Chapter (non-refereed)

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32. DEER AND THEIR WOODLAND HABITATS

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In Britain, 6 species of deer are found in woodland habitats (Table 47). Whereas the Chinese water deer *(Hydropotes inermis)* is restricted to south-east England, the others are more widespread, with red deer *(Cervus elaphus)* and roe deer *(Capreolus capreolus)* being abundant and nationally important.

Although red and roe deer have intrinsic value as wildlife and are sporting assets, they are also regarded as pest species, the former more particularly in the highlands of Scotland. Both species alter the composition, or prevent the regeneration, of many semi-natural woodlands, and additionally damage plantation trees by browsing and bark-stripping. Red deer, probably because of their larger size and tendency to herd, are generally regarded as the greater threat. The demand for shooting is increasing, particularly from sportsmen in continental Europe; the cost to shoot red deer stags in 1978 ranged from £75 - £300 and of roe bucks from £40 - £250. The price paid for venison in 1979/80 varied, but was usually from £1.43 - £1.76 kg^{-1} for red deer and £1.65 - £1.87 kg^{-1} for roe.

1. Red deer

Red deer are most numerous on open-hill ground in Scotland. In winter, they seek lower ground for food and shelter, and it is then that they may break into plantations or occupy semi-natural woods of conservation interest, frequently causing damage. Increasingly, however, they are becoming permanently resident in plantations, and, as a result, are posing new management problems. Red deer are social and gregarious animals. Hinds and stags segregate for most of the year, often into separate areas. Individuals have overlapping home ranges (Lowe, 1966) and generally join with others to form groups. These aspects of social organisation differ according to habitat, with group sizes and home ranges being smallest in woodlands and largest in open country (Staines, 1974). Animal

TABLE 47 Deer species found in British woodlands and problems of management.

Species	Distribution	Management problems and conservation interest
Chinese water deer *(Hydropotes inermis)*	Local in East Anglia, Bedfordshire and Hertfordshire	Small and probably decreasing numbers give cause for concern for its future.
Muntjac (*Muntiacus* spp)	Increasing numbers and range in southern and central England.	No important management problems obvious.
Fallow *(Dama dama)*	Widespread throughout southern and central England. Local populations in Wales, northern England and Scotland.	Browsing in plantations. Damage to farm crops and possible competition with livestock. Some local populations of special interest (eg Epping Forest, Mortimer Forest).
Sika *(Cervus nippon)*	Local populations scattered throughout Great Britain, locally abundant and thought to be increasing.	Browsing and bark-stripping in plantations. Hybridises in some areas with red deer.
Roe* *(Capreolus capreolus)*	Widespread and abundant in Britain apart from central England.	Browsing in plantations. Fraying of saplings by bucks and some bark-stripping. Affects regeneration of semi-natural woodland.
Red* *(Cervus elaphus)*	Widespread and abundant in the highlands and islands of Scotland. Locally large populations elsewhere, eg in north-west England and south-west Scotland.	Browsing and bark-stripping in plantations. Affects regeneration of semi-natural woodlands and other plant communities and species. Damage to farm crops. Local small populations of special interest (e.g. New Forest). Hybridisation with Sika influencing genetic make-up locally (eg NW England).

* 2 indigenous species

performance is similarly variable. On hill ground, hinds frequently grow slowly and rarely become sexually mature until 2 years 4 months; the annual recruitment of calves is only about 1/3 of the total adult stock. Current work by the Forestry Commission suggests that performance in plantations can be much better, with puberty one year earlier and fertility and growth rates much higher. Clearly culling levels based on data from the relatively poor hill populations will be inappropriate for controlling the more fecund woodland deer.

2. Roe deer

These animals are generally year-round occupiers of woodland, and have been studied most in this habitat; unlike red deer, they are rarely gregarious. From April to August, some bucks are territorial, territory size ranging from 8 ha - 128 ha according to locality and habitat (Bobek, 1977); non-territorial bucks have larger ranges which may overlap with those of other bucks, or they may be found in peripheral areas. If they are unable to establish a territory, they are not generally

TABLE 48 Ranked red deer preferences in different countries for different types of tree browse (Mitchell *et al.*, 1977). Where names are restricted to genus, the original authors either did not distinguish between species or did not give sufficient information to enable species to be determined.

Ranked preferences	White Russia	Poland	Poland*	West Germany	S Sweden	NW England
Highly preferred	*Salix* *Populus tremula* *Fraxinus* *Quercus*	*Quercus petraea* *Salix caprea* *Sorbus aucuparia* *Corylus avellana*	*Populus tremula* *Salix caprea* *Frangula alnus*	*Populus tremula* *Quercus borealis* *Abies* *Acer platanoides* *Fraxinus excelsior* *Quercus*	*Fraxinus excelsior* *Salix* *Frangula alnus*	*Juniperus communis* *Quercus borealis* *Pinus contorta* *Picea abies*
Preferred	*Sorbus aucuparia* *Betula*	*Acer platanoides* *Carpinus betulus* *Prunus serotina* *Frangula alnus*	*Quercus robur*	*Pinus sylvestris* *Picea abies* *Fagus sylvatica* *Pseudotsuga menziesii* *Larix*	*Betula*	*Larix* *Acer pseudo-platanus* *Pinus sylvestris* *Quercus robur* agg *Betula*
Seldom or never browsed	*Tilia* *Carpinus betulus*	*Pinus sylvestris* *Juniperus communis*	*Tilia cordata* *Carpinus betulus* *Betula*	*Picea sitchensis* *Alnus glutinosa* *Betula*	*Alnus glutinosa*	*Picea sitchensis* *Fagus sylvatica* *Alnus glutinosa*

* includes roe deer browsing.

Red deer are "intermediate" feeders (Hofmann, 1973), taking browse and grasses in varying amounts according to locality and season. There is sparse information on food preferences in British woodlands, but observations from better quality forests in continental Europe suggest that deciduous browse is the most preferred food, aspens and various species of willows being particularly favoured (Table 48). Browsing seems to be an important, natural feature of deer biology and is unlikely to be, as sometimes intimated, a pathological form of behaviour. To satisfy their requirements for growth, maintenance and reproduction, an "average" deer may consume 4 kg dry matter per day (Mitchell *et al.*, 1977).

seen again in the same area in subsequent years (Bramley, 1970). In the short term, at least, territories are traditional, and, when a territory is vacated (eg as a result of shooting), it may be quickly acquired by a new incoming buck, less frequently being absorbed into the territories of neighbouring animals (Bramley, 1972). Does have overlapping home ranges which may overlap the ranges of one or more territorial bucks. There is evidence to suggest that a yearling is prevented by social interaction from establishing its range within that of its mother (Bramley, 1972; Strandgaard, 1972), and, as a result, young animals emigrate. Because of this pattern of

behaviour, culling policies should be applied over a wide area, otherwise heavy shooting in one locality will be counteracted by immigration from neighbouring places where the cull is less than equal to the rate of recruitment. Recently, attempts have been made to relate territory and range size to habitat features or quality, so far with inconclusive results (eg Bobek, 1977; Hosey, 1974). But if, as is likely, habitat features are the determinants of overall density, then it is essential that these features should be better understood for the development of better management techniques.

Roe deer take more browse and forbs than red deer, although grasses are eaten to a limited extent in summer (Siuda *et al.,* 1969). The bucks may also damage saplings by fraying when they hold or take up territories (spring to mid-summer).

3. Effects of deer on forests and forest structure

What is 'damage'? Although all browsing and bark-stripping can be regarded as biological damage, concern is usually expressed only when timber production and/or quality is affected, or when regeneration is seriously jeopardised.

3.1 Semi-natural woodlands

In these habitats, the main problem relates to regeneration. In many woodlands, and particularly native Caledonian pine forests, regeneration is being prevented by the heavy browsing of seedlings and saplings by relatively large numbers of deer. Although these animals may not have been the main cause of the decline in areas of semi-natural woodland in upland Britain, there is little doubt that present-day populations, particularly of red deer in winter, thwart re-establishment even where conditions are otherwise favourable. In addition, deer affect woodland composition. Because they graze selectively, some species of trees are more vulnerable than others (Table 48), and may be eliminated from the ground flora or as sub-dominant trees; indeed, there are few species of tree, apart from the dominants, in many grazed woods in Scotland. The moral is obvious; if diversity is a priority, then there must be lower numbers of deer than if we merely wish to maintain the presence of woodland.

3.2 Plantation forests

The growth of young trees, up to about 2 m tall, can be adversely affected by the loss of leaders and side shoots from browsing, and larger trees are endangered by bark stripping, but how much apparent damage can be tolerated? What is acceptable to one person may be regarded as disastrous by another, and, because many years may elapse between the occurrence of damage and the harvesting of the final crop, it is not easy to assess the yield reductions and financial losses. It is necessary also to put the impact of deer into perspective with other factors that continuously or spasmodically reduce yields, such as invertebrate pests, nutrient deficiencies, climatic extremes and windblow. Sometimes, the latter mask the effects of deer; sometimes, they exacerbate them, eg slow-growing young trees are vulnerable to browsing for longer periods than more rapidly-growing specimens. Forest managers can do little to control some of the causes of damage, but, because numbers of deer can be altered and because income can be obtained when the stalking rights are leased, it is desirable to define the optimal densities at which to maintain populations of deer, a definition that must take account of many complexities. During the 3 or 4-year period following the removal of leaders by browsing, tree growth may be noticeably retarded, but should it be inferred that the final crop will be deleteriously affected? Damage to one tree may decrease the effects of competition on its neighbours which may therefore grow more rapidly. Furthermore, the herbivores may reduce the competitiveness of the ground vegetation, allowing the entire population of trees to grow more rapidly, as in orchards when herbicides are used to restrict growth of grass and herbs; browsing may also be analagous to pruning and cause better root development in crop trees. The effects of browsing need to be monitored over longer periods than hitherto, preferably with concomitant measurements of animal utilisation and density. In this way, it should be possible to get a better balanced assessment of the expense of deer control in relation to crop yield (Plate 24).

Bark stripping is possibly a more serious problem than browsing because trees are susceptible to stripping for longer periods (Mitchell *et al.,* 1977). At present, it is bark-stripping by red deer that causes concern, but we now know that roe and Sika deer also eat bark, and, potentially, their effects are equally serious. Severe stripping just once in 20 years, or the repeated occurrence of less intense stripping can both substantially damage tree crops, depending on how the trees respond to wounding. Growth may be retarded and timber defects caused, but openings are also provided for colonization by pathogens which degrade the structural properties of timber and increase the risks of "snapping" in windy and snowy conditions. Again, how does this damage compare with other forms of damage, such as that done when extracting timber?

Although Sitka spruce is less vulnerable to bark-stripping than many other conifers (Table 49), it could become more susceptible if populations of other, more vulnerable tree species are deliberately decreased as a result of positive manage-

TABLE 49 Ranked susceptibility of trees to bark-stripping by red deer in different countries (Mitchell *et al.*, 1977) Where names are restricted to genus, the original authors either did not distinguish between species or did not give sufficient information to enable species to be determined.

	White Russia	East Germany	West Germany	Denmark	Galloway, SW Scotland	NW England
Highly susceptible	*Salix* *Fraxinus*	*Picea abies* *Fraxinus excelsior* *Pseudotsuga menziesii*	*Picea abies* *Fraxinus excelsior* *Salix* *Populus*	*Picea abies* *Pinus contorta* *Pinus mugo* *Pinus sylvestris*	*Pinus contorta* *Pinus sylvestris*	*Pinus contorta* *Pinus sylvestris* *Picea abies*
Moderately susceptible	*Alnus incana* *Sorbus aucuparia* *Quercus* *Pinus sylvestris* *Picea abies* *Betula*	*Fagus sylvatica* *Abies* *Pinus sylvestris* *Acer*	*Pseudotsuga menziesii* *Tilia* *Pinus sylvestris* *Fagus sylvatica* *Larix* *Sorbus aucuparia* *Acer pseudoplatanus*	*Larix decidua* *Larix leptolepis* *Pseudotsuga menziesii* *Picea sitchensis* *Abies alba* *Abies grandis*	*Larix decidua* *Larix x eurolepis* *Larix kaempferi* *Picea abies*	*Pseudotsuga* *Larix leptolepis* *Larix decidua*
Seldom affected	*Tilia* *Carpinus betulus*	*Quercus*	*Abies* *Quercus robur* agg *Alnus glutinosa* *Betula*		*Picea sitchensis*	*Picea sitchensis*

ment decisions, or if the frequency and size of open feeding areas are progressively decreased. In the north of Scotland, the increasingly extensive planting of *Pinus contorta* may also be jeopardized, as this species is very vulnerable to stripping (Plate 25).

The structure and composition of woodlands undoubtedly influence the behaviour and performance of resident deer. Newly afforested areas, and areas in the early stages of re-afforestation, provide food but offer little cover for deer until trees are 1.5 m tall. Thereafter, the amount of cover increases rapidly, but, as the thicket stage is reached, amounts of available forage decrease. In Sitka spruce plantations, food continues to be scarce for the next 20 years, but, with the transition from the pole stage to high forest and with the removal of thinnings, the cover value decreases, whereas food availability increases, albeit slightly.

TABLE 50 Outline of the integrated programme of woodland research being done by ITE, the Forestry Commission (FC) and the Red Deer Commission (RDC).

	FC	RDC	ITE
1. Deer distribution and behaviour	–	+	+
2. Quantification of damage and its biological and economic effects	+	+	+
3. 'Census' technique	+	+	+
4. Longer term woodland management (including plantation design, silvicultural systems)	+	–	–
5. Management of red deer as a resource	+	–	–
6. Red deer population dynamics	+	–	+
7. Shorter term woodland management (including deer-related management techniques, control and plantation protection)	+	+	–

Within a forest, the mosaic of habitat types depends on successional planting dates, local site factors and silvicultural practice, and, to guide forest management, it is essential to know the relative importance of different types of food and cover in influencing the home range and density of deer, and how the impact of deer relates to variations in forest structure.

4. Current research

We need answers to the following questions:

a) What densities of deer can be tolerated on particular site types for given management objectives?

b) What factors affect these densities?

c) What are the deer's behavioural patterns and food preferences?

d) What are the responses of different plant species and communities to different grazing pressures?

Each of these questions may require many years of fundamental research and to alleviate immediate and pressing problems there is a need for *ad hoc* studies. The Forestry Commission, Red Deer Commission and ITE have recently formed a joint working party to consider the red deer problem in woodlands and evolve an appropriate research programme (Table 50). ITE is making fundamental investigations of grazing to support short- and long-term management studies being initiated by the Forestry Commission and the Red Deer Commission.

ITE has 2 lines of research: the first deals with techniques for estimating numbers or trends in deer populations (Mitchell, project 528). Without the ability to estimate numbers fairly precisely, it will be impossible to execute a rigorous and rational culling programme—existing methods leave much to be desired. The efficiency and accuracy of different counting techniques will be compared, and those based on systematic observations, and on 'drive' and faecal-pellet counts, seem likely to be the most useful. In the second project, the impact and behaviour of resident red deer within a mixed-age Sitka spruce plantation are being studied (Staines & Welch, project 479). Glenbranter Forest, Argyll, has been chosen for this study as it has a mosaic of habitats, with areas of second-rotation plantings next to existing thicket and high forest—a mixture which will be increasingly typical of productive woodland in Britain. The use of different structural types by red and roe deer, and amounts of bark-stripping and browsing on individually marked trees in permanent plots are being monitored, and the performance of the trees affected will be examined subsequently. Feeding behaviour and food preferences, and the home range and movement patterns of individually identified deer are also being investigated. In the long term, we hope to be able to predict the use made by deer of different areas within plantations, integrating their effects on individual trees and on populations.

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