexpensive equipment costs: fair
Inexpensive labour requirements: fair
Simple data analysis: fair
Data collection period: 1-5 days crop, 6-12 months habitat.

9. Track/slot counts

Data recorded: Number of pathways crossing the woodlands boundary per 100m.

Health & Safety considerations: Lone working aspects

Advantages:

- Suitable for most habitats.
- Relatively quick.
- Low labour requirement.
- Low equipment costs.

Disadvantages:

- Dense, grassy vegetation may obscure pathways.
- Only of use to provide and index of presence/activity.
- No age- or sex-class differentiation.
- Usually unreliable as an estimate as main assumptions are invalid

Performance as an estimate: very poor
Performance as an index: fair
Inexpensive equipment costs: excellent
Inexpensive labour requirements: excellent
Simple data analysis: very good
Data collection period: 1-4 days

10.Index of deer presence

Data recorded: Number of faecal pellet groups per plot or transect length sorted by species.

Equipment required: Compass measuring tape and pegs to set up plots.

Health & Safety considerations: Strong disposable gloves for searching in dense undergrowth for pellet groups.

Advantages:

- Applicable for any habitat group.
- Not effected by weather excepting snow.
- Quick method.
- Low labour costs (1 person).
- Low equipment costs.

Disadvantages:

- Only an index can be estimated.
- No age or sex classification possible.

Performance as an estimate: very poor
Performance as an index: good
Inexpensive equipment costs: excellent
Inexpensive labour requirements: excellent
Simple data analysis: good
Data collection period: 1-4 days

11.Clearance counts (FAR)

Data recorded: Number of pellet groups sorted by species, accumulated for each plot on the second visit and any decay loss of marked pellet groups.

Equipment required: Orienteering compass, tape measure, tent pegs or pins, posts, gloves.

Health & Safety considerations: Strong disposable gloves for searching pellet groups out of dense vegetation.

Advantages:

- Applicable in all habitats and weather excepting snow.
- Accuracy and reliability of estimate is better than for faecal pellet standing crop counts.
- Population estimate for a specific period of time equal to period between visits.
- Low labour requirement (1-2 people).
- Low equipment costs.
- Easily repeated.

Disadvantages:

- Species identification may be difficult where two or more species are present.
- No identification of sex- or age-class ratios.
- **Habitat specific decay should be monitored.**
- Delay in obtaining estimate. (2-3 months).
- Two site visits required.

Performance as an estimate: excellent
Performance as an index: excellent
Inexpensive equipment costs: excellent
Inexpensive labour requirements: poor
Simple data analysis: good
Data collection period: 2-3 months

12.Standing crop plot counts

Data recorded: For each plot, number of faecal pellet groups per deer species or unknown category. **Habitat and species specific faecal pellet decay length.**

Equipment required: Orienteering compass, measuring tape and tent pegs/pins (to mark out plots).

Health & Safety considerations: Disposable gloves

Advantages:

- Suitable for large areas.
- Suitable for most habitat types weather excepting snow.
- Confidence Limits for population estimation can be calculated.
- More precise than clearance counts.
- Population densities and size estimated for the number of animals contiguously using the area over the period of time equal to decay length (usually at least 3-6 months).
- Only one site visit to count pellet groups.
- In upland situation it is possible for 2 people to visit and check two or three 8 plot transects in a day. So low labour requirement.
- Low equipment costs.
- Habitat use can be researched.

Disadvantages:

- **Habitat and species specific decay rates need to monitored prior to counts to enable deer density to be calculated.**
- **Accuracy influenced by accuracy of defecation and decay rate estimates.**
- No sex or age class information.
- Species identification may be difficult where two or more deer species are present.

Performance as an estimate: good
Performance as an index: excellent
Inexpensive equipment costs: excellent
Inexpensive labour requirements: fair
Simple data analysis: fair
Data collection period: 4-12 months

13.Standing crop strip transect counts

Data recorded: For each plot, number of faecal pellet groups per deer species or unknown category. **Habitat and species specific faecal pellet decay length.**

Equipment required: Orienteering compass, measuring tape and pins/pegs (to mark out plots).

Health & Safety considerations: Disposable gloves.

Advantages:

- Suitable for large areas.
- Suitable for most habitat types.
- Not restricted by weather excepting snow
- Confidence intervals for the population estimate can be calculated.
- More precise than clearance counts.
- Population densities and size estimated for the number of animals continuously using the area over a period of time equal to decay length (3-6 months).
- Only one site visit required to count pellet groups
- Low labour requirement (1-2 people).
- Low equipment costs.
- Habitat use can be investigated

Disadvantages:

- Ha**bitat and species specific decay rates need to be monitored prior to counts to enable deer density to be calculated.**
- **Accuracy influenced by accuracy of defecation and decay estimates.**
- No sex- or age-class information.
- Species identification may be difficult if two or more deer species are present.

Performance as an estimate: good
Performance as an index: excellent
Inexpensive equipment costs: excellent
Inexpensive labour requirements: fair
Simple data analysis: fair
Data collection period: 4-12 months

14.Standing crop strip linear transect counts:

Data recorded: Number of pellet groups by species, in each 10m length. **Habitat and species-specific faecal pellet decay lengths.**

Equipment required: Orienteering compass, Walktac or wire and a measuring tape, 1m cane.

Health & Safety considerations: Disposable gloves.

Advantages:

- Suitable for large areas.
- Suitable for most habitat types and weathers excepting snow.
- Population estimate is for a period (3-6 months at least).
- Large areas sampled relatively quickly, particularly where ground vegetation is sparse.
- Habitat use may be indicated.
- Low labour requirements.
- Only one visit to count pellet groups.
- Low equipment costs.
- **Most useful in sites of low deer density.**

Disadvantages:

- Confidence intervals cannot be estimated unless a number of transects are sampled in each habitat.
- **Habitat and species-specific decay needs to be monitored before counts and finding sufficient fresh pellet groups may be a problem.**
- **Precision influenced by accuracy of defecation and decay estimates.**
- Sampling bias can cause over-estimation of population if protocol is not strictly adhered to.
- No sex- or age-class estimates.

Performance as an estimate: fair
Performance as an index: good
Inexpensive equipment costs: excellent
Inexpensive labour requirements: fair
Simple data analysis: good
Data collection period: 4-12 months.

Using Cull Information

As mentioned previously, accurate, clear and concise records of mortality and fertility can be used as a means of retrospectively calculating population size. Usually they depend on identifying the age/sex of all dead animals (culled/natural mortality). Accuracy is therefore effected by **ability to age** culled animals, amount of deer that die naturally and are not found and **migration** to/from other areas.
Usually in woodland deer populations a cull of 10-25% is required to keep the population stable but this again depends on natural mortality, fertility and emigration/immigration levels.

1. Balance sheet

Data recorded: Age- and sex-class of all deer seen during census, found dead or culled.

Equipment required: Binoculars, telescope, and map of area.

Health & Safety considerations: Disposable gloves when examining lower jaws of dead/culled deer.

Advantages:
- Suitable for all habitats.
- Not limited by weather.
- Sex- age-class ratios estimated.
- Provides comparison data for other census methods.
- Encourages detailed record collection.

Disadvantages:
- Requires **visual** census and cull data.
- Accuracy influenced by accuracy of original census and **mortality data**.
- **Assumption of a closed population is probably invalid.**

Performance as an estimate: poor
Performance as an index: fair
Inexpensive equipment costs: fair
Inexpensive labour costs: poor
Simple data analysis: fair
Data collection period: 6-9 months

2. Life tables

Data recorded: Age- and sex-class of all deer seen during census, found dead or culled.

Equipment required: For roe and fallow deer, age determination equipment.

Health & Safety considerations: Disposable gloves when examining lower jaws of dead/culled deer.

Advantages:

- Suitable for all habitats.
- Sex- age-class ratios estimated.
- Low labour requirement.
- Low equipment costs.
- Encourages detailed record keeping.

Disadvantages:

- Accuracy influenced by bias and accuracy of age determination methods and the proportion of dying and not recorded in woodland situation.
- **Assumption of a closed population is probably invalid.**
- Retrospective rather than current population is estimated.
- Requires data collection over a number of years.
- Requires experience in fitting mathematical models.

Performance as an estimate: fair
Performance as an index: good
Inexpensive equipment costs: good
Inexpensive labour costs: poor
Simple data analysis: poor
Data collection period: 5+ years

3. Cohort Analysis

Data recorded: Age and sex of all deer found dead or culled.

Equipment required: For roe and fallow deer, age determination equipment.

Health & Safety considerations: Disposable gloves when examining lower jaws of dead/culled deer.

Advantages:

- Suitable for all habitats.
- Sex- age-class ratios estimated.
- Low labour requirement.
- Low equipment costs.
- Encourages detailed record keeping.
- Useful for retrospectively checking accuracy of other methods.

Disadvantages:

- Accuracy influenced by bias and accuracy of age determination methods and the proportion of dying and not recorded in woodland situation.
- Requires data collection over a minimum of 5 years.
- Retrospective but can be used with 1, 2 and to be predictive.

Performance as an estimate: good
Performance as an index: good
Inexpensive equipment costs: very good
Inexpensive labour costs: poor
Simple data analysis: poor
Data collection period: 5+ years

4. Population modelling

Advantages:

- Suitable for all habitats and species.
- Sex- age-class ratios estimated.
- Different culling scenarios can be evaluated quickly and tested against true population information.
- Low equipment costs.
- Encourages detailed record keeping.
- Predictive.
- Effects of changes in mortality, fertility and age structure are easily shown.

Disadvantages:

- Accuracy influenced by accuracy of initial population estimate, age-class ratios and age-specific fertility and mortality data. These may vary annually.
- Requires use of computer and suitable software.

Performance as an estimate: excellent
Performance as an index: excellent
Inexpensive equipment costs: fair
Inexpensive labour costs: poor
Simple data analysis: poor
Data collection period: 1+ years

Birth Rates

Age class birth rate	=	Age class fertility	x	Age class survivorship	=	X
Age 9	=	14(26)	x	27 0.30	=	38
Age 8	=	15(26)	x	27 0.30	=	39
Age 7	=	16(26)	x	27 0.30	=	40
Age 6	=	17(25)	x	28 0.95	=	41
Age 5	=	18(25)	x	28 0.95	=	42
Age 4	=	19(25)	x	28 0.95	=	43
Age 3	=	20(25)	x	28 0.95	=	44
Age 2	=	21(25)	x	28 0.95	=	45
Yearlings	=	22	x	29 0.90	=	46
Kids	=	23	x	37	=	47

DEER (SCOTLAND) ACT 1996

Introduction:

The Deer (Scotland) Act 1996 consolidates provisions from the Deer (Scotland) Act 1959 and the Deer (Amendment) (Scotland) Acts of 1967, 1982, 1996 and deals with, amongst other matters, the Deer Commission for Scotland, conservation, control and management of deer of varying species, certain offences in relation to deer, enforcement of the law relating to deer, licensing of venison dealing and certain miscellaneous and general matters.

The Deer Commission For Scotland:

With effect from 18th October 1996, the former Red Deer Commission (RDC) was re-named the Deer Commission for Scotland (DCS), with certain changes to its functions:

Part 1, Section 1; The DCS shall further the conservation, control and **sustainable management** of deer in Scotland, and keep under review all matters, including their welfare, relating to deer;

Part1, Section 2; It shall be the duty of the DCS to take account as may be appropriate in the circumstances of-

- **(a) the size and density of the deer population and its impact on the natural heritage;**
- (b) the needs of agriculture and forestry; and
- (c) the interests of owners and occupiers of land.

The DCS's remit under the Act now extends to fallow, red, roe and sika deer and any other species of deer specified by statutory instrument, made by order of the Secretary of State.

The manner of appointment of the DCS under the new Act is significantly different from those of the RDC.

Close Seasons:

Wild deer remain protected by close seasons during which period they may not be taken, wilfully killed or injured (except in certain limited circumstances specified in the Act. The existing close seasons for the various species are set out in Appendix ?.The maximum penalty on summary conviction is a fine of level 4 on the standard scale (currently £2,500) for each deer in respect of which the offence is committed or 3 months imprisonment or both.

Close Season Control Measures:

There are certain provisions in the Act which excempt certain persons from prosecution for taking certain measures during the close seasons which would normally be a criminal offence. These exemptions may be classified according to whether the prior written authorisation of the DCS is **required or not**.

(1) Close Season measures **without** the authority of the DCS;

These are restricted to measures of prevention of suffering by deer (road traffic accident, orphaned fawn) and in these exceptional circumstances the suffering animal may be dispatched by some means other than shooting with a prescribed firearm.
Out of season measures for the prevention of serious damage to agricultural produce on **certain** ground or to enclosed woodland and **only by certain specified persons**.

(2) Close season measures **with** written authority of the DCS;

Such an authorisation must be in writing and specify how long it remains in force and have appropriate conditions attached. This permission could be for scientific purpose or in the interests of public safety. It also includes measures for the prevention of serious damage to any unenclosed woodland or serious damage, directly or indirectly, to the natural heritage generally.

Control Agreements and Control Schemes:

Control agreements and Control schemes may be required in particular geographical areas if the DCS are satisfied that deer numbers in the locality require to be reduced or if it appears to the DCS that circumstances require complete exclusion of deer, or of deer of a particular species, from that area and that any deer within that area should be taken, removed or killed. The areas to which such agreements or schemes relate are referred to as "**control areas"**. In each case, the Act specifies the **criteria** that the DCS must take into account before they can proceed to **draw up** a control agreement or **make** a control scheme.
Control schemes will work on a **voluntary** basis but control schemes import an element of **compulsion** upon owners and occupiers of land within the control area.
Before a control agreement may be considered, the DCS have to be sure that there has been, or is, or is likely to be, deer damage to woodland, agricultural production or to the natural heritage generally or injury to livestock and that deer have become a danger or potential danger to public safety. The damage, injury or danger or potential danger need not be serious but the DCS must be sure that certain measures are required to prevent its further occurrence. The DCS must then consult all the interested owners or occupiers of land who may be affected by the proposed measures to try and secure their agreement that some measures are necessary, about what these measures should be and when and by whom they should be carried out. If agreement is secured on these mattes, the DCS then draw up a control agreement, specifying the parties to it, of which all consultees must receive a copy whether or not they are party to the final agreement.

Control schemes may be made by the DCS, subject to confirmation by the Secretary of State, only for control areas or prospective control areas where the terms of a preceding control agreement are not being complied with or where the DCS, having identified a prospective control area, fail to secure a voluntary agreement amongst owners or occupiers with whom they have consulted, whilst the deer problem identified by the DCS remains and requires preventive action.
It should be noted that a control agreement may be made in **anticipation** of future damage, injury or danger, but a control scheme may only be made where deer **have caused, or are causing**, serious damage or injury or are and remain a danger to the public, necessitating action. The DCS has the power to carry out any requirement upon a particular owner or occupier under a scheme if necessary. It also has the power to dispose by sale or otherwise of deer killed or taken by them in the exercise of that power. The DCS may recover any additional expenses which they incur in carrying out measures instead of the defaulting owner or occupier.
The DCS cannot in a control scheme require any owner or occupier to enclose deer within a fence or other artificial obstruction.

Emergency measures to prevent deer damage:

There may be occasions when the owners or occupiers of land on which deer are located are unwilling or unable to effect proper management or control whilst these deer are actively causing serious damage to woodland etc. In these circumstances, if the DCS are satisfied they have no other powers to deal with the problem and that the killing or taking of deer is the only effective remedy, they may issue an authorisation to any competent person to follow and kill on the land mentioned the deer which appear to be the cause of the problem. The person owning or occupying the land must be given an opportunity to kill the deer responsible for the problem and it is only if that person declines or is unable to act that an authorisation can be issued to any other competent person.
The period for which such emergency authorisations are effective is restricted to 28 days or less and must be in writing. Again these emergency measures may be taken in relation to the natural heritage 2here serious damage is being caused on enclosed or unenclosed land.

Powers of entry onto land:

Any person authorised by the DCS in writing may enter upon land at all reasonable times to investigate any apparent damage, injury or danger and effect any necessary emergency measures authorised by the DCS. No advance notice of entry on the land is required in these circumstances. In other specified instances, 14 days notice must be given of intended entry upon land for a specified period of time, which must not be more than 1 month. Such notice is necessary for the following purposes; census taking, assessing the need for a control agreement or scheme, effecting measures under such a control agreement or scheme and finding out whether and how any requirement imposed upon any person under that part of the Act for the effective management or control of deer has been carried out.

Offences in relation to deer:

The statutory offences in this section include poaching, removal of deer carcasses without right or permission, taking or killing deer at night, using a vehicle to drive deer, offences connected with the use of vehicles or aircraft, firearms and ammunition offences, illegal possession of deer or firearms, offences committed by more than one person, attempted offences and act preparatory to the commission of these offences.

Unlawful killing, taking and injuring of deer; Deer in their natural state are wild animals and so do not belong to anyone. Hence deer cannot be stolen, as there is no legal right of property in any deer or its carcass unless and until it is lawfully taken or killed. The right to take or kill deer in season found on any land is a useful pertinent of land ownership as venison is in constant demand and this, coupled with the high value placed on certain species for sporting purposes, resulted in the statutory offence commonly referred to as “deer poaching”. The humane killing of injured or diseased deer to prevent suffering is not an offence but when the injury is caused deliberately, that in itself is an offence.
The unlawful removal from land of any deer carcass is a separate offence to the offence of unlawfully killing deer. So one could be charged with two offences in respect of one animal.

The only lawful method of deliberately killing a deer, except for humanitarian purposes for the prevention of suffering, is by shooting with a prescribed firearm, as defied by the Firearms Act 1968. In Scotland the general criterion for prescription is still the type of ammunition used as any firearm capable of using the prescribed ammunition may be used. The details of the prescribed ammunition are set out at Appendix ?.

The only restriction on rifle sights in Scotland is that the use of light intensifying or heat sensitive equipment or a sight which is a special device for night shooting is prohibited.

Taking or killing deer at night; It is an offence for anyone to take or kill any deer after the sun has been set for an hour until one hour before the next sunrise except for humanitarian reasons. Night shooting of deer at night is absolutely prohibited, except under specific authorisation from the DCS in exceptional circumstances. Authorisation from the DCS for the occupier or person nominated in writing by the occupier to take or kill deer at night can only be given if it is necessary to prevent serious damage to crops, pasture, foodstuffs or to woodland **and no other means of control which might reasonably be used will work.** By inference, it would appear that the applicant for such authorisation would require to demonstrate that other methods of control had been tied previously without real success. The authorisation must be in writing and specify how long it is effective.
The DCS where required by the Act to prepare and publish a ***Code of Practice for Night Shooting*** and all authorisations for night shooting must contain a condition that applicants must comply with the published Code and failure to do so may result in cancellation of the authorisation be the DCS.

Using vehicles to drive deer; It is an offence to use any vehicle to drive deer with the intention of taking, killing or injuring them. However the DCS may issue authorisation to any owner of land on which are deer, or to a person nominated in writing by such owner, permitting the use of any vehicle or boat (not aircraft or hovercraft) to take or kill deer for the purposes of deer management only.
Again there is a code of practice that must be followed.

Dealing in Venison; All venison lawfully marketed or sold in Scotland must pass through the hands of, and be properly recorded by, a licensed venison dealer.
A **council** as described in the Local Government Act 1994 may issue a venison dealer's licence, **valid for a period of 3 years**, to any fit or suitable applicant. The DCS must receive from the council a copy of each licence it issues and at the end of each year it must send a current list of licensed dealers in their area to the DCS.
Every licensed venison dealer must keep a book recording all purchases and receipts of venison. Any person from the DCS or constable may inspect these records required to be kept by the venison dealer. The record book must be kept for three years after the last entry was made
It is an offence for any person to sell any venison unless that person is a licensed venison dealer, or he does so for the purposes of selling that venison to a licensed venison dealer (£1,000 fine). It is also an offence to sell venison, which he knows, or has reason to believe has been unlawfully killed. (£2,500 fine and/or 3 months imprisonment). Failure to comply with record keeping requirements attracts a fine of £500.

Power to require returns of deer numbers taken or killed; The DCS can serve written notice on the owner or occupier of any land requiring him to make a return of the number of deer of each species and of each sex taken or killed on his land within a specified period, immediately preceding the issue of the notice. Such notice may require a return to be made for a period of up to 5 years. Failure to do so attracts a fine of £1,000and /or 3 months jail. To knowingly make a false return attracts the same punishment. The DCS may also ask for information about the number, sex and species of deer killed during the previous 12 months of occupancy.