

# **A survey of cattle-grazed woodlands in Britain**

**Helen M. Armstrong<sup>1,3</sup>, Liz Poulson<sup>1</sup>,  
Tom Connolly<sup>2</sup> and Andrew Peace<sup>2</sup>**

<sup>1</sup> Woodland Ecology Branch and  
<sup>2</sup> Statistics and Computing Branch,  
Forest Research,  
Northern Research Station,  
Roslin,  
Midlothian,  
EH25 9SY

<sup>3</sup>Email: [helen.armstrong@forestry.gsi.gov.uk](mailto:helen.armstrong@forestry.gsi.gov.uk)

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## **Introduction**

Cattle are thought to provide biodiversity benefits in woodlands when grazed at low density (Dennis 1998) since they eat vegetation of a low digestibility and break up vegetation mats with their hooves. This is thought to be beneficial for tree regeneration and as well as leading to a greater variety of vegetation types and associated invertebrate and bird assemblages. Because of these perceived benefits there is increasing interest in the use of cattle as a tool for nature conservation management in woodlands. Little information is available, however, with which the impacts of a given cattle grazing regime on a particular woodland can be predicted. Indeed there have been virtually no published studies of the impact of cattle on woodlands in Britain and very few in other countries. Additionally, there is little information available on the current use of woodlands for cattle grazing in Britain. This study, therefore, had the following objectives:

- Gain an overview of the number, distribution, size and type of sites where cattle are currently being grazed in woodlands in mainland Britain.
- Collate information on the reason for stocking with cattle, the cattle stocking regime, breed of cattle and the presence of other grazing animals at each site.
- Collate observational information from site managers on cattle behaviour in woodlands.
- Collate observational information on tree regeneration in the presence of cattle.
- If possible, draw conclusions about the impacts of cattle on woodlands and draw out generalisations about the effect of different stocking regimes.
- Recommend further work to improve our ability to predict the impacts of different grazing regimes of cattle on different woodland types

The aim was not necessarily to include all cattle-grazed woodlands in Britain and, in fact, by the end of the data gathering period in 2002 there remained many leads still to be followed up. Rather, the aim was to collect a sample large enough to be representative of cattle-grazed woodland sites in Britain.

## **Methods**

### ***Data collection***

An Access database was set up to receive information on woodland sites in mainland Britain where cattle were being grazed (a blank data entry form is shown in Appendix 1). All types of woodland, from park woodland to plantations of exotic conifers, were included in the survey. At the start of the project in 2000, details of the survey were sent to relevant organisations with a request for information on sites and site contacts. Between 2000 and 2002, land managers were contacted by telephone, email, letter or fax and asked for the information shown in Appendix 1. This included: the location of the site, the reason for stocking with cattle, the grazing regime and stocking rate, the breed of cattle, the presence of other large grazing animals, the woodland type, the nature of the ground flora (including details of any tree regeneration), the presence of any exclosures, whether any monitoring was being carried out or not and any additional information. The initial return was normally

followed up with a telephone call to clarify information or to fill in any gaps in the written response.

In September 2001, 33 of the sites in the database were selected for site visits. Sites were selected only if the woodland was largely of native tree species and if the quality of the site information provided by the land manager was reasonably good. A standard recording form was developed for making visual assessments on site (Appendix 2) and guidance was provided on completing the form (Appendix 3). The information collected included confirmation of much of that collected previously from the land managers but also included observations on the density of, and browsing level on, seedlings (less than 25 cm tall) and saplings (between 25 cm and 1 m tall) of each tree species as well as on the canopy cover of adult trees. Density was categorized as 'none', 'occasional' or 'common' and browsing level was categorized as 'none', 'occasional', 'common' or 'all'. Each grazing mammal species present at a site, other than cattle, was estimated from sightings, signs and discussion with the site manager as being at high, medium, low or occasional densities. The country was divided into seven areas and the same observer visited all the sites located in any one of these areas. One of the authors (HA) accompanied each of the observers responsible for the site visits in each of the four Scottish areas on at least one site visit. No Welsh sites were visited because the two suitable sites were flooded at the time of the site visits.

### *Data analysis*

The information obtained from the site visits sometimes differed from that collected indirectly from the site managers. This applied particularly to woodland area, cattle numbers and cattle management regime. The assumption was made that the information obtained from the site visits was more reliable hence the information in the database was updated following a site visit. Many of the analyses of the data in the database were carried out separately for visited and unvisited sites because of the likely higher reliability of the information from the sites that were visited.

Average cattle stocking rate (cattle ha<sup>-1</sup>) was calculated based on the total area to which the cattle had access during the times that they also had access to the woodland. A measure of cattle grazing pressure (cattle-months ha<sup>-1</sup> year<sup>-1</sup>) was calculated as the product of average stocking rate and the length of time (months) that the cattle had access to the woodland. For the visited sites, an index of total herbivore grazing pressure was obtained by summing an index of relative grazing pressure for each large herbivore present. For cattle, the index was obtained by converting cattle grazing pressures of 0-1.99, 2-4.99, 5-9.99 or > 10 cattle-months ha<sup>-1</sup> year<sup>-1</sup> into a score of 1, 2, 3 or 4 respectively. The uneven categories of cattle grazing pressure were chosen so as to obtain approximately equal frequencies for each category (see Figure 3 for a frequency distribution with equal category sizes). For the other large herbivore densities, the categorization of 'none', 'occasional', 'low', 'medium' or 'high' was converted into a score of 0, 1, 2, 3 or 4. An index of total canopy cover was calculated for the visited sites by summing the estimates of percentage canopy cover for each of the tree species present at a site.

The status of tree regeneration was noted at 73 of the 77 sites for which cattle grazing pressure could be calculated (27 were in England, 41 in Scotland and five in Wales). Thirty-one of these sites were visited. Tree regeneration was classed as good where many young trees representing most of the species in the canopy were growing free from browsing. Poor regeneration was where few young trees were growing free from browsing or where only a few species of young tree were present (usually birch, hawthorn and/or holly). No regeneration was where there were no young trees present or where all young trees were

heavily browsed or where young trees occurred only in areas inaccessible to browsing animals. An ordinal logistic regression was then carried out to look for relationships between cattle grazing pressure and the probability that sites would fall into each of the tree regeneration categories.

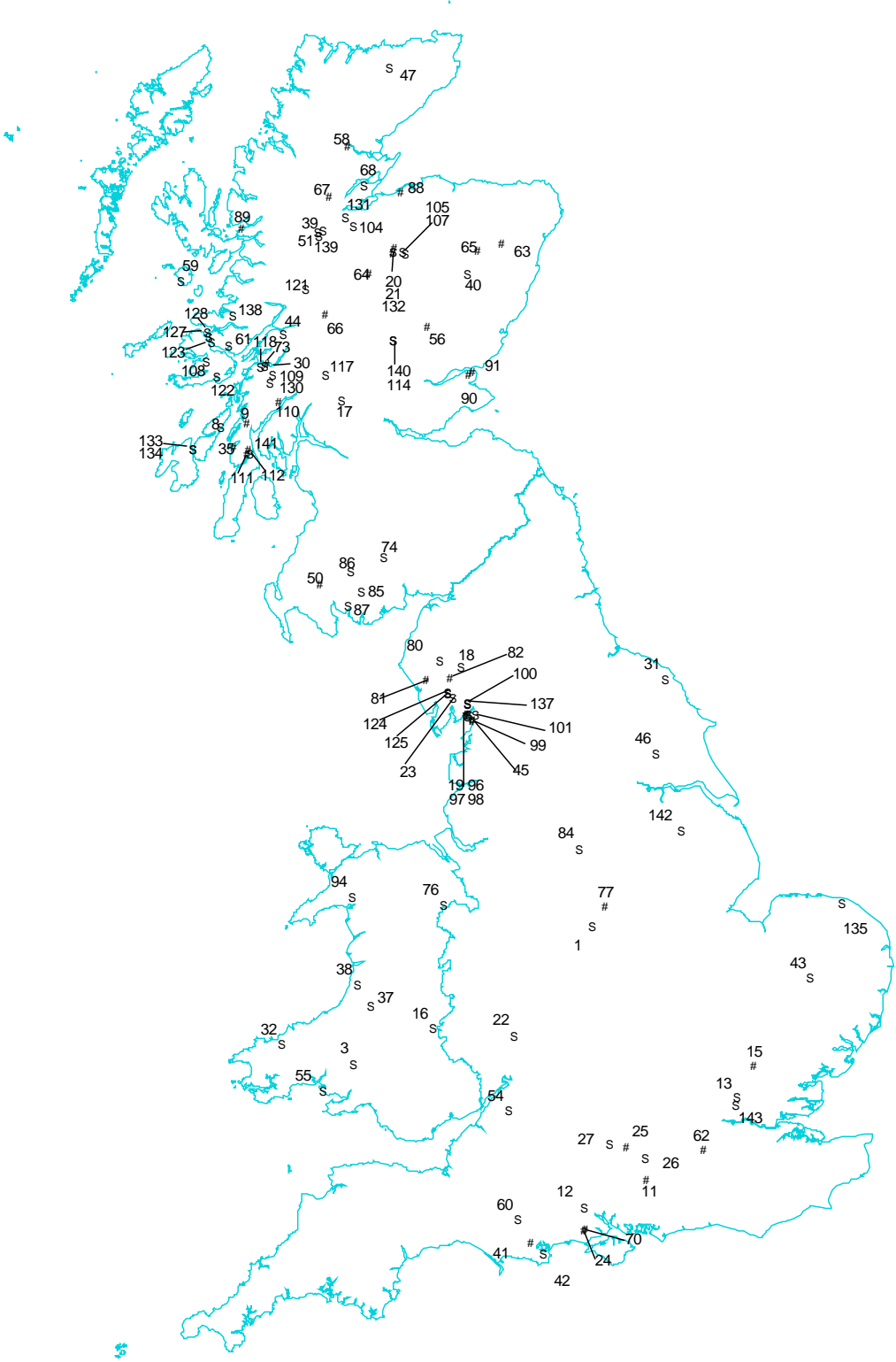
For each species of tree at each of the thirty-three sites that was visited, sapling and seedling densities were coded 0 or 1 in two ways; firstly with 'none' coded as 0, and 'occasional' or 'common' coded as 1 and secondly with 'none' or 'occasional' coded as 0, and 'common' coded as 1. The relationship between sapling or seedling density and a range of potential explanatory variables was assessed using a stepwise logistic regression. The potential explanatory variables tested were: presence /absence of roe deer, presence /absence of red deer, presence /absence of rabbits, length of time that the cattle had access to the woodland, average cattle stocking rate, cattle grazing pressure, total canopy cover, eastings and northings.

An index of overall sapling density i.e. of all tree species combined, was derived for each site visited. Saplings of each species at each site, whose density was classed as none, occasional or common, were given a score of 0, 1 or 2 respectively. The average for all sapling species at each site was taken as a measure of overall sapling density. An attempt was then made to fit linear, quadratic and exponential models to the relationship between overall sapling density and total canopy cover, cattle grazing pressure and total herbivore grazing pressure. The procedure was repeated for seedling density.

Information from the thirty-three site visits was used to determine relative browsing pressure on saplings of different tree species. At each site a comparison was made between the browsing categories for each species of sapling. If a species was one, two or three categories more heavily browsed than the species it was being compared with, the comparison was scored 1, 2 or 3 respectively. Conversely, if it was less heavily browsed the comparison was given a score of -1, -2 or -3. If it was in the same browsing category, the comparison was given a score of 0. Thus, a number of comparisons between the same species pairs were generated from the data for all 33 sites. For all species pairs where there were three, or more, comparisons, a mean was calculated. This value can be seen as an indication of the relative preference of browsing mammals for one species of the pair over the other. This generated, for each tree species, a series of values representing the relative browsing preference for all the other tree species for which there were three or more comparisons. The data in all these series were summarized into overall measures of the relative preference for each tree species. This was done by setting the value for the comparison with birch to zero and adjusting all the other values so that they remained the same relative to each other i.e. the value for birch was subtracted from the value for each of the other species. Birch was chosen as the 'reference' species because birch was the most commonly found species and there were comparisons available between birch and all the other species. The average could then be taken of the preference values for each species. The number of samples for each species was the number of other species with which comparisons had been made. Thus confidence limits associated with the final preference values could be generated. The calculations of relative browsing pressure rely on the assumption that there is a linear increase in browsing level between the different categories used in the study (none, occasional, common and all). We regard this as a reasonable assumption in the absence of more detailed information. There were insufficient data for a similar analysis to be carried out for browsing preferences for seedlings.

**Results**

*Figure 1 Location of sites. Sites marked with closed circles were visited; those marked with open circles were not.*



### *Number and location of sites*

Information was collected on 105 cattle-grazed woodland sites. Forty of these were in England, 57 in Scotland and 8 in Wales. Thirty-three sites were visited (13 in England and 20 in Scotland). The sites were widely distributed across the country although there were no sites in the Outer Hebrides, the extreme south east of Scotland or the north east of England (Figure 1, Appendix 4). There were higher concentrations of sites in the south of England, Cumbria and north Scotland. The sites that were visited were distributed similarly to the sites that were not visited (Figure 1).

### *Ownership of sites*

Most sites were owned solely by a non-Governmental organisation (NGO), a public body or a private owner (Table 1). Only three sites were jointly owned by one or more of these. Three sites had unknown ownership. Of the solely-owned sites, 29 were owned by an NGO, 19 by a public body and 51 had private owners. The pattern of ownership differed markedly between Scotland and England with 80% of Scottish and only 16% of English solely-owned sites being privately owned (Table 1). In Scotland the remaining 11 sites were split almost equally between NGOs and public bodies (Table 1). In England, almost twice as many of the remaining 31 sites were owned by NGOs as by public bodies (Table 1). The six Welsh sites of known ownership followed the English pattern and were split equally between NGOs and public bodies. In terms of ownership, the visited sites were a reasonable representation of the total sample of sites except that sites owned by public bodies were somewhat under-represented in England (Table 1).

*Table 1. Number of sites owned by NGOs, public bodies and privately in England, Scotland and Wales.*

	All sites				Visited sites		
	England	Scotland	Wales	Total	England	Scotland	Total
<b>NGO</b>	20	6	3	29	7	2	9
<b>Public body</b>	11	5	3	19	2	3	5
<b>Private</b>	6	45	0	51	2	15	17
<b>NGO /Public body</b>	1	0	0	1	1	0	1
<b>NGO /Private</b>	1	0	0	1	0	0	0
<b>NGO /Public body /Private</b>	1	0	0	1	1	0	1
<b>Unknown</b>	0	1	2	3	0	0	0
<b>Total</b>	40	57	8	105	13	20	33

The National Trust owned half (16) of the NGO-owned sites in England and Wales (Table 2). Of the remainder, only the Royal Society for the Protection of Birds, The Woodland Trust, the Hampshire Wildlife Trust and the National Trust for Scotland owned more than one site (4, 3, 3, and 2 respectively). Three other County Wildlife Trusts owned one site each, as did the CLA Charitable Trust. Of the woodlands owned by public bodies, Forest Enterprise owned just over a third (8). Although most (5) of these were in England, they also owned cattle-grazed woodlands in both Scotland (2) and Wales (1). In Scotland, Scottish Natural Heritage owned a further three sites as did the Corporation of London in England. The Countryside Council for Wales and English Nature owned one site each in their respective countries. The remaining publicly owned sites were owned by city, parish and district councils, the Crown Estates and a National Park Authority.



Table 2. Number of sites owned by NGOs and public bodies. Sites shared by two bodies have been entered for both.

<b>NGOs</b>	<b>England</b>	<b>Scotland</b>	<b>Wales</b>	<b>Total</b>
CLA (Country Landowners' Association?) Charitable Trust	1	0	0	1
Cumbria Wildlife Trust	1	0	0	1
Gloucestershire Wildlife Trust	1	0	0	1
Hampshire Wildlife Trust	3	0	0	3
Lancashire Wildlife Trust	1	0	0	1
National Trust	13	0	3	16
National Trust for Scotland	0	2	0	2
Royal Society for the Protection of Birds	1	3	0	4
Woodland Trust	2	1	0	3
<b>Total</b>	<b>23</b>	<b>6</b>	<b>3</b>	<b>32</b>
<b>Public bodies</b>	0	0	0	0
Corporation of London	3	0	0	3
Countryside Council for Wales	0	0	1	1
Crown Estates	1	0	0	1
Forest Enterprise	5	2	1	8
English Nature	1	0	0	1
Hart District Council	1	0	0	1
Lancaster City Council	1	0	0	1
Newbury District Council	1	0	0	1
Pembrokeshire Coast National Park	0	0	1	1
Scottish Natural Heritage	0	3	0	3
Silchester Parish Council	1	0	0	1
<b>Total</b>	<b>15</b>	<b>5</b>	<b>3</b>	<b>23</b>

### **Woodland type**

Around 85% of all sites contained semi-natural woodland alone (Table 3). This was the same in all three countries. Of the remainder, most contained plantation or a mix of plantation and semi-natural woodland. In England, three sites contained coppice woodland. One site in Scotland and one in England contained park woodland i.e. a largely open landscape with scattered trees.

Table 3. Number of sites containing woodland of different types.

<b>Woodland type</b>	<b>England</b>	<b>Scotland</b>	<b>Wales</b>	<b>Total</b>	<b>Total (visited sites only)</b>
Coppice	1	0	0	1	0
Coppice /Park woodland	1	0	0	1	1
Coppice /Pollard	1	0	0	1	1
Park woodland	0	1	0	1	0
Plantation	3	6	1	10	4
Plantation /Semi-natural	0	2	0	2	0
Semi-natural	34	48	7	89	27
<b>Total</b>	<b>40</b>	<b>57</b>	<b>8</b>	<b>105</b>	<b>33</b>

69% of sites contained woodland dominated by either oak or birch (Table 4). Oak-dominated woodland was more common in England and Wales and birch-dominated woodland was more common in Scotland. 72% and 58% of sites had birch or oak, respectively, as either the dominant species or as a component of the woodland. In England, woodlands at five sites were dominated by ash and in Scotland five were dominated by

Scots pine. 15% of sites had Scots pine as either the dominant species or as a component of the woodland. Other dominant native tree species were alder (two sites), willow (two sites), blackthorn (one site) and hornbeam (one site). The non-native dominant tree species were Sitka spruce (five sites), beech (three sites), Bishop pine (one site) and Corsican pine (one site).

*Table 4. Number of sites dominated by trees of different species.*

<b>Dominant Tree species</b>	<b>England</b>	<b>Scotland</b>	<b>Wales</b>	<b>Total</b>
Alder	0	2	0	2
Ash	5	0	0	5
Beech	2	1	0	3
Birch	7	24	0	31
Bishop pine	1	0	0	1
Blackthorn	1	0	0	1
Corsican pine	0	0	1	1
Hornbeam	1	0	0	1
Oak	21	16	4	41
Pine	1	0	0	1
Scots pine	1	5	0	6
Sitka spruce	0	5	0	5
Willow	0	2	2	4
Not recorded	0	2	1	3
<b>Total</b>	<b>40</b>	<b>57</b>	<b>8</b>	<b>105</b>

#### ***Woodland, and total site, area***

Information was collected on both the total area of land to which the cattle had access as well as the area of woodland alone. However, during the course of the site visits, it became clear that the information collected before the site visit was often inaccurate. Often the area of woodland was not separated from the total area giving the impression that the woodland area was larger than in reality. This is borne out by comparing the proportion of sites composed solely of woodland for both visited, and non-visited, sites. At 33% of the visited sites the cattle only had access to woodland. The equivalent figure for non-visited sites was 65%. Since it is unlikely that the non-visited sites were different from the visited sites, and since many of the area figures changed after site visits, it can be concluded that the figures for woodland area for non-visited sites are inaccurate. Of the 67% of visited sites where cattle had access to open ground as well as to woodland, the proportion of woodland varied from less than 10% to over 90%.

Bearing in mind the inaccuracies in some of the woodland area information, it appeared that the sites documented in the database had a very wide range of total areas and areas of woodland (Figure 2). Most of the woodlands grazed by cattle were less than 50 ha in size (Figure 2a) and 11 woodlands were less than 5 ha in size. The total area of most sites was also less than 50 ha but some sites were very large (Figure 2b). It should be remembered that visiting the sites often resulted in a reduction in the estimate of woodland area. The visited sites also show large numbers of small sites and a few larger sites (Figure 2b).

Figure 2a. Number of woodlands in different size categories

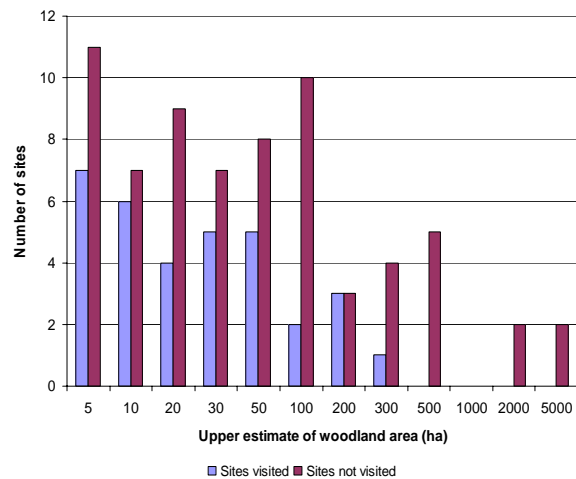
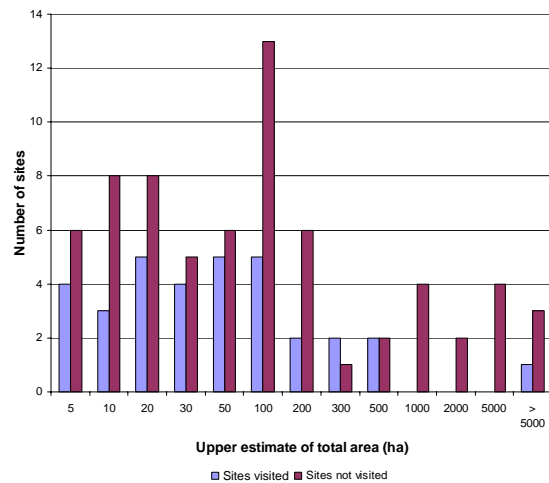


Figure 2b. Number of sites in different size categories.



### Reasons for grazing cattle in woodlands

The two main reasons given for grazing cattle in woodlands were either to improve, or maintain, the nature conservation value of the woodland or for agricultural production (Table 5). In England, the primary aim at more than three quarters of the sites was nature conservation whereas in Scotland the primary aim at more than three quarters of the sites was production. The eight sites in Wales were split evenly between nature conservation and production as a primary aim. At many of the sites, if nature conservation or production was not a primary aim, it was a secondary aim. However, even when this is taken into account, it is clear that there is a much greater emphasis on nature conservation in England and a greater emphasis on production in Scotland. This could be seen as reflecting the differences in land ownership (see above) on the assumption that NGOs and public bodies are more likely to give high priority to nature conservation aims whereas private owners are more likely to give priority to production. At six sites, perpetuating a long tradition was given as one reason for grazing cattle.

Table 5. Number of sites associated with each primary and secondary reason for grazing cattle in woodlands.

		England	Scotland	Wales	Total
Primary aim	Nature conservation	33	14	4	51
	Production	5	42	4	51
	Historic	1	0	0	1
	Amenity	0	1	0	1
	Keep grass short	1	0	0	1
Secondary aim	Nature conservation	0	11	1	12
	Production	7	3	0	10
	Historic	2	2	1	5

The reasons for grazing cattle in woodland can be broken down further by reference to specific reasons given (Appendix 5). Table 6 gives the number of sites in England, Scotland and Wales where each of eight specific reasons applied. Such detailed reasons were not given for all sites and several reasons could apply at one site, hence the column totals do not add up to the total number of sites in the database. However, the results do give an indication of the range of reasons for grazing cattle in woodland. Where cattle production was important, the use of the woodland for shelter in winter was often as, or more, important than its use for forage. Many respondents simply stated the reason for keeping cattle in the woodland as ‘production’ and did not specify forage provision hence the provision of forage is likely to be more important than is suggested by the results in Table 6.

Where nature conservation was an aim, five specific objectives appeared overall to be about equally important. These were to: encourage tree regeneration, benefit individual species or species groups, prevent tree or scrub regeneration, maintain open areas, reduce the shrub layer and reduce dominant ground layer plant species. In Scotland, sites were more likely to be managed to encourage tree regeneration than in England and were less likely to be managed to maintain open areas or to reduce the shrub layer (Table 6). This may be because nature conservation was more likely to be a secondary aim in Scotland and was stated simply as encouraging natural tree regeneration. In England, where nature conservation was more likely to be a primary aim, the aim of management was often to produce and /or enhance all the features of a pasture woodland. This often meant reducing, rather than encouraging, tree regeneration.

*Table 6. Detailed breakdown of reasons for grazing cattle. Species or habitat types given in brackets are those that it was hoped would be encouraged by the presence of cattle. This information was not supplied for all the sites included in the table.*

	England	Scotland	Wales	Total
<b>Provide forage</b>	2	7	1	10
<b>Provide shelter</b>	4	16	1	21
<b>Encourage tree regeneration</b>	4 (oak)	12 (birch, aspen, Scots pine)	0	16
<b>Benefit individual species or groups</b>	7 (Netted carpet moth, High brown fritillary, Scotch argus, butterflies, lichens)	6 (birds, black grouse, lapwings, butterflies, invertebrates)	2 (silver studded blue, lichens)	15
<b>Prevent tree/scrub regeneration</b>	3	2	0	5
<b>Maintain open habitats</b>	11 (grassland, limestone grassland, heathland, wet heath)	2 (dune heathland, marram grass dunes, sand dune lichen community, herb rich flush)	1 (wet heath)	14
<b>Reduce shrub layer</b>	9 (bramble, dense tree regeneration)	3 (bramble, dense tree regeneration)	1 (bramble)	13
<b>Reduce dominant</b>	10 (bracken, Molinia,	9 (rough grasses, bracken,	1 (Molinia)	20

<b>ground species</b>	tussocky grass, <i>Sesleria</i> , <i>Holcus</i> , Michaelmas daisy	<i>Molinia</i> , keep grass short)		
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Information on the particular species or habitat that it was thought cattle would benefit was supplied for some sites. Cattle were recorded as being used to encourage the regeneration of four tree species: oak in England and birch, aspen and Scots pine in Scotland (Table 6). It is likely that oak regeneration was also an objective in Scotland since relevant information was only supplied for four of the twelve sites at which tree regeneration was stated as an objective of grazing cattle. Several of the other Scottish sites with this objective contained oak in the mature woodland.

At several sites, lepidopteran conservation was given as a key reason for grazing cattle. Particular species mentioned were the netted carpet moth, the high brown fritillary, the Scotch argus and the silver studded blue. The conservation of birds generally, and of black grouse and lapwings in particular, as well as of lichens, was also given as a reason for grazing with cattle (Table 6).

In many cases, the cattle had access to open areas either within the woodland or adjacent to it. An objective of management was often to keep these areas open and free of scrub and tree invasion. Such open vegetation types included: grassland, limestone grassland, heathland, wet heath, dune heathland, marram grass dunes, sand dune lichen communities and herb rich flushes. The scrub species most commonly cited as being controlled by cattle was bramble and at several sites cattle were being used to reduce the cover of regenerating trees. Cattle were also being used at several sites to keep down dominant ground layer plant species to maintain the species diversity of open areas within the woodland. Such dominant species included bracken, *Molinia caerulea*, *Sesleria albicans*, *Holcus* sp., Michaelmas daisy and tussocky /rough grass generally (Table 6).

### ***Exclosures and monitoring***

Cattle were excluded from part of about 37 of the 105 sites in the survey (17 in England, 17 in Scotland and 3 in Wales; Appendix 6). These ‘exclosures’ ranged from large blocks of woodland to small areas of coppice that were temporarily fenced. Monitoring, of some description, was taking place at 43 of the sites (22 in England, 20 in Scotland and 1 in Wales; Appendix 6). A wide variety of taxa was monitored, from ground flora to birds and butterflies, depending on the objective for the site. A wide range of techniques was employed. At nine sites monitoring was by fixed-point photographs only. However at many sites some form of quantitative monitoring was taking place but the results had seldom been analysed and written up. At many sites, monitoring had been in place for only one or two years.

### ***Other grazing mammals***

Sheep, red deer, roe deer, fallow deer, sika deer, muntjac deer, rabbits, hares, horses, ponies, goats and pigs were recorded as present at one or more sites (Table 7). Roe deer were the most common other herbivore occurring at roughly three quarters of sites in England and Scotland (Table 7). The only record of deer being present at any of the Welsh sites was one occurrence of fallow deer at one site (Table 7). Sheep were present at more than half the Scottish and Welsh sites and about a third of English sites. The pattern for red deer was similar to that for sheep for England and Scotland. Fallow deer were more common at English than Scottish sites and sika deer were fairly equally common at both Scottish and

English sites (Table 7). Muntjac deer were present at 20% of English sites. Rabbits occurred at slightly less than half of all sites. Hares were present at less than 20% of sites in England and Scotland but were not recorded for Wales. A few sites in all three countries were grazed by horses or ponies. Pigs were present at one English site and goats at one Scottish site. Only four sites (ID numbers 16, 22, 55 and 128) were not grazed by sheep and /or deer as well as cattle. The apparent lack of sheep or deer at site 16 was probably due to a lack of information. There were therefore probably only three sites where cattle were the only large, mammalian herbivore.

After a visit, the list of grazing mammals present at a site often increased, indicating that the information for the sites that were not visited may often be incomplete. There were no visited sites that did not have at least one other grazing mammal present. One of the criteria for choosing sites to visit was that there were low densities of, or no, sheep previously recorded. Even so, one site had high densities of sheep and seven had low densities (Appendix 7). Sixteen sites (out of 33) had high densities of sheep, deer, or both. An additional four sites had high densities of rabbits. None of the other grazing mammals occurred at high densities thus there were 13 sites where other grazing mammals were at occasional, low or medium densities. Of these, 10 sites had other grazing mammals present at either occasional or low densities.

*Table 7. Percentage of sites grazed by mammalian herbivores of each species. At many sites there was more than one mammalian herbivore present hence the percentages for each country, and in total, add up to more than one hundred.*

Species	England	Scotland	Wales	Total
Sheep	30	54	63	46
Roe deer	73	75	0	69
Red deer	35	58	0	45
Fallow deer	23	5	13	12
Sika deer	10	12	0	10
Muntjac deer	20	0	0	8
Rabbits	50	40	25	43
Hares	15	18	0	15
Horses or ponies	10	4	25	8
Goats	0	2	0	1
Pigs	3	0	0	1

### ***Breed of cattle***

*Table 8. Number of records of different breeds of cattle being grazed across all sites. At several sites more than one breed of cattle was used. In many cases, cattle were cross breeds in which case the breed of the parents has been included in the table.*

Breed	England	Scotland	Wales	Total
Aberdeen Angus	6	8	0	14
British White	1	0	0	1
Brown	1	0	0	1
Charolais	1	2	0	3
Devon	1	0	0	1
Dexter	2	0	0	2
English Longhorn	3	0	0	3
Friesian	3	1	1	5
Galloway	3	5	0	8
Gloucester	1	0	0	1
Hereford	3	0	0	3

Highland	2	22	0	24
Holstein	1	1	0	2
Irish Moiled	1	0	0	1
Limousin	2	9	1	12
Luing	0	11	0	11
Mixed	4	2	1	7
North Devon	5	2	0	7
Red Poll	0	1	0	1
Saler	0	1	0	1
Shetland	1	0	0	1
Shorthorn	3	9	0	12
Simmental	3	6	0	9
Sussex	3	1	0	4
Welsh Black	1	0	2	3
White Park	0	0	1	1

Table 8 gives a breakdown of the breeds of cattle grazed at all the sites, where this information was given. More detailed information on breeds is given in Appendix 8. In England, 22 different cattle breeds were used with no one breed predominating. In Scotland, 15 breeds were used with Highland making up a quarter of all records and Aberdeen Angus, Limousin, Luing and Shorthorn also common. The six records for Wales where cattle breed was recorded showed a range of breeds being used. Welsh Black cattle, with two records, was the only breed to have more than one record.

### *Stocking season*

Nearly two thirds of sites in all three countries were grazed by cattle in summer (Table 9). In England, roughly a third of all sites were grazed in spring, autumn and /or winter. In Scotland a higher proportion of sites was grazed in these three seasons with one third being grazed in winter and nearly a half in spring and /or autumn. In Wales only a quarter of sites were grazed by cattle in autumn and /or winter and less than a sixth in spring. However, the sample size for Wales is small. Cattle were grazed in a wide range of combinations of different seasons in all countries (Appendix 8).

*Table 9. Percentage of sites in each country, and in total, which were grazed by cattle in each season. At many sites the cattle were grazed in more than one season hence the percentages for each country, and in total, add up to more than one hundred.*

	<b>England</b>	<b>Scotland</b>	<b>Wales</b>	<b>Total</b>
Spring	29	43	13	36
Summer	60	62	63	62
Autumn	35	47	25	42
Winter	38	69	25	53

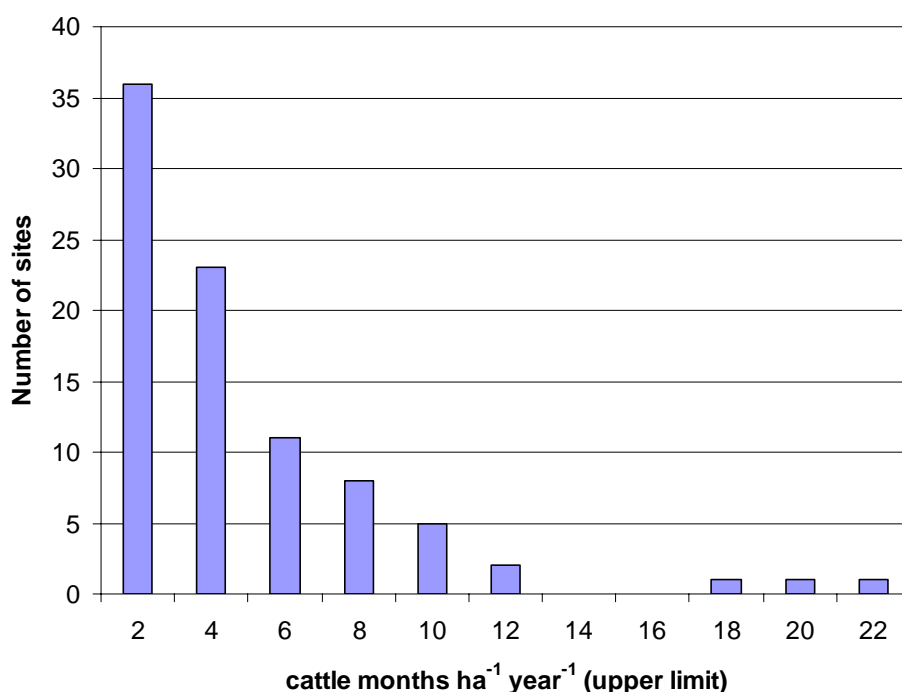
### *Cattle grazing pressure*

Appendix 8 gives average cattle stocking rates for all sites. Since the calculation of stocking rates was based on the total area to which the cattle had access, and not just on the woodland area, stocking rate values should not be affected by the apparently frequent recording of the total area as the woodland area on non-visited sites (see section on ‘Woodland, and total site, area’ above). Stocking rates varied widely but this is to be expected given that, in some cases, the cattle were in the woodland for a very short time. Appendix 8 also gives the length

of time that the cattle had access to the woodland. There was information to calculate cattle grazing pressure (the product of stocking rate and the length of time cattle had access to woodland) for 88 sites. Cattle grazing pressure varied widely (Figure 3) but with the majority of sites having relatively low levels. A stocking rate of cattle that is recommended for many types of nature conservation grazing is 0.1 cattle ha<sup>-1</sup> grazed all year (Mayle 1999). This equates to 1.2 cattle-months ha<sup>-1</sup> year<sup>-1</sup>. 31% of sites had cattle grazing pressures at, or below, this level. Only five sites had cattle grazing pressures of greater than 10 cattle-months ha<sup>-1</sup> year<sup>-1</sup>.

Average cattle grazing pressure was similar regardless of whether the reason for grazing cattle was for stock production, to maintain open areas or to encourage tree regeneration. Average cattle grazing pressure did not differ between Scotland and England (the sample size for Wales was too small to make a valid comparison). The median cattle grazing pressure of visited sites was slightly higher than the median cattle grazing pressure of unvisited sites but the difference was small (2.6 c.f. 2.3 cattle-months ha<sup>-1</sup> year<sup>-1</sup>). The median is presented here rather than the mean because of the skewed distribution of the data (Figure 3).

Figure 3. Frequency distribution of cattle grazing pressure.



### ***Tree regeneration***

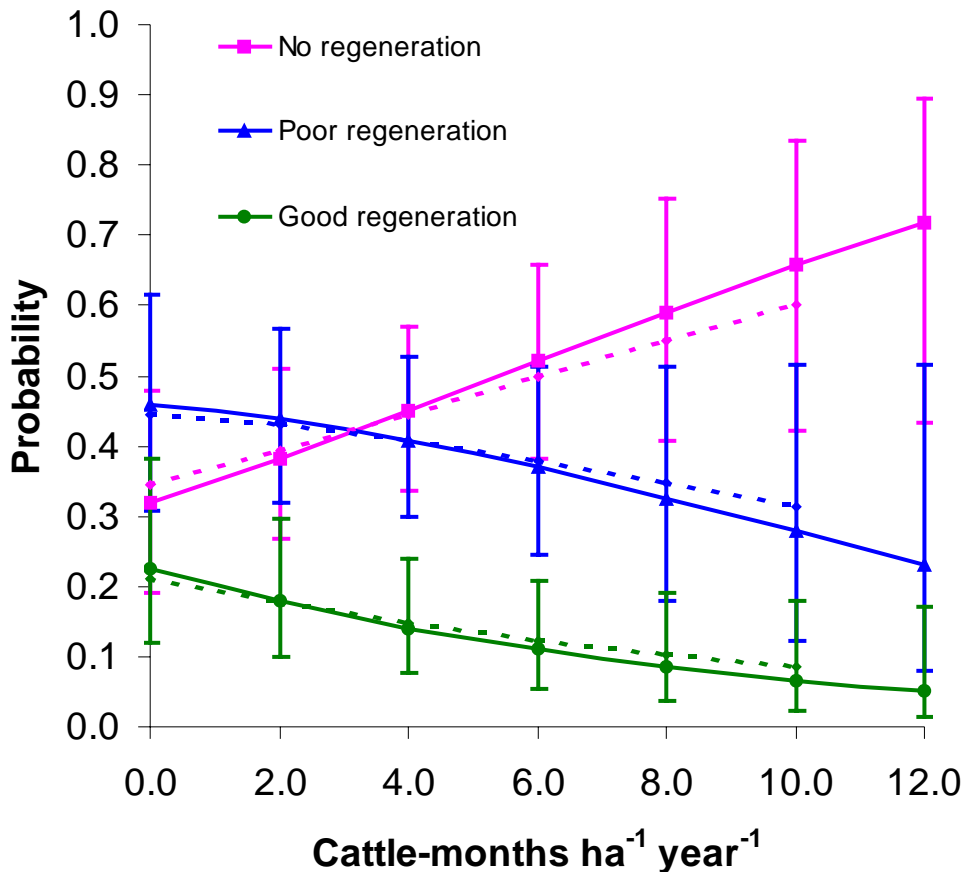
The ordinal logistic regression of the proportion of sites falling into each tree regeneration category against cattle grazing pressure showed that the average probability of obtaining good or poor regeneration without cattle grazing was 22% and 46% respectively (Figure 4). This fell for both categories of regeneration as cattle grazing pressure increased and reached 5% and 23% respectively at 12 cattle-months ha<sup>-1</sup> year<sup>-1</sup> (Figure 4). By contrast, the average probability of obtaining no tree regeneration (except in inaccessible areas) rose from 32% to 72% over the same range in cattle grazing pressures (Figure 4). The large confidence limits associated with these relationships and especially for poor, and no, regeneration (Figure 4) are probably a reflection of both the wide range of site conditions as well as of the relative inaccuracy of the grazing pressure information obtained for sites which were not visited (42



out of a total of 73 sites that were used in this analysis; see methods section on ‘Data analysis’ above). There was no evidence of a decreased probability of good or poor tree regeneration at very low cattle grazing pressures but confidence limits are large (Figure 4) so it would only have been possible to detect a large effect.

The small difference between the regression curves produced using all the data and those produced using only the sub-set with cattle grazing pressures of less than 10 cattle-months  $\text{ha}^{-1} \text{ year}^{-1}$  (68 sites; Figure 4) indicates that the small number of sites with high grazing pressures, and no, or poor, tree regeneration, did not significantly affect the shape of the curves derived using the whole dataset.

Figure 4. Probability of achieving good, poor or no regeneration as a function of cattle grazing pressure. Good regeneration is where many young trees representing most of the species in the canopy were regenerating free from browsing. Poor regeneration is where few young trees were regenerating free from browsing or where only a few species of tree were regenerating (usually birch, hawthorn and /or holly). No regeneration is where there were no young trees present or where all young trees were heavily browsed or where young trees occurred only in areas inaccessible to browsing animals. 95% confidence limits are shown. Dotted lines show the results using only sites with a cattle grazing pressure of less than 10 cattle-months  $ha^{-1} year^{-1}$ .



When the data for sapling density collected from the site visits were fitted to cattle grazing pressure, total herbivore grazing pressure and canopy cover, the resulting models explained between 20.6% and 25.9% of the variance (based on the adjusted  $r^2$  value) when only one of the three explanatory variables was used. There was an indication that sapling density declined with cattle grazing pressure (Figure 5a) however this interpretation of the results rests on a small number of points at the higher end of the cattle grazing pressure range. The low percentage of the variation accounted for by the model also indicates that it has little predictive power.

When sapling density was plotted against the index of total herbivore pressure (Figure 5b), there was again an indication of a decline in sapling density as total herbivore grazing pressure increased but, again, the model had low predictive power. The only other variable which appeared to be related to sapling density was total canopy cover (Figure 5c) with sapling density apparently increasing as total canopy cover increased. This is contrary to expectation since most tree species in Britain are light demanding hence regeneration is generally expected to increase as light availability increases. It is possible that there was a higher seed supply at sites with a high canopy cover and that this caused a higher density of

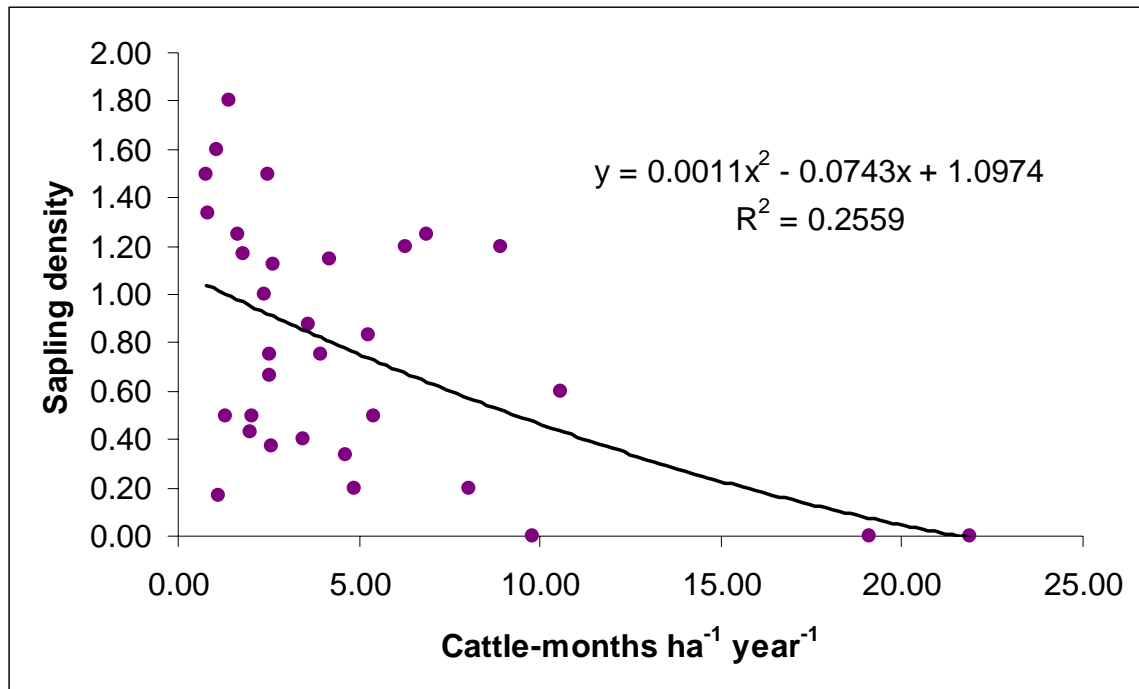
saplings. However, the low predictive power of the model means that this conclusion needs to be tested further.

Attempts to fit more than one response variable at a time did not produce significant results.

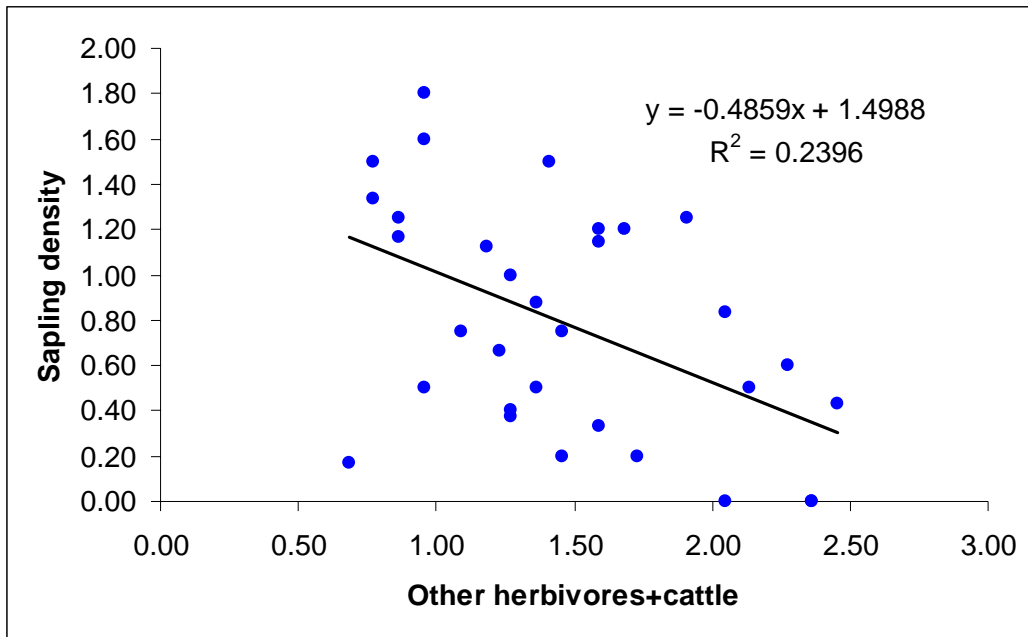
None of the potential explanatory variables had any power to predict either overall seedling density or the density of saplings, or seedlings, of any particular tree species.

Figure 5. Index of sapling density plotted against a) cattle grazing pressure, b) index of total herbivore pressure and c) total canopy cover.

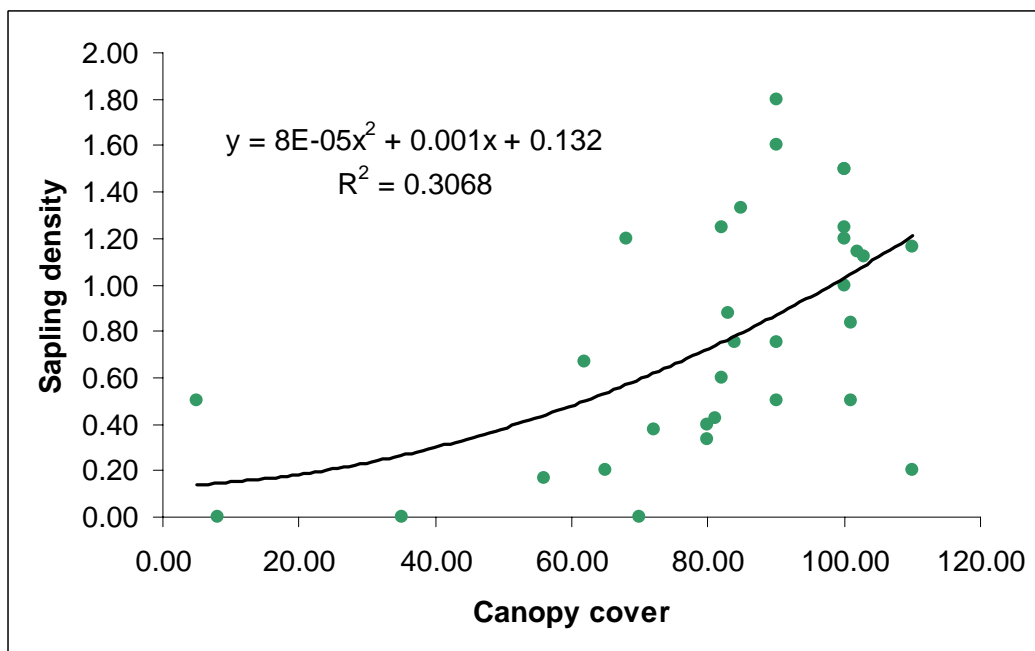
a)



b)



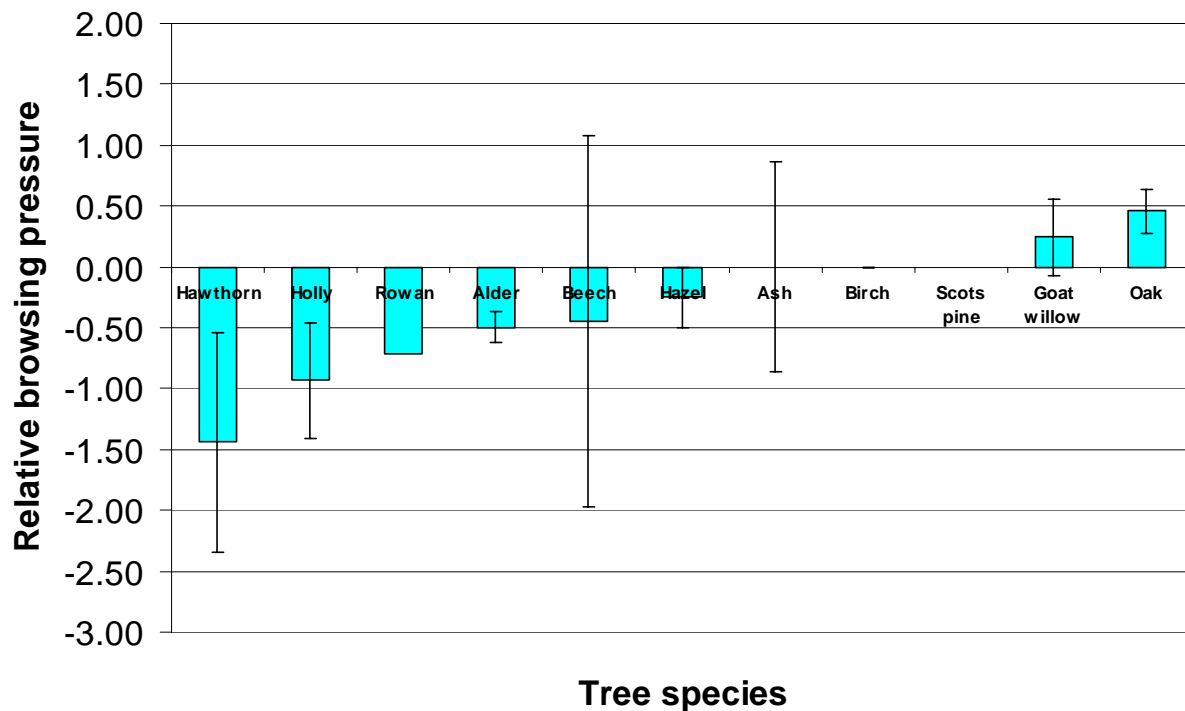
c)



### ***Browsing on saplings***

Since all of the sites visited were grazed by at least one large herbivore other than cattle, and all but one were grazed by deer (Appendix 7), the browsing rates exhibited at the sites were the result of a mixture of large herbivore species, but are especially those of cattle and roe deer. Figure 6 shows the relative browsing pressure on each of the species of sapling, in relation to that on birch (the browsing pressure on birch was set to 0). Appendix 10 gives more details of the results. Hawthorn was the least preferred species and oak was the most preferred.

*Figure 6. Relative browsing pressure on saplings of a range of tree species. Pressure is shown in relation to that for birch. Negative pressures denote species that are less preferred than birch. Positive pressures denote species that are more preferred than birch. Error bars, where present, show 95% confidence limits for those species for which there were enough comparisons with other species for confidence limits to be calculated. The value for birch was set to zero hence has no associated confidence limit.*



### ***Achievement of objectives of grazing with cattle***

Information was obtained from 30 sites about whether the objectives of stocking with cattle were thought to have been achieved or not. Of these, the objectives had not been fulfilled at 5 sites and had been fulfilled at 25 sites (Appendix 11). Where the objectives had not been fulfilled, this was often attributed to inappropriate stocking densities or to the presence of other large herbivores.

### ***Observations on stock husbandry, cattle behaviour and impacts on trees and ground vegetation.***

Casual observations made by site managers on stock husbandry, cattle behaviour and impacts of cattle on trees and ground vegetation were frequently recorded during the survey. These are often site specific observations that may not apply at other sites. They are listed in Appendix 12 and can be summarized as follows:

#### *Cattle husbandry and behaviour*

- in oak mast years acorns can cause poisoning in cattle, sheep and horses.
- yew is eaten by cattle and they appear to develop tolerance very easily.
- cattle can get red water fever from ticks if they are not raised in a red water fever area.
- in wet woodlands fluke can be a problem in summer.
- cattle kept outside are healthier
- sheep are likely to get caught up in thorn scrub and holly thickets.
- with regular herding, cattle become 'hefted' to an area.
- electric fencing can be used to keep cattle confined to one area.
- cattle will not go onto steep ground.
- some cattle do not like dogs so cannot be used in areas where dogs are walked.
- Highland cattle have their legs too far apart and their fringes are too long so they are not any good at going along narrow paths.
- concentrates can be placed in areas where the cattle grazing is wanted e.g. in areas of bracken, and moved around when the desired effect is achieved.
- cattle distribute themselves evenly over the hill.
- cattle move about 1 km from feeding sites and 2-3 miles each day.
- cattle will concentrate on flatter areas with better pasture
- cattle (small breeds) seen every day are not hard to handle.
- cattle will eat more rough vegetation if they are fed concentrates rather than bulk feed.
- on freely drained, sandy soil there may not be enough grass growth in summer for cattle.
- if calves are taken off their mothers very young the cows have less of a nutritional demand and can survive the winter on the hill.
- native breeds of cattle kept on rough ground over winter will show compensatory growth if put on better land in summer.
- calves have to be tagged and that cannot be done on the hill.

#### *Impacts on trees*

- cattle 'brash' mature trees, creating shelter for all animals as well as allowing light to reach the woodland floor and grasses to grow.
- lower branches of mature pines can be browsed, even where rowan is regenerating relatively unscathed. This is probably because the pines are grazed by stock in winter when the rowan has no leaves.
- birch, beech and oak regeneration is confined to the shelter of bracken, bramble, holly and fallen dead wood.
- inside deer-proof fences brambles build up and take over then die back in the centre of clumps. Trees can then regenerate in these patches of dead bramble.

- oak saplings can get away within the protective cover of hawthorn scrub
- hawthorn saplings /seedlings are often found growing in bracken patches.
- browsing is noticeably less on hawthorn than on the other tree species, even when not 'protected' by bracken.
- cattle eat birch saplings in preference to rowan saplings.
- hazel is the most conspicuously cattle grazed tree
- Scots pine and Western hemlock are virtually unaffected by cattle grazing.
- if there are both cattle and deer, you only get alder, willow and birch seedlings (no oak, ash or hazel seedlings) but few seedlings are recruited as saplings.
- with no cattle, lots of oak and hazel seedlings appear in drier W11 areas but are browsed off by deer.
- birch regeneration is particularly abundant on the edge of mires and within *Molinia* areas.
- stocking rates will not be sufficient to predict whether regeneration will happen or not since the grazing pressure is not distributed evenly.
- cattle do not eat saplings when they get older but they do eat the seedlings and young trees.
- cattle are not seen to eat young saplings.
- cattle will bend down older trees and eat the foliage.
- cattle will not touch willow then will suddenly attack a tree then leave it alone. They only do this to willow.
- cattle do not bark strip.
- when birch is cut, cattle will eat the fine tips and buds.
- in the absence of cloven hooved animals only willow, birch, alder and rowan will grow.
- where cattle have been grazing the trees are bigger because the dung fertilizes them.

#### *Impacts on ground vegetation*

- bracken increases if cattle are removed.
- cattle graze largely on *Nardus* if the alternative is heather.
- 9 - 10 ha per cow on heather moorland is about right to allow heather regeneration after a burn.
- cattle graze the heather patchily. Some patches can be kept at about 8 inches tall because of cattle grazing.
- when cattle make tracks in heather, blaeberry regrows and this helps to break up the heather monoculture.
- blaeberry is browsed by cattle.

## **Discussion**

### ***Number and location of sites***

The wide-ranging distribution of the sites shows that cattle-grazed woodlands occur throughout the country. The high number of sites in the south of England is perhaps due to a high land ownership by NGOs in this part of the country and a desire to return to a traditional form of pasture woodland management. In Cumbria, many of the woods have been traditionally grazed by cattle and this management is persisting. The high number in north Scotland is perhaps due to the large number of privately-owned woodlands in Argyll that have also been traditionally grazed by cattle.

### ***Ownership of sites***

The lower number of sites owned by NGOs and public bodies in Scotland is perhaps due to pasture woodland only recently being recognised as a traditional, and beneficial, land use in this country. There are signs that this is beginning to change with the Royal Society for the Protection of Birds using cattle in Corrimony and at Wood of Cree and investigating the use of cattle at Abernethy nature reserve in Inverness-shire (N.Cowie, personal communication). The Scottish Wildlife Trust is also planning to introduce cattle to some of its woodland reserves (D. Kennedy, personal communication). In England and Wales the National Trust owns a large number of cattle-grazed woodlands.

### ***Woodland type***

Semi-natural woodlands dominated by birch or oak were by far the most common woodland types to be grazed by cattle. Most woodlands that were not dominated by these species had one, or both, of them as a component. In England and Scotland there were a few sites dominated by ash, and Scots pine, respectively. This probably reflects the overall frequency of semi-natural woodland types in Britain.

### ***Woodland, and total site, area***

At most sites (67%), cattle had access to areas adjacent to the woodland at the same time as they had access to the woodland. At these sites, the degree to which cattle will use the woodland will vary depending on the availability of forage and shelter outside the woodland in relation to that inside and depending on the needs of the cattle. In cold, windy conditions shelter is very important (Simpson *et al.* 1978), so winter use of woodlands is likely to be high even if better forage is available elsewhere. By contrast, in summer, cattle with access to better forage outside the woodland would be unlikely to spend much time foraging within it. This uneven distribution of foraging time between areas outside, and inside, the woodland is likely to be a major contributor to the poor fit of the derived relationship between cattle grazing pressure and sapling density (see results under 'Tree regeneration' above). It also means that suitable grazing regimes for such sites will have to be determined on a site-specific basis, taking into account the time that the cattle are likely to spend outside the woodland (see 'Future research needs' below). Other factors, such as the steepness of the ground or the presence of biting insects, will also result in differential usage of different parts of a woodland and will also have to be taken into consideration when making site-specific recommendations.



53% of the sites were less than 50 ha in total area. On such, relatively small, sites it will be difficult to achieve low stocking rates if the cattle are on the site all year. Currently the recommended stocking rate for biodiversity grazing by cattle is often as low as 0.1 cattle ha<sup>-1</sup> on all year (Mayle 1999). This would mean stocking with only 5 cattle on a 50 ha site. Since cattle are a herd species, it would not be reasonable to use a smaller herd than this. Thus, on small sites, there may be limits to the range of grazing regimes that are possible; either the stocking rate will have to be higher than 0.1 cattle ha<sup>-1</sup> or the cattle cannot be on all year.

### ***Reasons for grazing cattle in woodlands***

The difference between Scotland and England was again seen in the fact that far more sites in Scotland list production as a primary reason for grazing cattle in woodland and more sites in England list nature conservation as a primary aim. In Scottish woodlands where production was the primary aim, any additional nature conservation objective was often simply to encourage tree regeneration.

### ***Exclosures and monitoring***

Exclosures of some description were present at about a third of sites and some form of monitoring was taking place at between a third and a half of sites. However, the size of exclosures was variable with many being too small to make valid comparisons between areas grazed by cattle and those not grazed by cattle. There appeared to be few cases where the results of monitoring had been analysed and written up. In many cases monitoring had been in place for only a short time so it would have been too early to use the information to judge success. It was not possible to summarize the results of site monitoring schemes in this survey but the results are likely to have contributed to the subjective assessments of success, or otherwise, of cattle grazing in achieving management objectives (see results under 'Achievements of objectives of grazing with cattle' above).

### ***Other grazing mammals***

All but three of the sites in this study, and all of the sites that were visited, were grazed by other mammal species as well as cattle. The interpretation of the effects of cattle thus has to take into account the densities of other grazing mammals at any site. The almost ubiquitous presence of other grazing animals will have been a major factor contributing to the poor fit of the derived relationship between cattle grazing pressure and sapling density (see results under 'Tree regeneration' above).

### ***Breed of cattle***

The wide range of cattle breeds used in England probably reflects the wide ownership of the sites by nature conservation bodies. Such bodies may also have an interest in the conservation of rare breeds of cattle and may therefore be more likely to use them for grazing management. In England, too, there is not so much need for the hardier breeds as there is in Scotland, where the most common breed used is the Highland. Different breeds of cattle graze, and browse, in different ways however it is likely that the past experience of individual cattle is as important as the breed in determining the diet selected by cattle since the gut of the animal takes time (perhaps several months) to adapt to a new diet.

### ***Stocking season***

Most sites were grazed by cattle in summer. This is when most food is available and even cattle of a non-hardy breed might be expected to maintain condition on all but the roughest sites. The less hardy breeds might be expected to lose condition if left out at other times of the year. The tendency for the English sites to be grazed by non-hardy breeds of cattle may explain why fewer sites were grazed by cattle in spring, autumn or winter than in summer (Table 8). Similarly, the tendency for the Scottish sites to be grazed by more hardy breeds of cattle, such as Highland (Table 8), and the frequent use of these sites for production, and more particularly for shelter (Table 6), may explain why the Scottish sites were as likely to be grazed by cattle in winter as in summer.

The effects of cattle on woodlands are likely to be different depending on the season in which cattle are in the woodland. There has been very little work comparing the effects of cattle in summer and winter. One such trial is being carried out on the island of Rum (site 59 in Appendix tables), off the west coast of Scotland. The aim of grazing by cattle was to reduce the cover of *Molinia caerulea* to open up the vegetation and allow natural regeneration of trees to occur. Initial monitoring results have shown that broadleaved trees were more likely to be browsed in summer than were Scots pine trees whereas the opposite was true in winter (Scoggins 1999; 2000). This supports a general observation that saplings of deciduous trees are more likely to be browsed in summer, when they are in leaf, than in winter although browsing on deciduous saplings can also occur in winter. Similarly, conifer seedlings are more likely to be browsed in winter when there is often little other green forage available.

### ***Cattle grazing pressure***

Information on stocking rate for the full dataset may be unreliable due to the difficulties of obtaining accurate information on cattle numbers and the duration of grazing however it appears that about a third of sites were grazed a level that is thought to be suitable for many nature conservation management objectives (0.1 cattle ha<sup>-1</sup> on all year; Mayle 1999). However, higher rates are likely to be needed where scrub control and the complete prevention of tree regeneration is the objective. There appeared to be no association between grazing pressure and the objective of stocking with cattle probably because of the wide range of nature conservation objectives (some requiring high, and some lower, grazing pressures) and of site conditions.

### ***Tree regeneration***

We found that, as cattle grazing pressure increased, the probability of achieving good, or poor, tree regeneration declined and the probability of achieving no tree regeneration increased (Figure 4). The fact that we obtained significant relationships despite the wide range in the other factors likely to affect tree regeneration, including grazing pressures from other large herbivores, and that the grazing pressures calculated for sites that were not visited are likely to be relatively inaccurate, suggests that the effect of cattle grazing pressure is strong. The relationships derived can be used to predict the likely probability of achieving good, poor or no regeneration at a given cattle grazing pressure (Figure 4). The confidence of such predictions can also be estimated from the confidence limits calculated for this study (Figure 4). However the confidence limits associated with the predictions are relatively large especially for the prediction of no, or poor, regeneration (Figure 4).

The probability of achieving good, or poor, tree regeneration with no cattle grazing was 68%. This declined by only 20%, to 48%, at 6 cattle-months ha<sup>-1</sup> year<sup>-1</sup> (equivalent to 0.5 cattle ha<sup>-1</sup> on all year) and fell to 28% at 12 cattle-months ha<sup>-1</sup> year<sup>-1</sup> (equivalent to 1 cow ha<sup>-1</sup> on all year). This indicates that some tree regeneration, and even good tree regeneration, is possible in some cases in the presence of cattle up to quite high grazing pressures and that grazing pressures at the high end of this scale would be needed to be sure that cattle would suppress tree regeneration. Even with no cattle grazing, the probability of achieving good tree regeneration was only 22%. This probably reflects the wide range of factors, other than cattle grazing pressure, that can affect successful tree regeneration.

By their trampling, cattle are thought to create regeneration niches for trees (Dennis 1999). It is therefore possible that, at low cattle grazing pressures, an increased number of trees germinating will offset any mortality of young trees caused by cattle browsing. We found no evidence that there is increased tree regeneration at low grazing pressures as cattle grazing pressure increases. However, any effect is likely to be small and we may not have been able to detect this with our approach. Although we had many sites with low cattle grazing pressure, we had none with no cattle grazing at all so the predictions of tree regeneration under no cattle grazing pressure are extrapolated. Targeted experiments are likely to be needed to discover whether cattle can, in fact, increase the chances of achieving successful tree regeneration.

There was an indication that the density of saplings decreased as cattle grazing pressure on its own, or the index of total grazing pressure, declined (Figures 5a and 5b). Instead of indicating a decline in sapling density, on average, with cattle grazing pressure, the data might also be interpreted as indicating that there is a maximum sapling density possible under any cattle grazing pressure and that this maximum declines as cattle grazing pressure increases. The wide range of sapling densities possible below this maximum, at any given cattle grazing pressure, indicates that many other factors influence the density of saplings and means that the maximum density, for a given cattle grazing pressure, is rarely achieved. There was also an indication that the density of saplings increased as total canopy cover increased (Figure 5c). There was much variation around these derived relationships. This is not surprising given the subjective nature of the measures not only of sapling density but also of herbivore density and canopy cover. It is also likely that many other factors such as site type, location, past grazing history, site preparation and weather all affect the density of saplings. Given that even a small and subjective dataset, such as the one used here, can apparently be used to detect relationships between sapling density and single variables, it is possible that a larger dataset, of the same type, could be used to fit statistical models incorporating several variables at once and that these could be used for prediction. If this information could be collected by site managers with a high degree of consistency then the additional cost might be minimal and the results should enable us to improve our predictive ability. However, training and testing might be needed to ensure consistency and this may be prohibitively expensive.

### ***Browsing on saplings***

Figure 6 can be used to predict the likely browsing pressure on one species of sapling given a knowledge of the browsing pressure on another species. Thus hawthorn and holly can be used as indicators of heavy browsing pressure. If they are browsed heavily then it is likely that all other species of sapling will also be browsed heavily. Conversely, if oak, goat willow or birch saplings are lightly browsed then it is likely that all other species of sapling will also be lightly browsed if they are browsed at all. Since the sites visited in this study had a range of densities of different species of sapling, it would appear that the density of

saplings of a different species, or in total, has little effect on the relative degree to which any one species is browsed. Similarly, since forage availability will have varied greatly between sites, the results suggest that the availability of alternative forage has little effect on relative browsing levels on the different species of sapling. The fact that saplings of the two thorny species, hawthorn and holly, were less heavily browsed than other species of sapling provides support for Vera's (2001) view that thorn scrub can successfully regenerate under grazing pressures that would suppress unprotected saplings of other tree species. This, together with the field observations of cases where hawthorn and bramble thickets appeared to be protecting young trees from browsing (see 'Observations on tree regeneration' above), supports Vera's hypothesis that the formation of thorn scrub is integral to the successful regeneration of a range of tree species in the presence of moderate grazing pressures.

### ***Future research needs***

There was a lack of control areas at any of the sites in this survey. Suitable control areas would be areas of similar size to the cattle grazed woodland with similar vegetation type and structure, and with a similar past history, but that received no cattle grazing. The lack of suitable controls meant that it was impossible to differentiate between the impacts of cattle and those of other large herbivores. Similarly, there were no sites where different cattle grazing regimes had been applied to otherwise similar woodlands. Setting up control areas, or areas with different cattle grazing regimes, would greatly increase the value of any data collected. Targeted experiments are likely to be needed to discover whether cattle, at low densities, can encourage tree regeneration.

This study has confirmed that the effect of cattle on tree regeneration is likely to be affected by the wide range of site variables that are encountered. Despite this, our results indicate the existence of a broad relationship between cattle grazing pressure and density of saplings. More data like those collected on the site visits might enable the effect of the various variables that are likely to influence seedling and sapling density to be distinguished. If a large number of factors have an effect then a very large dataset would be needed. Despite the data collected on the site visits being observational and qualitative rather than quantitative, useful information was acquired, especially relating to browsing preferences between tree species. This indicates that such qualitative data can be reliable. Since they are cheaper to collect than quantitative data, it may be possible to generate large datasets if site managers adopted a recording system similar to the one used in this study. The field data sheets and supporting notes from this project will be made available to site managers and they will be invited to return completed data sheets to Forest Research for analysis. The potential is there, in this way, to gradually accumulate a large, and useful, dataset. However, it may be that some training would be needed to ensure consistency in data quality and this may make this approach prohibitively expensive.

The data collected from the site visits in this study focussed largely on tree regeneration. However, there is also a need for monitoring other aspects of woodlands likely to be impacted by cattle such as ground vegetation, lichens, invertebrates, birds and mammals. Formal monitoring was being carried out at less than a half of the sites and, even when monitoring was in place it was often limited in scope and had not been in place for long. Success was therefore often judged on the basis of casual observation. This approach can be adequate, especially if the same person manages the site for many years, however a more formal approach to monitoring, where resources allow, will give a firmer basis on which to make management decisions. Fixed-point photography is probably the least resource demanding method of monitoring vegetation however the interpretation of the photographs relies on a subjective judgement. It may be possible to develop qualitative methods of

assessing various aspects of woodland vegetation which will require relatively little staff time (such as that described in MacDonald *et al.* 1998 for upland vegetation). Monitoring of invertebrates, birds and mammals will, in most cases, have to be more labour intensive.

New data collected from sites with controls and treatments, as well as data accumulated from monitoring a wider range of sites, could be used along with existing information to produce, and test, simulation models such as those produced by Jorritsma *et al.* (1999) and Kramer *et al.* (2001). Whilst there have been few site-scale studies of cattle impacts on woodlands, we do have information on both the foraging behaviour, and diet selection, of cattle as well as on the response of different plant species, and communities, to being grazed and of young trees of different species to being browsed (Hulbert 2002). Such models could synthesise such process-based information to enable site-specific, testable predictions to be made, not only of the impacts of cattle on the species and density of tree regeneration but also on the species composition and structure of ground vegetation. They would allow virtual, long term experiments to be carried out and would help with long-term planning.

## Conclusions

1. Cattle are being grazed in a large number of woodland sites spread widely across mainland Britain. There is perhaps a slightly higher density of sites in Cumbria, Argyll and the south of England. In the first two cases this may be because cattle grazing is a traditional use of woodlands that has persisted. In the south of England it is more likely to be due to a recent increase in interest, particularly on the part of NGOs and public bodies, in the use of cattle as a management tool to increase the nature conservation value of woodlands.
2. Most cattle-grazed woodlands are semi-natural and are dominated by, or contain, birch or oak. Scots pine is also a common component in Scotland as is ash in England.
3. Most sites in Scotland are owned by private individuals whereas in England and Wales most are owned by NGOs and public bodies. This may account for the greater number of sites in Scotland where stock production is the primary objective of keeping cattle in woodland in contrast to England and Wales where nature conservation is more likely to be the primary objective.
4. At most sites where cattle graze in woodlands, they also have access to land adjacent to the woodland. This means that recommendations on suitable grazing regimes for cattle will have to predict the likely timing, and duration, of use of the woodland by the cattle. This requires a knowledge of cattle behaviour, seasonal forage availability and the seasonal requirement for shelter.
5. Most sites are relatively small (up to 50 ha in total) making it difficult to achieve year-round grazing with cattle at low densities. Seasonal grazing may therefore be useful at such sites but the likely effects of grazing at different times of the year will need to be considered before recommendations are made on suitable grazing regimes.
6. In terms of nature conservation, there are three broad reasons for keeping cattle in woodlands. These are:
  1. To benefit biodiversity generally by:
    - Reducing tree /scrub regeneration.
    - Reducing the existing shrub layer.

- Maintaining open habitats.
  - Reducing dominant plant species.
2. To benefit individual species or groups.
  3. To encourage tree regeneration.

Most site managers are happy that the cattle are achieving the desired result and, where they are not, there is often a known reason.

7. 'Control' areas with no cattle grazing are present at many sites although they are often small. Monitoring is taking place on many sites but is highly variable in terms of both the elements of the site that are monitored and the methods used. At many sites monitoring has only recently been put in place.
8. There are extremely few cattle-grazed woodlands that are not also grazed by deer and /or sheep. Other herbivore species are often present as well. Any guidance on cattle grazing therefore has to take into account that other grazing animals are likely to be present, often in high numbers.
9. Many different breeds of cattle are being grazed in woodlands in England and Wales. This suggests that, under more mesic climatic conditions, most breeds of cattle can be grazed in woodlands. Where forage is of low quality, past grazing history may be as, or more, important than breed in determining how well the cattle will do. Fewer breeds are grazed in Scottish woodlands and these tend to be the hardier ones, such as Highland, probably because of the harsher climatic conditions and the frequent use of woodland for winter shelter. Breed may, therefore, be more important under such conditions.
10. Cattle are grazed at a wide range of stocking rates and in a wide range of combinations of different seasons in all countries although in Scotland there is more winter use of woodlands. This may reflect the greater use of woodlands for shelter in Scotland. Cattle grazing pressure (cattle-months ha<sup>-1</sup> year<sup>-1</sup>) also varied widely and did not differ, on average, between sites managed for cattle production and those managed for nature conservation.
11. Trees can regenerate in the presence of cattle although the chances of achieving some tree regeneration (good or poor) decline as cattle grazing pressure increases. However, even at 12 cattle-months ha<sup>-1</sup> year<sup>-1</sup>, there is still an approximately 30% chance of achieving some tree regeneration. With no cattle grazing, there is only an approximately 20% chance of achieving good tree regeneration and this declines as cattle grazing pressure increases. Cattle grazing pressures above 12 cattle-months ha<sup>-1</sup> year<sup>-1</sup> would be needed to be sure that no trees would establish due to cattle impacts alone.
12. The density of saplings in a woodland appears to decline as cattle grazing pressure increases. However, the fit of the relationship derived from this study was very poor. There are two main reasons why this should be the case. Firstly, there are many other factors likely to affect sapling density. One important factor is likely to be the density of other browsing animals and all but three of the sites in this study had at least one other mammalian herbivore present. Secondly, cattle do not forage evenly across the area available to them. At many of the sites in this study cattle had access to open areas as well as to the woodland and the degree to which the woodland was used would have been affected by many different factors.
13. Subjective assessments of the severity of browsing on saplings were sufficiently consistent between observers, and sites, for the data to provide useful information on the

relative preferences of large browsing mammals for saplings of different tree species. These appear to be generally consistent regardless of tree species composition, sapling density, herbivore species, herbivore density or seasonality of grazing or other environmental conditions. In this study, relative preferences of a mix of large, browsing mammals (mostly cattle and roe deer) for saplings of eleven tree species were quantified. The order of preference, with the most preferred first, was: oak, goat willow, {Scots pine, birch, ash}, hazel, beech, alder, rowan, holly and hawthorn.

14. The low preference for holly and hawthorn supports theories that these species can regenerate under higher browsing pressures than can other tree species. This, together with observations of saplings apparently being protected from browsing by clumps of thorny species, such as hawthorn and bramble, supports broader theories that thorn scrub is a necessary pre-requisite for the regeneration of many other tree species under moderate grazing pressures.
15. A large number of factors are likely to influence the impacts of cattle on woodlands. This means that large datasets are needed if predictive relationships are to be derived. The best way to derive such datasets with limited resources might be to use qualitative monitoring methods such as those used in this study for the field visits (Appendices 2 and 3). However some form of training and data checking may be needed to ensure consistency between observers at different sites. Much better information on the effects of cattle would be obtained if control areas, with no cattle grazing, could be set up at more sites. Similarly, setting up areas with different cattle grazing regimes would yield useful additional information. Computer models, leading to decision support systems, are likely to offer the best way of integrating process information on cattle behaviour and plant responses to grazing and browsing, to provide the site-specific predictions that are needed by managers.
16. The expense of data collection and modelling has to be carefully weighed against the perceived need for such prediction. This is underlined by conclusion 6 above that suggests most managers who graze cattle in woodland under existing guidance and their own local knowledge are content with the effects. However, it would be advisable for guidance to be available for managers on the installation of exclosures and on monitoring approaches so that they can carry out valid monitoring of the impacts to check that these are in line with their objectives.

## **Acknowledgements**

We would like to thank the many site managers who gave of their time to provide the information contained in this report. Several members of the Technical Services Unit of Forest Research conducted the site visits. They were Dave Anderson, Brian Jones, Willie Kelly, Alistair MacLeod, Hazel McLean, Richard Nicoll, Liz Richardson, Dave Tracy, Nick Tucker, Duncan Williams and James Wilson. Jon Clare linked the Access database to ArcView and Louise Sing helped to produce the map of cattle-grazed sites. Richard Thompson, Steve Gregory and Peter Quelch provided useful comments on an earlier draft of this report.

## References

- Dennis, R. (1998) The importance of traditional cattle for woodland biodiversity in the Scottish Highlands. A personal view. Unpublished report.
- Hulbert, I.A.R. (2002) Livestock grazing of woodlands – impact and management options. *Scottish Forestry*, **56**(1), 5-16.
- Jorritsma, I.T.M., van Hees, A.F.M., & Mohren, G.M.J. (1999) Forest development in relation to ungulate grazing: a modeling approach. *Forest Ecology and Management*, **120**, 23-34
- Kramer, K., Baveco, H., Bijlsma, R.J., Clerkx, A.P.P.M., Dam, J., Goen, T.A., Groot Bruinderink, G.W.T.A., Jorritsma, I.T.M., Kalkhoven, J., Kuiters, A.T., Lammertsma, D., Prins, R.A., Sanders, M., Wegman, R., van Wieren, S.E., Wiydeven, S., & van der Wijngaart, R. (2001). Landscape forming processes and diversity for forested landscapes - description and application of the model FORSPACE, Rep. No. 216. Alterra, Wageningen
- MacDonald, A.M., Stevens, P., Armstrong, H.M, Immirzi, P. & Reynolds, P. (1998). A Guide to Upland Habitats. Surveying Land Management Impacts. Scottish Natural Heritage, Battleby.
- Mayle, B. (1999) Domestic stock grazing to enhance woodland biodiversity. *Forestry Commission Information Note*, 28.
- Scoggins, S. (1999). The impact of grazing Highland cattle during the summer in established native woodland on the Rum National Nature Reserve. Unpublished contract report to Scottish Natural Heritage.
- Scoggins, S. (2000). The impact of grazing Highland cattle during the winter in established native woodland on the Rum National Nature Reserve. Unpublished contract report to Scottish Natural Heritage.
- Simpson, A.M., Webster, A.J.F., Smith, J.S. and Simpson, C.A. (1978) Energy and nitrogen metabolism of red deer (*Cervus elaphus*) in cold environments; a comparison with cattle and sheep. *Comparative Biochemistry and Physiology*, **60**, 251-256.
- Vera, F.W.M. (2001) Grazing ecology and forest history. CABI Publishing, Oxford.



# Appendix 1 Blank page from the site database

Site name	Grid reference	ID	Reason for cattle
First name	Last name	Area	
Region	County		Notes
Location	Owner		
Woodland type	Breed		
Stocking regime			
Other herbivores			
Ground flora			
Enclosures and Monitoring			

## Appendix 2 Data recording form for site visits

Inventory of cattle-grazed woodland sites – field data

Data recorder:

Date of visit:

### Site Information

Site name:

Location:

Grid Reference:

Owner :

Manager:

Grazing tenant:

Altitude:

Aspect:

Soil types:

Reason for stocking with cattle i.e. production, conservation etc. (if conservation, state the conservation aims):

### Animal information

Stock species	Breed	Numbers	Seasonality of stocking and any other management information e.g. Type and location of feeding
Cattle			
Sheep			
Horses			
Goats			
Other			

Wild /feral herbivore species	Numbers (or high, low, occasional etc.)
Red	
Sika	
Roe	
Fallow	
Rabbits	
Hares	

### Habitat information

Draw a rough map of the habitats to which the cattle have access and list below.

Habitat type	Area (ha)
Total	

**Woodland information**

Percentage of open areas within the woodland:

Occurrence of poaching within the woodland (none, localised or widespread):

Tree species	Canopy cover within wooded areas	Density and height distribution of saplings (25 cm – 1 m tall) <sup>1</sup> .	Browsing on saplings (25 cm – 1 m tall) <sup>2</sup>	Density of seedlings (< 25 cm tall) <sup>1</sup>	Browsing on seedlings (< 25 cm tall) <sup>2</sup>	Density of seedlings 1 – 2 years old <sup>1</sup> (small root collar diameter)

<sup>1</sup> Record as: occasional and localized (state which sort of areas they are found in); occasional and evenly spread; common but localized (state which sorts of areas they are found in), common and evenly spread.

<sup>2</sup> Record the degree of browsing (none, occasional, common but not on all seedlings /saplings found, on all seedlings /saplings found) and the likely species of browser (if possible). Note whether browsing rates differ depending on the height of the sapling.

Woodland ground flora species	Percent cover	Vegetation height (cm)	Open areas within woodland: ground flora species	Percent cover	Vegetation height (cm)

**Exclosures and monitoring**

Presence of exclosures (if so, are there any obvious differences inside and outside the exclosures):

Existence of any monitoring information:

Any other information about the site or the grazing animals, including previous grazing history where known:

## **Appendix 3 Guidance notes for site visits**

### **Inventory of cattle-grazed woodlands – notes on field data collection**

Return forms to:

Dr. Helen Armstrong,  
Northern Research Station,  
Forest Research,  
Roslin,  
Midlothian,  
EH25 9SY  
Tel: 0131 445 6954  
Fax: 0131 445 7335  
Email: [helen.armstrong@forestry.gsi.gov.uk](mailto:helen.armstrong@forestry.gsi.gov.uk)

Please contact me at any time if you have any queries or comments.

#### **Timescale**

If possible, please complete one pro forma and return to me by the middle of January 2001 at the latest with any comments you might have on the ease of completion of the form or suggestions for improvement. I will make any changes necessary and send out new pro formas and /or notes if necessary. If possible please complete the rest of the sites before the end of February and by mid-March at the latest. Please let me know if these deadlines aren't possible for you.

#### **Aim of the project**

FC's Livestock Exclusion Annual Premium Scheme (LEAP) for encouraging the natural regeneration of semi-natural woodland through the exclusion of stock, has recently been withdrawn. FC will be formally reviewing the results of the scheme to assess the conditions under which it has, or has not, been a success. One of the reasons for withdrawing LEAP and assessing its effectiveness, is that some concern has been expressed that the total exclusion of stock can lead to a build-up of ground vegetation. This not only leads to greater 'weed' competition with young trees but can also lead to a reduction in the diversity of ground layer species because a few dominant species (usually grasses) shade out some of the less vigorous herb species. A loss in structural complexity can also lead to a reduction in numbers of invertebrates, birds and mammals. The feeling is that cattle grazing may provide greater benefits in terms of biodiversity and tree regeneration than do sheep or other more selective grazing animals. Cattle are non-selective grazers hence are efficient at reducing the dominance of rank grasses. Their trampling can also help to reduce bracken cover, provide regeneration niches for young trees and paths through the ground vegetation of woodland grouse chicks. The dung also provides a valuable resource for many invertebrate species. Although there is much anecdotal information on the effects of cattle, there is little hard information. If LEAP is to be replaced by a scheme which allows some degree of grazing then we need to know more about the effects of different stocking and management regimes on different types of woodland so that we can recommend the most suitable management practices for each woodland. This project is the first step towards providing such information. The aim is to find out what management systems are currently being used in woodlands across Britain. So far I have over 100 sites in my database containing basic information (see site descriptions). Unfortunately there are no sites grazed by cattle alone. All are grazed by sheep and /or deer as well and some are grazed by goats, ponies, rabbits and /or hares! Despite this, the information held in the database provides some basic information about the grazing conditions under which tree regeneration is likely to take place. The information in the database was collected solely from phone conversations and by letter and we feel that it would be worth 'hardening up' on the information for the 'best' sites by undertaking site visits to collect data in a subjective but systematic and slightly more formal, manner. There are 39 such sites (13 in England, 2 in Wales and 24 in Scotland).

## Site Visits

For each site there is a print-out of the information already in the database. This includes the site details and details of the contact or contacts for the site. The contact person or people will have to be contacted prior to a site visit to get permission and, if possible, to arrange to meet the site manager / grazing managers. Much of the information asked for on the form can be collected on site without the site manager but the information on stocking rates and management systems can only be obtained from the site manager. The best way to obtain this information plus any other relevant local knowledge will probably be to meet them on site. If this isn't possible then a follow-up conversation may be needed though please bear in mind that I will have already talked to the contact person /people to obtain the information that is already in the database. Any phone conversation should therefore be to confirm the information in the database and to fill in on any missing information.

## The form

### **Site information**

*Data recorder* and *date of visit* are both self evident.

*Site name*: This will normally be the same as the name in the database but there may be cases where I have got the name wrong or where it could be made more specific.

*Location*: supply any general information about the location i.e. near village x or between x and y on road z.

*Grid Reference*: The national grid reference is given in the site information provided for each site but there may be cases where it is slightly out and can be made more accurate.

*Owner*: Please confirm ownership details where possible. If the manager wants the owner to remain anonymous just put 'private' here.

*Manager*: Where the manager is a different person to the owner or grazing tenant please note their name and contact details.

*Grazing tenant*: as for Manager.

*Altitude*: From the OS map, note the average altitude, or altitude range, of the woodland.

*Aspect*: Where the woodland is on a slope, note the aspect.

*Soil type*: Where known, note the soil types on the site.

*Reason for stocking with cattle*: The owner, manager or grazing tenant should be able to say whether the reason for stocking for cattle is largely for forage, shelter, nature conservation or a combination. If it is for nature conservation please state the conservation aims which it is hoped the cattle will help to achieve. Some or all of this information may already be in the site details from the database in which case it will just need to be confirmed.

### **Animal Information**

*Domestic stock*: Information on domestic stock will have to be obtained from the site manager / grazing tenant. Please collect as much information as possible on the management of the different stock species. If there isn't enough space then continue at the end of the form or on the reverse side of the page.

*Wild /feral herbivore species*: This information will have to be obtained mostly from the site manager but there may be signs in the field of usage by different wild species which may help to confirm the site manager's opinion. Such signs might be the density of dung of the different species or evidence of browsing damage that can be attributed to one of these species.

### **Habitat information**

*Habitat map:* Please draw a rough map of the different habitats that the cattle have access to. I don't need this to use a formal vegetation classification system (e.g. rough grassland dominated by *Molinia* would do) but if you want to use NVC classes that is fine. I just need a rough description of the location of the different habitat types.

*Habitat areas:* Estimate the areas of each habitat block. Again I don't need it to be very accurate, just a rough estimate.

### **Woodland information**

*Percentage of open areas within the woodland:* If there open habitats within the woodland, estimate the percentage of the total woodland areas that is open. Don't include 'glades' within the woodland which have woodland ground flora.

*Occurrence of poaching within the woodland:* Give some idea of whether the cattle have poached the ground either locally or generally over the whole site.

*Woodland description:* For the main tree species within the woodland, please estimate canopy cover of adult trees. For each species also estimate the density and distribution of saplings (25 cm – 1 m tall), seedlings (< 25 cm tall) and seedlings which look like they are no more than 1 – 2 years old judging from the size of the root collar. Their occurrence should be recorded as: occasional and localized (state which sort of areas they are found in); occasional and evenly spread; common but localized (state which sorts of areas they are found in), common and evenly spread. The relative densities of saplings of different sizes should also be recorded if possible i.e. whether they are all large or all small or evenly distributed in size. Record the degree of browsing (none, occasional, common but not on all seedlings /sapling found, on all seedlings /saplings found) and the likely species of browser (if possible) for each of the major tree species.

*Woodland ground flora:* In the left hand half of the table, estimate percentage cover of the most obvious woodland ground flora species, together with an estimate of the height of the plant species. This should include the flora of any 'glades' but not of open areas which are within the woodland but which have a different plant species composition to that of the woodland itself. These should be recorded in the right hand side of the table under 'open areas within woodland: ground flora species'. No information is needed on the ground flora composition of open areas, which are not within the woodland, but to which the cattle have access i.e. adjacent fields, grassland, heath or moor.

*Exclosures and monitoring:* Note the presence and size of any exclosures and note any obvious differences inside the exclosures in terms of ground vegetation species composition or cover or in terms of tree regeneration.

*Existence of any monitoring information:* Confirm any information on this in the database print-out by talking to the owner and /or manager.

*Any other information:* If you can gain any information about the previous grazing history of the site, please note it here. Note any other information that you think may be relevant.

Helen Armstrong (5.12.00)

## Appendix 4. Location, ownership, management aims, area and type of cattle-grazed woodlands.

The ID number can be used to locate each site on Figure 1.

Table 4.1 Sites in England.

Region	ID	Site Name	Ownership	Owner	Aim 1	Aim 2	Area of wood (ha)	Woodland type	Main tree species	Site visit
Berkshire	27	Greenham and Crookham Common	Public body	Newbury District Council	Nature conservation		42	Semi-natural	Oak	
Cumbria	18	Low Wood	NGO	The National Trust	Production		79	Semi-natural	Oak	
Cumbria	19	Dobshall	NGO	Woodland Trust	Nature conservation		2.6	Semi-natural	Birch	
Cumbria	23	Private	Private		Production		10	Semi-natural	Ash	
Cumbria	80	Peace Howe	NGO	The National Trust	Production		2	Semi-natural	Oak	
Cumbria	81	High Coppice	NGO	The National Trust	Nature conservation		9.5	Semi-natural	Oak	Yes
Cumbria	82	Colwith Pasture	NGO	The National Trust	Nature conservation		3.9	Semi-natural	Oak	Yes
Cumbria	100	Whitbarrow	NGO/Private	Part owned by Cumbria Wildlife Trust, part leased by Forest Enterprise and part privately owned.	Nature conservation	Production	100	Semi-natural	Birch	
Cumbria	124	Dodgson Wood	NGO	National Trust	Nature conservation		6.1	Semi-natural	Oak	
Cumbria	125	Low Peel Near	NGO	National Trust	Nature conservation		2	Semi-natural	Oak	
Cumbria	137	Farrer's Allotment	Public body	Forest Enterprise	Nature conservation		15	Semi-natural	Birch	
Derbyshire	1	Deer Cote Spinney, Calke Abbey	NGO	The National Trust	Nature conservation		15	Semi-natural	Oak	
Derbyshire	84	Longshaw estate	NGO	The National Trust	Nature conservation	Historic	162	Semi-natural	Birch	
Dorset	41	Morden Bog	Public body	Forest Enterprise and English Nature	Nature conservation		145	Plantation	Bishop pine	Yes
Dorset	42	Newton Heath	Public body	Forest Enterprise	Nature conservation		220	Plantation	Pine	
Dorset	60	Twinworth Down	NGO	The National Trust	Nature conservation	Production	27	Semi-natural	Ash	
Essex	13	Epping Forest 1	Public body	The Corporation of London	Nature conservation		225	Semi-natural	Oak	
Essex	15	Hatfield Forest	NGO	The National Trust	Nature conservation	Production	210	Coppice /Park woodland	Hornbeam	Yes
Essex	143	Epping Forest 2	Public body	The Corporation of London	Nature conservation	Historic	5	Semi-natural	Oak	
Gloucestershire	54	Lower Woods	NGO	Gloucestershire Wildlife Trust	Nature conservation		48	Coppice	Ash	
Hampshire	11	Binswood	NGO	Woodland Trust	Nature conservation	Production	42.8	Semi-natural	Oak	Yes
Hampshire	12	New Forest	Public body	Crown Estates own common (attached commons have other owners)	Historic	Production	3,646	Semi-natural	Beech	
Hampshire	24	Roydon Woods - Dawkins Bottom	NGO	Hampshire Wildlife Trust	Nature conservation		8.2	Semi-natural	Oak	Yes

Hampshire	25	Pamber forest and Silchester Common	Private/Public body/NGO	Silchester Parish Council, Hampshire Wildlife Trust	Nature conservation		51	Semi-natural	Oak	Yes
Hampshire	26	Odiham common	Public body	Hart District Council	Nature conservation		66.6	Semi-natural	Oak	
Hampshire	70	Roydon Woods - Baker's copse2 (Cricket Ground)	NGO	Hampshire Wildlife Trust	Nature conservation		7.1	Coppice /Pollard	Oak	Yes
Hampshire	142	Private	Private		Nature conservation		80	Semi-natural	Oak	
Lancashire	45	Warton Crag local nature reserve	Public body /NGO	Lancaster City Council /Royal Society for the Protection of Birds	Nature conservation		6.5	Semi-natural	Ash	Yes
Lancashire	96	Arnside Knott	NGO	The National Trust	Nature conservation	Production	~50	Semi-natural	Oak	
Lancashire	97	Heathwaite	NGO	The National Trust	Nature conservation		25	Semi-natural	Oak	Yes
Lancashire	98	Private	Private		Nature conservation		12	Semi-natural	Birch	Yes
Lancashire	99	Warton Crag	NGO	Lancashire Wildlife Trust	Nature conservation		~5	Semi-natural	Ash	Yes
Lancashire	101	Hale Moss	NGO	CLA (Country Landowners' Association?) Charitable Trust	Nature conservation	Production	12	Semi-natural	Birch	
Norfolk	135	Felbrigg Estate	NGO	The National Trust	Nature conservation		25	Semi-natural	Beech	
Nottinghamshire	77	Private	Private		Nature conservation		35	Semi-natural	Oak	Yes
Suffolk	43	East Harling	Public body	Forest Enterprise	Nature conservation		20	Plantation	Scots pine	
Surrey	62	Ashtead Common	Public body	Corporation of London	Nature conservation		2.4	Semi-natural	Blackthorn	Yes
Worcestershire	22	Private	Private		Keep grass short		10.8	Semi-natural	Oak	
Yorkshire	31	Sneaton Forest	Public body	Forest Enterprise	Production		2	Semi-natural	Birch	
Yorkshire	46	Private	Private		Production		12.1	Semi-natural	Oak	



Table 4.2 Sites in Scotland.

Region	ID	Site Name	Ownership	Owner	Aim 1	Aim 2	Area of wood (ha)	Woodland type	Main tree species	Site visit
Aberdeenshire	40	Private	Private		Production		1,425	Semi-natural	Birch	
Aberdeenshire	63	Private	Private		Production		17	Semi-natural	Birch	Yes
Aberdeenshire	65	Private	Private		Production		130	Semi-natural	Scots pine	Yes
Angus	56	Private	Private		Production		~8-16	Plantation	Sitka spruce	Yes
Argyll	9	Daill grazings	Public body	Forest Enterprise	Nature conservation	Production	32	Semi-natural	Birch	Yes
Argyll	30	Private	Private		Production	Historic	125	Semi-natural	Oak	Yes
Argyll	35	Private	Private		Nature conservation		45	Plantation	Birch	Yes
Argyll	44	Meal Mor	NGO	National Trust for Scotland	Nature conservation			Semi-natural	Alder	
Argyll	61	Private	Private		Production	Nature conservation	part of 14,164	Semi-natural	Oak	
Argyll	73	Private	Private		Production			Semi-natural	Oak	
Argyll	109	Private	Private		Production		~81	Semi-natural	Oak	
Argyll	110	Private	Private		Production		22	Semi-natural	Oak	Yes
Argyll	111	Private	Private		Production	Nature conservation	60	Semi-natural	Oak	Yes
Argyll	112	Private	Private		Production	Nature conservation	~73	Semi-natural	Birch	
Argyll	118	Private	Private		Production		243	Semi-natural	Oak	
Argyll	123	Private	Private		Production		27	Semi-natural	Oak	
Argyll	127	Private	Private		Production		300	Semi-natural	Oak	
Argyll	128	Private	Private		Production		80	Plantation		
Argyll	130	Private	Private		Production		20	Semi-natural	Oak	
Argyll	138	Private	Private		Production		370	Semi-natural	Oak	
Argyll	141	Private	Private		Production	Historic	12	Semi-natural	Birch	Yes
Dumfriesshire	74	Private	Private		Production		54	Park woodland	Oak	
Dumfriesshire	85	Private	Private		Production		50	Semi-natural	Alder	
Dumfriesshire	86				Production		2	Semi-natural	Birch	
Dumfriesshire	87	Private	Private		Production		3.2	Semi-natural	Birch	
Fife	90	Morton Lochs	Public body	Scottish Natural Heritage	Nature conservation		35	Semi-natural	Beech	Yes
Fife	91	Tentsmuir	Public body	Scottish Natural Heritage	Nature conservation		12	Semi-natural	Willow	Yes
Galloway	50	Wood of Cree	NGO	Royal Society for the Protection of Birds	Nature conservation		5.8	Semi-natural	Oak	Yes
Inverness-shire	20	Private	Private		Production	Nature conservation	9.4	Semi-natural	Birch	Yes

Inverness-shire	21	Private	Private		Production	Nature conservation	8.4	Semi-natural	Birch	Yes
Inverness-shire	39	Private	Private		Production		54	Semi-natural	Birch	
Inverness-shire	51	Corrimony - Compartment 8	NGO	Royal Society for the Protection of Birds	Nature conservation		30	Semi-natural	Birch	
Inverness-shire	64	Private	Private		Nature conservation		4.7	Semi-natural	Birch	Yes
Inverness-shire	67	Private	Private		Production		81	Semi-natural	Birch	Yes
Inverness-shire	88	Private	Private		Nature conservation		7.8	Semi-natural	Birch	
Inverness-shire	104	Private	Private		Production		148.1	Semi-natural	Birch	
Inverness-shire	105	Private	Private		Production	Nature conservation	~100	Semi-natural	Scots pine	
Inverness-shire	107	Private	Private		Production	Nature conservation	~400	Semi-natural	Scots pine	
Inverness-shire	121	Private	Private		Production	Nature conservation	486	Plantation	Sitka spruce	
Inverness-shire	131	Private	Private		Production	Nature conservation	40	Semi-natural	Birch	
Inverness-shire	132	Private	Private		Production	Nature conservation	13	Semi-natural	Birch	
Inverness-shire	139	Corrimony - Compartment 6	NGO	Royal Society for the Protection of Birds			4	Semi-natural	Willow	
Isle of Jura	8	Private	Private		Production		25	Semi-natural		
Isle of Jura	133	Private	Private		Production		26.9	Plantation /Semi- natural	Sitka spruce	
Isle of Jura	134	Private	Private		Nature conservation	Production	4.4	Semi-natural	Birch	
Isle of Mull	108	Private	Private		Production		~420	Semi-natural	Oak	
Isle of Mull	122	Private	Private		Production		405	Semi-natural	Birch	
Isle of Rum	59	Rum	Public body	Scottish Natural Heritage	Nature conservation		8	Plantation /Semi- natural	Scots pine	
Morayshire	68	Private Bankhead farm	Private		Production		4	Semi-natural	Birch	Yes
Perthshire	17	Glen Finglas	NGO	Woodland Trust	Production	Nature conservation	260	Semi-natural	Oak	
Perthshire	66	Private	Private		Amenity		~25	Plantation	Sitka spruce	Yes
Perthshire	114	Private	Private		Nature conservation		8.75	Semi-natural	Birch	
Perthshire	117	Private	Private		Production		7	Semi-natural	Oak	
Perthshire	140	Private	Private		Production		5.7	Semi-natural	Birch	
Ross and Cromarty	89	Creag nan Garadh	NGO	The National Trust for Scotland	Production		35	Semi-natural	Birch	Yes
Sutherland	47	Dyke	Public body	Forest Enterprise	Nature conservation	Production	5,000	Plantation	Sitka spruce	
Sutherland	58	Private	Private		Production		4	Semi-natural	Scots pine	Yes

Table 4.3 Sites in Wales.

Region	ID	Site Name	Ownership	Owner	Aim 1	Aim 2	Area of wood (ha)	Woodland type	Main tree species	Site visit
Caernarvon	94	Hafod Garegog	NGO	The National Trust	Nature conservation		20	Semi-natural	Oak	No
Carmarthenshire	3	Dinefwr Park	NGO	The National Trust	Nature conservation	Historic	44.5	Semi-natural		No
Carmarthenshire	55	Pembrey forest	Public body	Forest Enterprise	Nature conservation		50	Plantation	Corsican pine	No
Ceredigion	37	Mynachlog Fawr			Production			Semi-natural	Oak	No
Ceredigion	38	Afon Rheidol ger Capel Bangor			Production			Semi-natural	Willow	No
Clwyd	76	Chirk Park	NGO	The National Trust	Production		135.2	Semi-natural	Oak	No
Pembrokeshire	32	Tycanol	Public body	Pembrokeshire Coast National Park	Nature conservation		50	Semi-natural	Oak	No
Radnorshire	16	Rhos Goch	Public body	Countryside Council for Wales	Production	Nature conservation	0.9	Semi-natural	Willow	No

## Appendix 5. Reasons for grazing cattle in woodlands

Table 5.1 Sites in England.

ID	Aim 1	Aim 2	Detailed reasons for grazing cattle
27	Nature conservation		Commoners have rights to graze and the Council's land. Aim is to manage the Commons for conservation benefits.
18	Production		Production, shelter, feeding, convenience
19	Nature conservation		Conservation
23	Production		Convenient shelter and hard standing for feeding
80	Production		Production
81	Nature conservation		Conservation. To reduce undergrowth, particularly bramble, to enhance natural regeneration.
82	Nature conservation		Nature Conservation. To maintain the wood as wood pasture and to encourage regeneration in poached areas.
100	Nature conservation	Production	Nature conservation. The site hadn't been grazed for 70-80 years, which had lead to a dominance of Sesleria grass. They want to hold back scrub encroachment and diversify the grassland.
124	Nature conservation		To create ground disturbance to promote the Touch Me Not Balsam and Nettle Carpet moth. Both are biodiversity action plan species. The Balsam is an annual species and thrives in woods with disturbed ground.
125	Nature conservation		Promote Touch Me Not Balsam and Nettle Carpet moth both of which are Biodiversity Action Plan Species. Touch Me Not Balsam is an annual which thrives in woodlands with disturbed ground
137	Nature conservation		To maintain the open limestone grassland.
1	Nature conservation		Nature conservation. The aim of having the cattle is to break up the tussocky grassland and to reduce the cover of bracken to encourage some of the herb species such as hare bell and provide better grazing for the sheep.
84	Nature conservation	Historic	Nature conservation - to keep it more open and diverse and also historic.
41	Nature conservation		Nature conservation. To manage the heathland.
42	Nature conservation		Nature conservation
60	Nature conservation	Production	Nature conservation and production
13	Nature conservation		Nature conservation. This is a long-standing wood pasture site, which they want to maintain. The aim is to maintain the structural complexity of the woodland and the current extent of open grasslands. The grasslands, and the veteran trees in the open woodland, are important for invertebrates. It will be necessary to maintain an open woodland to continue to get oak regeneration since it won't regenerate in shade.
15	Nature conservation	Production	Nature conservation but also production. The site has been grazed for hundreds of years.
143	Nature conservation	Historic	Conservation of the heathland and protection of the ancient commoners' rights. The idea is to graze as early as possible to check the growth of <i>Molinia caerulea</i> without the grazing affecting the annual growth increment of <i>Calluna</i> too much.
54	Nature conservation		Conservation objectives
11	Nature conservation	Production	The aims are, generally, nature conservation and, to a lesser degree, production but there is a more detailed management plan held by the Woodland Trust. The site is stocked with cattle to try to maintain the woodland pasture nature of the site but the ultimate desire is to ensure that maintenance and restocking of the woodland can be done at little or neutral outlay. This may ultimately result in the removal of cattle if they significantly affect the regeneration of tree species.
12	Historic	Production	Unbroken tradition of depasturing commonable stock, mainly cattle and ponies, for time out of mind (a precise English legal term meaning before the reign of King John). Probably actually stretches back to the bronze age.
24	Nature conservation		Nature conservation. The Trust would like to restore wet heath flora within the site boundaries in contrast with the normal 'New Forest Management' outside the site boundaries. Cattle churn up the ground to mud. Cross-leaved heath and marsh thistles are coming back into poached areas. The stream has been canalized in the past. Bog myrtle, bracken and <i>Molinia</i> came right up to the edge of the stream. The stream has recently been dammed to bring back the meanders and wet areas. The cattle poach the wet areas and marsh plants are re-establishing. Cross-leaved heath is coming back further away from the stream.

25	Nature conservation		Nature conservation and public access. In Pamber Forest the intention is to restore and maintain traditional woodland pasture. Cattle are grazed throughout the area to reduce bracken, bramble and birch regeneration. On Silchester Common the hope is that the grazing will allow the acid grassland flora to spread by keeping the Holcus and bracken in check.
26	Nature conservation		To return the common to its former use as a woodland pasture in order to increase the biodiversity of the site. The site has been without grazing for decades and is suffering in its diversity as a result. They hope to arrest this development through the management plan which, as well as other things, includes grazing.
70	Nature conservation		Nature conservation. Want to restore wet heath flora in contrast to the normal 'New Forest Management' outside the site boundaries.
142	Nature conservation		Nature conservation. To re-gain a pasture woodland i.e. to keep the grass under control and prevent scrub encroachment to keep the woodland open.
45	Nature conservation		Nature conservation - reduction of encroaching scrub, creation and maintenance of grassland sward to encourage limestone herb-rich grassland flora.
96	Nature conservation	Production	Nature conservation. Control of bracken and bramble. The site is managed primarily for wildlife (High-brown fritillary, Scotch argus); control density of sward, increase herb richness and check scrub development after clearance by hand. Also provides some animal production but not much. Focus on providing an abundance of violets as food plant for fritillary, and retaining tussocks of Sesleria for the Scotch Argus.
97	Nature conservation		The objectives are very similar to Arnshide Knott with the aim being to create a wood of mature trees for butterflies, flowers and other wildlife. The aim of the cattle grazing is to prevent tree, bramble and other scrub regeneration.
98	Nature conservation		Grazing with cattle to maintain open areas and suppress shrub development under trees. Scuffing of cattle's' feet may activate heather seed bank to assist restoration of heath.
99	Nature conservation		The grazing objectives refer to the grassland, scrub, bracken and butterflies, with little consideration to its impact on woodland. Scrub clearance is done on a long rotation, equivalent to coppicing. Grazing extends the coppice cycle and delays closure
101	Nature conservation	Production	Mainly nature conservation but animal production is needed to sustain management.
135	Nature conservation		Nature conservation to achieve Biodiversity Action Plan targets for species and habitats. The main aims of the grazing are to maintain an open structure to the woodland to retain the lichen flora on ancient trees, and to manage the trees and deadwood for invertebrates. Any benefit we can get from the grazing regime by way of diversifying the ground cover in terms of height and species composition will be a useful addition.
77	Nature conservation		Nature conservation. The cattle keep any dense regeneration down and help to keep the cut /treated bracken under control. There is an old chestnut avenue where birch and oak scrub had come up. This was cleared and the cattle are keeping this down.
43	Nature conservation		Largely used as a storage area but the trial was set up to see what effect the grazing had on the botanical interests.
62	Nature conservation		A trial to investigate the feasibility of using cattle to control Michaelmas Daisy (Aster sp.). They want to eradicate the daisy using various means while trying to conserve the natural flora and encourage the colonization of pepper saxifrage and fleabane.
22	Keep grass short		To maintain a fairly short sward so that the area can be used as a caravan park for a number of events held at the Three Counties Showground. The main events are in May, June and September. Cattle grazing is thus a management technique.
31	Production		Used as shelter by cattle, and probably sheep.
46	Production		Production

Table 5.2 Sites in Scotland.

ID	Aim 1	Aim 2	Detailed reasons for grazing cattle
40	Production		Beef production (sucklers and followers)
63	Production		Forage and shelter. Also nature conservation. The hope is that hoofprints will provide suitable regeneration niches for trees.
65	Production		Forage, shelter and exercise for the cattle.
56	Production		Production. Summer feeding
9	Nature conservation	Production	Nature conservation / production
30	Production	Historic	Production. Traditional. Principal reason for management is to shoot pheasants.
35	Nature conservation		To get birch regeneration (grant scheme)
44	Nature conservation		Conservation management with real commercial pressures!
61	Production	Nature conservation	Production and environment
73	Production		Production of calves
109	Production		This is part of a mixed hill cattle and sheep farm.
110	Production		Production although at some point they will want to get regeneration. and a woodland grant scheme from this area.
111	Production	Nature conservation	Production and ground improvement. Encouragement of regeneration is a secondary objective.
112	Production	Nature conservation	Production and conservation.
118	Production		Production. The LEAP areas are used for pheasant shooting.
123	Production		Suckled calf production
127	Production		Production
128	Production		Production
130	Production		Production
138	Production		Shelter in winter
141	Production	Historic	Production: shelter and tradition.
74	Production		Production
85	Production		Production. Shelter in winter
86	Production		Grazing tenancy
87	Production		Shelter in winter
90	Nature conservation		Nature conservation, to control scrub and graze grasses. The original reason was to keep down the reeds in the lochs. The first lot of cows did this but the second lot didn't. It is also desirable that the cattle keep the rough grassland down and prevent any tree regeneration to keep the woodland surrounding the lochs open. There is poaching in a limited area but this is not considered a problem.
91	Nature conservation		To prevent tree regeneration and graze off the rougher grasses. They want to maintain dune heathland and marram grass dunes. To keep the lichen community on the sand dunes open and free from tree and scrub encroachment.
50	Nature conservation		Nature conservation. This is the best area on the reserve for butterflies because of the mix of open glades. The aim is to maintain the open areas between woodland stands by preventing scrub encroachment, and maintain herb rich flushes. The wood has been grazed, probably by cattle as well as by deer, for a long time and this has led to an open structure of glades and denser wood that is excellent for invertebrate and bird diversity. The aim is to retain this varied structure to maintain the biodiversity interest. The fear is that, with no grazing, the open areas would scrub over and the woodland understorey would become a bramble and bracken thicket. It is hoped that the cattle, in particular, will help to keep the bracken in check.
20	Production	Nature conservation	Production /conservation. To encourage birch and aspen regeneration. The hope is that the cattle will keep down the vegetation and that their hoof prints will act as regeneration niches.

21	Production	Nature conservation	Production /nature conservation. To encourage birch, aspen and Scots pine regeneration.
39	Production		Production
51	Nature conservation		Nature conservation. To encourage tree regeneration. The aim is to create an area of patchy woodland, scrub and open areas that might be better for black grouse. The cattle are to keep the ranker vegetation down to maintain the species richness and also because black grouse don't seem to like long, rank vegetation.
64	Nature conservation		To break up the ground to encourage regeneration.
67	Production		Forage and shelter.
88	Nature conservation		Nature conservation - to respace and thin the regenerating trees. The ultimate aim is to allow the biggest trees to get bigger and to produce good amounts of seed to allow regeneration.
104	Production		Production. Woodland Grant Scheme objective is to expand the native broadleaved and pine woodland habitats over the open ground by means of natural regeneration.
105	Production	Nature conservation	Production although the owner thinks they are good for conservation as well.
107	Production	Nature conservation	Production although the owner thinks they are good for conservation as well.
121	Production	Nature conservation	The wood was put in as a 'tax shelter'. It is mostly a Sitka plantation put in 2-3 years before the current owner bought it. The current owner bought it ultimately to provide shelter in winter for deer, to create opportunities for other wildlife and to reshape it with open areas for deer, birds and stock.
131	Production	Nature conservation	Production. The cattle get access to some of the woodland in winter and this is used for shelter. Cows are also being used to encourage birch regeneration.
132	Production	Nature conservation	Agricultural production and nature conservation (regeneration demonstration)
139	Nature conservation		Nature conservation. The area contains a black grouse lek site. They wanted to know if the black grouse would prefer the grass shorter at the lek site. There has been an increase in the number of birds using the lek site since cattle were introduced.
8	Production		Production /shelter
133	Production		Area 3: Nature conservation. Can help reduce bracken infestation by trampling. They also help to open up areas where young tree cover is very dense. Cattle and deer also gain shelter. This is a useful area to cattle for calving in February to April.
134	Nature conservation	Production	Area 1: Fence dismantled 10 years ago for management reasons to allow cattle and deer to shelter in inclement weather. Area 2: To enclose this area would eliminate one of the sheltered wintering areas for deer and cattle.
108	Production		Shelter and some back-end grazing.
122	Production		Production
59	Nature conservation		To break up the Molinia and stimulate natural regeneration.
68	Production		Shelter
17	Production	Nature conservation	The main reason is production but in future tree regeneration and demonstration of integrated land management.
66	Amenity		Originally only for amenity value.
114	Nature conservation		To encourage natural regeneration by breaking up the grass sward. However the grazing pressure doesn't seem to be high enough to achieve this.
117	Production		Part of a park used by cattle and sheep.
140	Production		Production
89	Production		Production but it is judged to be in good condition in terms of conservation (apart from the exotic tree species).
47	Nature conservation	Production	Diversification for Forest Enterprise and conservation of lapwings and black grouse by grazing off the in-bye. Production for the farmer. The hope is that the cattle will open up the wet flushes in the woodland.
58	Production		Shelter for cattle in winter.

Table 5.3 Sites in Wales.

ID	Aim 1	Aim 2	Detailed reasons for grazing cattle
94	Nature conservation		The woods are on rocky knolls, scattered around a wet heath, which is managed primarily for the rare butterfly, the silver studded blue. This species requires an open habitat with no shade, and with little tall vegetation. The cattle are used to graze the purple moor grass on the wet areas of heath, whilst not damaging the ling on the drier areas. Sheep are introduced for short bursts of grazing in winter periodically, to prevent rank growth of ling.
3	Nature conservation	Historic	To maintain the biodiversity of the deer park and for historic interest
55	Nature conservation		The cattle keep the bramble down. CCW reckon that disturbing the sand is beneficial.
37	Production		Winter shelter for cattle
38	Production		Additional grazing
76	Production		Production.
32	Nature conservation		One of the main features is the lichen interest. It is essential to maintain a grazing programme by domestic stock to maintain this interest. It is hoped that cattle will a) reduce the possible mineral depletion effects of a sheep only programme and b) raise the average height of the lower branches of trees to allow more light to the base of trunks, which is advantageous for lichen communities.
16	Production	Nature conservation	Stocked with cattle because it is a Commoner's right.



## Appendix 6. Details of exclosures and monitoring.

Table 6.1 Sites in England.

ID	Exclosures	Monitoring
31		SNH's records go back to the 1970's.
70		Fixed-point photography every five years.
42	None	None
100		They take fixed point photographs and do some other vegetation monitoring every 3-5 years.
99	None	Monitoring of orchids, dark red helleborines and butterflies. Also grasses and flora in open grassland swards are surveyed in quadrats and with photographs at fixed locations.
98	None	None
97		Not aware of any vegetation monitoring but comparisons could easily be made between different areas. Butterfly transect data is available for the past 7-8 years (in 2000).
27	Experimental exclosures in the wet gully areas.	A number of transects are being surveyed, probably every two years depending on funds.
45	None	Weekly butterfly transect counts from April to September. Annual count of Dark Red Helleborines. Orchid count. Yearly survey of grasses and flora in sward by quadrats and photographs at fixed locations.
41	One 1 ha exclosure (planted and fenced in 1999 along with the rest to compare with like outside fence). Fenced area includes bog surrounded by pine forest.	Fixed point photography started in the exclosures in 2001.
54	A number of small coupes in Spoil Coppice are coppiced and exclosed each year for up to 5 years to enable coppice regeneration.	
84	300 additional acres of wood have been fenced off.	None
81	None	None
80	None	None
77	There is a 10 ha exclosure.	There is ongoing vegetation monitoring looking at the effect of the grazing and bracken treatments. Also moth and beetle surveys. The latter with respect to dead wood and with assistance from English Nature.
143	No exclosures but the cattle have been fenced into a 1.6 ha compound recently (as of August 2002).	The open heath flora was monitored between 1994 and 1999 using random 1 x 1 m quadrats within two 50 x 50 m grids. A paper was published in the Essex Naturalist (new series), 16: 59-70.
62	Some areas within the grazing areas are exclosed to provide control plots for monitoring.	Ecological monitoring is carried out annually - before, during and after each grazing period.
96	At least two exclosures established but botanical data may not be available yet (September 2000).	Weekly butterfly transects.
124		Fixed point photographs and annual surveys of plants and moths.
137	There is one small area fenced off to regenerate yew.	No monitoring known of but they have been working with English Nature who may have done some.
1	There are some areas around planted trees that are fenced but these are mostly in bracken areas.	
43		No monitoring except of the newt ponds. The plants were surveyed before the scheme started in early 1999.
23	None	None

26	Four coupes were felled in 1999, 3 of which were fenced temporarily in early 2000 and planted with hazel (the dominant coppice species in these sections). These will be fenced for a couple of seasons until the coppice is sufficient to withstand any grazing pressure.	Monitoring throughout the whole common was begun in 2000 with a baseline survey before major works were carried out. Limited surveys, e.g. hydrology and invertebrates, done in the past.
12		Tree regeneration transects are being carried out as part of a LIFE project - started in 2000.
13	None	A 2 km butterfly transect is carried out annually for 26 weeks of the year using the national monitoring protocol. Monitoring of the botanical interest and of grassland and veteran tree invertebrates will be running by 2003.
15	Short term exclosures are put up around coppice that is less than 12 years old to prevent browsing.	None
135	Just to protect selected regeneration, nectar source shrubs and poisonous plants (yew).	There is fixed point photography and records are kept of stocking dates and numbers.
125		Fixed point photographs. Annual survey of plants and moths.
11	There are fenced boundary banks with taller ground vegetation and scrub.	Started fixed point photography in September 2000. Measuring sward height in July in some of the grassy areas.
18	Four exclosures present, the earliest dating from 1978 and the others from 1987.	
19		Yearly monitoring of plant species at the site to ensure grazing is achieving the desired results. The first year there was no grazing at all at the site and a species list was drawn up by local naturalists.
24		Fixed point photos every five years.
142	There are some areas that have been fenced.	The whole thing will be monitored by FE and English Nature.
25	There are ten exclosures but only two in the woodland.	Vegetation monitoring is being carried out in woodland and on the heath. The site manager annually monitors species presence /absence inside and outside the exclosures in a 10 x 10 m area and does a full botanical survey in a 2 x 2 m area. A photographic record is also kept.
22	None but the grazed area is part of a larger wood, the rest of which is not grazed.	

*Table 6.2 Sites in Scotland.*

ID	Exclosures	Monitoring
59		Tree regeneration has been monitored.
58	None	None
21	None	They will estimate dry matter production and offtake and monitor sward height and species diversity (see Scottish Agricultural College report). In June every year the number of seedlings in circular quadrats is counted. They also use a 'plonker' (a stick with a disc that falls down to sward height) to get a measure of biomass.
61	There are some exclosures mostly set up under Woodland Grant Schemes.	SWT woods have lots of monitoring mostly in these woodlands, others have less. SNH also has plenty of info. on the exclosed SSSIs.
63	None	None
8		None
56	None	Some monitoring of tree regen. and cattle movements by the Game Conservancy.
9	None	See site management plan for monitoring information.

51		They are monitoring 500 ha for regeneration. Monitoring was set up in 1999. These were 25 m x 25 m plots with 4 small plots inside them where % cover, height etc. were measured. This was done on contract and the report has not yet been received (August 2002). Also 14 permanent plots of 5.6 m radius to record number, height and browsing on birch regeneration.
47		None
17	Exclosures in some of the woodlands.	Monitoring timings, numbers of livestock (sheep, cattle) and deer, tree and ground flora and climate at 10,20,30 and 40 years.
64		Some fixed point photos taken in 1999
40	No exclosures but the western portion of the NNR is not cattle grazed.	
35	10 Experimental 10 m x 10 m exclosures set up in about 1995.	The stockman keeps records of where the stock are and MLURI have been doing detailed monitoring.
30	No exclosures except for a deer fence around a 25 ha site containing mostly felled conifer but also standing larch, pine and spruce, birch and open ground.	SNH's records go back to the 1970's.
50	There are no exclosures up in this cattle-grazed bit but there are in similar adjacent bits of woodland. There is a deer exclosure plot of 1 ha outside the cattle-grazed bit.	Some monitoring is done in the exclosures. Within the exclosure brambles are dense and waist high in places. Blaeberry 40 cm in, 15 cm out. Some baseline vegetation quadrats have been recorded for percentage cover but have never been re-recorded.
122	1 enclosure	
133		No monitoring information at present.
73		None but regular observations for over-grazing – normal practice.
111	None	No formal monitoring.
112		Nothing formal.
114	There are several ESA cages, which have been in place for over 5 years. Additional trial cages are proposed. There are some experimental areas fenced to keep out deer and /or rabbits.	There is a photographic record.
117		None
109	None	None
121		The present owner lives on the ground and has film and photographic comparisons.
108	One field of about 20 acres and with about 15 – 20 trees is exclosed. It might be used to keep deer in the future.	SNH may do some visual monitoring.
123	None	None
127	None	Part of an SSSI and a proposed SAC. SNH will have assessed originally.
134		None
128	None	None
130	None	None
131		Some photographic monitoring taking place. 2 control plots have been established for monitoring of birch
132	No exclosures at present but two planned.	2 years' worth of data on regeneration plots (1 <sup>st</sup> year data partially lost) to be continued indefinitely. Based on 12 circular monitoring plots (5 m radius) in which number of tree species and number of tree seedlings is recorded along with the height of 3 saplings. The presence of flora as a measure of grazing (grazing tolerance is known for species such as blaeberry, wood rush and chickweed wintergreen). Monitoring is done in September. Monitoring is also done in the Tier 1 area as a comparison.

118	2 Livestock Exclusion Premium areas, one of about 600 acres (242 ha) and one of about 380 acres (154 ha).The bracken has been sprayed in here.	
88	None	There is some monitoring going on.
67	None	None
68	None	None
20	None	They will estimate dry matter production and offtake and monitor sward height and species diversity (see Scottish Agricultural College report).
74	Yes there are exclosures.	None
141	None at present but the site abuts a larger native woodland that is not grazed by cattle or sheep and so is useful for comparison.	None
85	There will be exclosures shortly (as of August 2002) as part of the Environmentally Sensitive Area. There are some bits with stock excluded. One area of about 7 ha has only deer grazing.	
138		None
110	Three exclosures of a third of a ha each for woodland grant scheme. The fences are poorly maintained and there was much evidence of deer activity within.	Some monitoring of regen. will be done in order to get the payment.
89	None	No monitoring yet but there will be some.
90	None	Monitoring of birds and water levels.
91	None	No monitoring of regeneration or anything relevant to grazing effects.
139	Over the fence it is only deer grazed so that acts as a control. There are also 4 stock-fenced areas of 10 x 10 m where the Macaulay Institute is doing some clipping trials.	None
104		Scottish Woodlands Ltd. will monitor 'damage' to regenerating trees from deer browsing and produce an annual report to the FC and the DCS. Don't know final details of the monitoring scheme but see cattle grazing plan.
105	The RSPB Abernethy reserve next door has no cattle.	None
107	The RSPB Abernethy reserve next door has no cattle.	None

Table 6.3 Sites in Wales.

ID	Exclosures	Monitoring
3	Only tree guards/ exclosures.	
16	None	None
37	None	None
38	None	None
94	There is an exclosure on the estate, which has been in existence for around 10 years. This is on a more extensive woodland, rather than the patchy areas that are grazed by cattle.	Some monitoring has been done, but mostly on the heath rather than the woody areas. Photo-monitoring should include images of the woods.
76	None	None
32	In any 10 year period, approx. 3 ha is fenced as stock exclosures to allow tree regeneration. At the end of the 3 year period, the exclosures are taken down and re-erected elsewhere in the wood.	

## Appendix 7. Relative densities of grazing mammals, other than cattle, at the sites visited.

ID	Country	Region	Woodland category	Main tree species	Sheep	Red deer	Roe deer	Fallow deer	Sika deer	Muntjac deer	Rabbits	Hares	Equines
81	England	Cumbria	Semi-natural	Oak	Low		Occasional					Occasional	
82	England	Cumbria	Semi-natural	Oak		Occasional	High						
41	England	Dorset	Plantation	Bishop pine			Low		Low		Low		
15	England	Essex	Coppice /Park woodland	Hornbeam	Low			High		Low	High		
11	England	Hampshire	Semi-natural	Oak			High				Low		
24	England	Hampshire	Semi-natural	Oak		Low	Low	Low	Low				Low
25	England	Hampshire	Semi-natural	Oak			High	Low		Low	Low		
70	England	Hampshire	Coppice /Pollard	Oak		Low	Low	Low	Low		Low		Medium
45	England	Lancashire	Semi-natural	Ash		Occasional	High				High	Occasional	
98	England	Lancashire	Semi-natural	Birch		Low	High				Low	Occasional	
99	England	Lancashire	Semi-natural	Ash		Occasional	High				High	Occasional	
77	England	Nottinghamshire	Semi-natural	Oak		Low		Low			Low	Low	
62	England	Surrey	Semi-natural	Blackthorn			Low						
63	Scotland	Aberdeenshire	Semi-natural	Birch			Low				High		
65	Scotland	Aberdeenshire	Semi-natural	Scots pine		High	High						
56	Scotland	Angus	Plantation	Sitka spruce	Low	Occasional	Medium				High		
9	Scotland	Argyll	Semi-natural	Birch			High				Low	Low	
30	Scotland	Argyll	Semi-natural	Oak		Low	High				Low		
35	Scotland	Argyll	Plantation	Birch			Low		Low		Low		
110	Scotland	Argyll	Semi-natural	Oak	Low	High	High				Low		Low
111	Scotland	Argyll	Semi-natural	Oak	High		High		Low		Low	Occasional	
141	Scotland	Argyll	Semi-natural	Birch	Low	Low	Medium		Low		Low	Occasional	
90	Scotland	Fife	Semi-natural	Beech			Low				Low	Low	
91	Scotland	Fife	Semi-natural	Willow			Low				High		
50	Scotland	Galloway	Semi-natural	Oak		High	High	Occasional					
20	Scotland	Inverness-shire	Semi-natural	Birch			Low				Medium		
21	Scotland	Inverness-shire	Semi-natural	Birch			Low				Low		
64	Scotland	Inverness-shire	Semi-natural	Birch							Low		
67	Scotland	Inverness-shire	Semi-natural	Birch	Low	Low	High				Low		
68	Scotland	Morayshire	Semi-natural	Birch	Low		Low				High		
66	Scotland	Perthshire	Plantation	Sitka spruce		High							Low
89	Scotland	Ross and Cromarty	Semi-natural	Birch		Low	Low						
58	Scotland	Sutherland	Semi-natural	Scots pine			Low		High		Low		

## Appendix 8. Breed, and stocking rate, of cattle at all sites.

Table 8.1 Sites in England. Blank cells indicate where no information was provided.

ID	Breed	Season cattle in wood	Average stocking rate (cattle ha <sup>-1</sup> )	Total length of time cattle in wood (months)	Total cattle-months ha <sup>-1</sup> in wood	Site visit
27	Hereford crosses and Aberdeen Angus crosses.	Summer	0.37	7	2.62	No
18	Aberdeen Angus	Early winter	0.38	2	0.76	No
19	Brown beef cattle	Autumn/Winter	1	6	6	No
23		Winter		5		No
80	Unknown	Summer/Autumn		5		No
81	Aberdeen Angus	Winter	1.26	5	6.3	Yes
82	Galloway beef suckler	Autumn/Early spring	2.3	3.5	8.05	Yes
100	Mixed. Have been Red Devons but are now a bluish colour.	Autumn/Winter/Spring/Early summer	0.1	10	1	No
124	Traditional	Early spring	2	1	2	No
125	Traditional	Late spring	2	1	2	No
137	Devon and Devon Cross	All year	0.27	12	3.24	No
1	Friesian, Simmental, Limousin crosses but they want to start using Shorthorns	Summer	2	2	4	No
84						No
41	Various	Summer	0.15	6	0.9	Yes
42	Unknown					No
60	Longhorn and Shorthorn	Summer	0.48	6	2.88	No
13	English longhorns (a conservation breed)	Summer	0.04	7	0.27	No
15	Mixed beef herd - Limousin, Charolais, Welsh Black and others.	Summer /Autumn	1.4	7	9.8	Yes
143	English Longhorn	Early summer	2	3	6	No
54	Various dairy	Summer		7		No
11	Mixture - whatever's cheapest at the market. Cost, weather, < 30 months old, quality of grazing, choices between beef cattle or cows & calves all affect the choice of breed and numbers.	Spring/Summer	0.65	4	2.6	Yes
12	Mostly beef breeds. Occasional black and white.	All year	0.8	12	9.6	No
24	Mix of Galloway, Angus, Sussex, Shorthorn etc. They don't want big animals because they want them to be easy to handle. They see them every day and they aren't difficult to deal with.	Summer /Autumn	0.97	5	4.87	Yes
25	Highland and Dexter	All year	0.33	12	3.96	Yes
26	Highland, British White, Irish Moiled, Gloucester, Dexter.	Early summer	0.12	2	0.24	No

70	Mix of Galloway, Angus, Sussex, Shorthorn etc. They don't want big animals because they want them to be easy to handle. They see them every day and they aren't difficult to deal with.	Winter	0.66	7	4.62	Yes
142	Shetland. They eat anything and are very hardy	All year	1	12	12	No
45	North Devon cross	Late summer/Winter	0.15	7	1.05	Yes
96	North Devon cross	Autumn/Winter/Spring	0.2	8	1.6	No
97	North Devon cross	Early summer/Late summer	0.5	5	2.5	Yes
98	North Devon cross	Summer/Winter	0.5	5	2.5	Yes
99	North Devon cross	Early summer/Autumn/Early winter	0.235	6	1.41	Yes
101		Summer		6		No
135	Simmental hybrid	Spring/Summer/Autumn	0.9	7	6.3	No
77	Varies from year to year. A dairy/beef cross. In 2001 Fresian crosses and Holstein x Simmental crosses.	Summer	0.69	3	2.07	Yes
43	Various	All year - intermittently	0.67	4	2.68	No
62	Sussex Red	Summer	1.7	1.5	2.55	Yes
22	Probably both dry cows and store cattle used.	Spring/late summer		3		No
31	Angus/Hereford cross Friesian	Winter	0.32	7	2.24	No
46	Highland		0.81			No

Table 8.2 Sites in Scotland. Blank cells indicate where no information was provided.

ID	Breed	Season cattle in wood	Average stocking rate (cattle ha <sup>-1</sup> )	Total length of time cattle in wood (months)	Total cattle-months ha <sup>-1</sup> in wood	Site visit
40	Aberdeen crosses	All year	0.07	12	0.84	No
63	Aberdeen Angus. Currently he has a mix of Canadian Aberdeen Angus and Scottish Aberdeen Angus but he wants to get the whole herd to Scottish because they are much hardier and don't need help with calving. Canadian AA can put up with snow and -40oC but not	All year	0.88	12	10.56	Yes
65	Beef breed crossed with a Limousin bull.	Winter	0.42	4	1.68	Yes
56	Highland	Summer	0.76	1.75	1.34	Yes
9	Brown!	All year	0.16	11	1.81	Yes
30	Luing	All year	0.3	12	3.6	Yes
35	Highland and Commercial crosses.	Summer	0.2	4	0.8	Yes
44	Highland	Summer		6		No
61	About 10 pure highlanders. The rest of the herd is made up of first cross highlanders with a white short horn bull, and those are crossed either once or twice with a Simmental bull.	Late summer/Autumn/Late winter	0.02	7	0.17	No



73	Luing	All year		12		No
109	Luing x Highland	All year	0.62	12	7.44	No
110	Saler crosses	All year	0.45	12	5.4	Yes
111	Limousin x, Charolais x (1999), Aberdeen Angus (bull)/ Shorthorn / Highland crosses (2000/01/02)	Winter	0.56	7.5	4.2	Yes
112	Highland	All year	0.09	12	1.08	No
118	Highland	All year	0.1	12	1.2	No
123	Galloway	Late winter/ Spring/Summer/ Autumn	0.26	9	2.34	No
127	Continental X Shorthorn	Winter	0.83	5	4.15	No
128	Continental X Shorthorn	Winter	0.12	5	0.62	No
130	Simmental/Limousin cross	Spring/Summer/Autumn	1	8	8	No
138	Luing or some other breed 1st cross with Simmental	All year	0.055	12	0.67	No
141	Highland	Winter	0.44	12	5.28	Yes
74	Angus, Friesian	All year		12		No
85	Black suckler crosses.	Winter	0.93	5	4.65	No
86		Winter	0.93	7	6.51	No
87	White Galloway	Winter	0.52	5	2.6	No
90	Highland 350 kg liveweight.	All year	0.3	11.5	3.45	Yes
91	Highland	All year	0.07	12	0.84	Yes
50	Beef cattle. Mix of colours. Used to be Highlanders on the site until the grazing tenant changed.	Late summer/winter	1.72	4	6.88	Yes
20	Charolais cross	Early Winter (9 days)	8.51	0.3	2.55	Yes
21	Beef sucklers of a variety of breeds	Autumn	1.11	1	1.11	Yes
39	Red poll x Sussex. Sussex is beef breed and Red poll is dual purpose (milk and beef).	Winter	0.33	3	0.99	No
51	Mixed	Summer	0.038	4.5	0.17	No
64	Limousin crosses.	Winter	1.49	6	8.94	Yes
67	Aberdeen Angus crosses though largely Aberdeen Angus now. Black	Early winter	1	2	2	Yes
88	Highland	All year	0.51	12	6.12	No
104	Mixed breed beef	Winter	0.27	5	1.35	No
105	Hardy cattle. Aberdeen Angus bull. Heifers a mix of shorthorn, Aberdeen Angus, Limousin, Highland, Red Devon, Luing. Too expensive to buy pure Highlanders and they have to be taken to shows to get the best price for them.	Spring/Summer/Autumn	0.22	5	1.1	No
107	Hardy cattle. Aberdeen Angus bull. Heifers a mix of shorthorn, Aberdeen Angus, Limousin, Highland, Red Devon, Luing. Too expensive to buy pure Highlanders and they have to be taken to shows to get the best price for them.	Spring/Summer/Autumn	0.055	7	0.38	No
121	Shorthorn, Shorthorn Cross and some Galloways	Summer/Winter		8		No

131	12 Highlanders, 1 Shorthorn Bull, 18 Shorthorn cross cows and heifers, 1 Limousin Bull	Summer	1.25	3	3.75	No
132	Shorthorn X Simmental	Spring/Late summer	1	3	3	No
139	Luing	Mid-summer	1.75	2	3.5	No
8	Luing	Winter	0.5	6	3	No
133	Highland	All year	0.088	12	1.06	No
134	Highland	Late Winter	0.08	12	0.96	No
108	Luing and Luing x Limousine	All year	0.03	12	0.36	No
122	Highlands and Highland Cross	Summer		3		No
59	Highland	Summer or winter	1.25	3.5	4.37	No
68	Holsteins (dairy cattle)	All year	1.59	12	19.08	Yes
17	Luing	All year	0.025	12	0.3	No
66	Highland	All year	0.2	12	2.4	Yes
114	Unknown, but probably dairy crosses	Autumn	6.3	1	6.3	No
117	Galloway	Spring/Autumn		2		No
140	Simmental cross sucklers	Summer	0.40	2.5	1.01	No
89	Continental crosses (Simmental, Limousin, Aberdeen) - all crosses.	Spring/Summer/Autumn	0.44	6	2.64	Yes
47	Galloway, Highland, Luing, Blue-grey crosses. Wants to produce faster-growing lowland cross calves because need to get a saleable calf rapidly because of BSE regulations but that means will have to source pure-bred cows as replacements.	Summer	0.012	7	0.084	No
58	Highland	Winter	4.37	5	21.87	Yes

Table 8.3 Sites in Wales. Blank cells indicate where no information was provided.

ID	Breed	Season cattle in wood	Average Stocking rate (cattle ha <sup>-1</sup> )	Total length of time cattle in wood (months)	Total cattle-months ha <sup>-1</sup> in wood	Site visit
94	Variable. But Welsh Black-based. The cattle used here have to be born into a 'red water' area to be resistant to this otherwise fatal condition (which he thinks is carried by ticks).	Summer	1.8	5	9	No
3	White Park	All year	0.34	12	4.08	No
55						No
37		Winter		5		No
38				4		No
76	Friesian heifers, some Limousin heifers and bullocks.	Summer/Autumn	2.47	7	17.29	No
32	Welsh Black	Summer	0.12	5	0.6	No
16	Various	Summer (few weeks)	0.24	1	0.24	No

## Appendix 9. Details of tree regeneration at all sites.

Table 9.1 Sites in England. Blank cells indicate where no information was provided.

ID	Main mature tree species	Other mature tree species	Is tree regeneration occurring?	Regeneration details	Site visit
27	Oak	Ash, Birch, Alder		?	No
18	Oak	Birch, Ash, Alder		?	No
19	Birch	Ash, Cherry, Sycamore, Hawthorn, Blackthorn, Hazel	Yes	There is some regeneration of ash and sycamore further into the wood and uphill away from the field where the cattle spend most of their time. Wouldn't expect anything else to be regenerating - too young yet	No
23	Ash	Oak, Rowan, Birch, Alder	No		No
80	Oak	Hawthorn	No		No
81	Oak	Birch, Beech, Norway spruce, Holly, Rowan	Yes	Good regeneration of oak. Moderate regeneration of birch, beech, holly and rowan.	Yes
82	Oak	Birch, Holly, Rhododendron, Beech, Ash, Alder	Yes	Only holly is regenerating. No saplings or seedlings of any other tree species present.	Yes
100	Birch	Ash, Yew, Larch, exotic conifers	Yes		No
124	Oak	Birch, Ash	Yes	Low amounts of regeneration.	No
125	Oak	Birch, Alder, Ash	Yes	Poor regeneration	No
137	Birch	Yew	Yes	Some birch is now regenerating	No
1	Oak	Hornbeam, Beech, Lime, Ash, Sweet chestnut, Horse chestnut, Hawthorn, Hazel, Alder	No	No regeneration but some new trees have been planted and protected from grazing.	No
84	Birch	Oak, Sycamore, Holly, Maple, Thorns	No	No regeneration obvious outside of fences. There is inside the fenced-off bits.	No
41	Bishop pine	Maritime pine, Scots pine, Corsican pine, Lawson cypress, Western hemlock, Monterey pine	No		Yes
42	Pine				No
60	Ash	Oak			No
13	Oak	Birch, Hornbeam, Holly	Yes	There is lots of regeneration especially of hornbeam, birch and pedunculate oak. The oak does not regenerate within the closed-canopy woodland though the holly does.	No
15	Hornbeam	Oak, Ash, Hazel, Field Maple, Crab apple, Hawthorn, Elm, Beech	No	No regeneration except of coppice re-growth in short-term exclosures round coppice of less than 12 years old.	Yes
143	Oak	Beech, Birch	Yes	Lots of birch regeneration with some oak and beech.	No
54	Ash	Field maple		A number of small coupes in Spoil Coppice are coppiced and exclosed each year for up to 5 years to enable coppice	No

				regeneration.	
11	Oak	Beech, Ash, Hazel, Holly, Hawthorn, Birch, Willow	Yes	For two years after the Trust bought the site there was no grazing so some oak got away. There is still some regeneration in areas that the cattle can't get to. There is also regeneration within the fenced boundary banks. On site visit only hazel, holly and hawthorn were regenerating with c. 50 - 100 saplings >25 cm /ha. They were evenly spread over the site and there was no obvious browsing on them. Seedlings (<25 cm) of these three species were occasional and mostly where the understorey was denser restricting browsing. All were 1-2 years old.	Yes
12	Beech	Oak, Holly, Alder, Ash, Hazel, Willow, Birch	Yes	Active regeneration is widespread at present grazing levels. Birch, beech and oak regeneration is confined to the shelter of bracken, bramble, holly and fallen dead wood. Exotic conifers, mainly Scots pine and Western hemlock are virtually unaffected by the grazing levels.	No
24	Oak	Scots pine, Birch, Beech, Holly, Willow	No	Only holly and willow saplings present (25 cm - 1 m tall). Holly saplings are heavily browsed. The willow is in dense clumps by streamsides and is too tall to be browsed. There are some seedlings (< 25 cm) of oak (where grazing is less intense), holly (very little browsing) and beech (no browsing). Birch seedlings are common.	Yes
25	Oak	Ash, Field maple, Birch, Holly, Hazel	Yes	Tree regeneration is mainly of birch and aspen but it is sparse in the woodland with most of it being on heathland at the woodland edge. In the woodland, there is a low density of unbrowsed oak regeneration both above and below 25 cm tall and also recent seedlings. Some birch and hazel regeneration that is also unbrowsed.	Yes
26	Oak	Birch, Hazel	Yes	Birch and hazel regeneration.	No
70	Oak	Lime, Hawthorn, Birch, Beech, Holly, Hazel, Ash, Alder, Conifers	Yes	Hawthorn saplings of 25 cm - 1 m are common and evenly spread over the site. Holly of the same height are occasional and localized. Both species are commonly browsed. Hawthorn seedlings < 25 cm tall are common and localized in bracken patches. Holly seedlings of the same height are occasional and localized. There are a few unbrowsed beech seedlings of 1 - 2 years old. No regeneration of any other species.	Yes
142	Oak		No	The only way to get tree regeneration is to fence deer out.	No
45	Ash	Elm, Oak, Hazel, Birch, Hawthorn, Holly, Blackthorn	Yes	Saplings (25 cm - 1 m) of ash, hazel, birch and hawthorn common. Holly saplings common under the canopy. All species of sapling usually browsed except holly and hawthorn that are occasionally browsed. Seedlings (<25 cm) of ash, holly and hawthorn only and these are occasionally browsed.	Yes
96	Oak	Yew, Ash, Sycamore, Birch, Hazel, Sycamore, Ash	Yes	Stocking rate is too low to allow for consistent overall suppression of stump regeneration or seedlings, though the level of browse damage, especially on sycamore, appears to be significant.	No
97	Oak	Sycamore, Yew, Birch	Yes	Where rabbits have been excluded since 1996 and grazing with cattle is restricted to Sept/Oct, the growth of birch seedlings is very vigorous.	Yes
98	Birch	Scots pine, Oak, Yew, Hazel, Sycamore, Ash, Holly	Yes	Young (25 cm - 1 m tall) birch, oak, yew, Scots pine and hazel trees were common and sycamore, ash and holly occurred occasionally. All young trees of all species were browsed apart from holly that was only occasionally browsed. The only young trees less than 25 cm tall were of holly. These occurred occasionally and were not browsed.	Yes
99	Ash	Birch, Hazel, Holly, Hawthorn, Blackthorn	Yes	Ash and hazel saplings (25 cm - 1 m) common, and birch saplings occasional, but all browsed. Holly and hawthorn saplings common and only occasionally browsed. No seedlings (< 25 cm) of any species except holly and hawthorn. These were common and occasionally browsed. Holly and hawthorn therefore seem to be the only tree species successfully regenerating.	Yes
101	Birch	Willow, Oak, Scots pine, Ash			No
135	Beech	Oak, Sweet chestnut, Sycamore, Birch, Conifers, Lime.	No	There has been little tree regeneration so far but it is expected in the future in some areas.	No
77	Oak	Birch, Sweet chestnut	No	There is occasional oak regeneration in the more open areas but it doesn't get very far before being grazed so 10 of the oaks are being protected each year. No birch or sweet chestnut regeneration.	Yes
43	Scots pine	Scots pine			No
62	Blackthorn	Hawthorn, Willow, Oak, Field maple, Dog rose	Yes	Blackthorn and hawthorn saplings 25 cm - 1 m tall are occasional and evenly distributed over the grazed area. Browsing on them is common but not on all of them. There is a very occasional oak sapling of the same height with occasional browsing. There were no trees smaller than 25 cm and no willow seedlings or saplings.	Yes
22	Oak		No		No
31	Birch	Oak	No		No
46	Oak	Ash, Hazel			No

Table 9.2 Sites in Scotland. Blank cells indicate where no information was provided.

ID	Main mature tree species	Other mature tree species	Is tree regeneration occurring?	Regeneration details	Site visit
40	Birch				No
63	Birch	Rowan, Larch, Scots pine, Willow, Alder, Cherry, Spruce	No	Rowan saplings >25 cm, < 25 cm and 1-2 years old are common in open areas, under larch and in poached areas. There is some browsing on these. There are occasional birch and larch saplings > 25 cm tall with little browsing on the birch. No other regeneration.	Yes
65	Scots pine	Birch, Larch, Beech, Rowan, Spruce, Dog rose	Yes	There are a few browsed pine saplings >25cm tall. None smaller. There are a few birch saplings >25 cm which are all browsed but in variable amounts. Birch seedlings <25 cm are rare. In localized areas of pine there is a profusion of saplings and seedlings of rowan that are not heavily browsed. In the pine areas there are rare saplings of dog rose that are lightly browsed. Beech saplings are rare and browsed,	Yes
56	Sitka spruce	Larch, Birch, Rowan	Yes	There are a few rowan saplings that are browsed by deer. There was no regeneration when the site was sheep grazed. The deer, and possibly cattle, eat the birch regeneration that is why there is only rowan regeneration.	Yes
9	Birch	Oak, Goat willow, Hazel, Alder, Ash	Yes	Good regeneration of birch, goat willow, hazel and alder is occurring. No regeneration of oak or ash.	Yes
30	Oak	Birch, Goat willow, Alder, Hawthorn, Rowan, Holly, Hazel	Yes	Alder, willow and birch regenerate under cattle and deer grazing. Oak, ash and hazel don't. Don't know if that's the deer or the cattle that prevent it (or other factors e.g. lack of light). But see under Airds Park where there are now no cattle. Small numbers of birch, willow, alder, holly and hazel probably getting away but almost no oak, if any.	Yes
35	Birch	Goat willow	Yes	Birch regeneration common adjacent to existing stands with no browsing evident. Goat willow regeneration occasional with no browsing evident.	Yes
44	Alder	Ash, Birch			No
61	Oak	Birch, Hazel, Rowan, Ash	Yes	There is only regeneration in the fenced woodlands although, in the unfenced ones, there is some regen. in areas that are slightly less accessible suggesting that more regen. would get away if the grazing pressure were reduced slightly.	No
73	Oak	Holly, Birch	Yes	There are bits where young birch is getting away. No oak regeneration. If grazing is low then <i>Betula pubescens</i> , <i>Salix caprea</i> and <i>cinerea</i> and occasionally rowan and very occasionally holly, will get away but not much else.	No
109	Oak	Birch, Alder, Hazel	Yes	A little tree regeneration on the steeper faces.	No
110	Oak	Birch, Beech, Hazel, Ash, Rowan, Holly, Hawthorn	No	Only a very small amount of oak and beech regeneration on the steepest slopes and burn sides that the cattle and deer cannot get to. Oak, birch and beech regeneration elsewhere all browsed.	Yes
111	Oak	Birch, Willow, Alder, Ash, Hazel, Holly, Hawthorn	Yes	A little oak, birch, goat willow and alder regeneration. Holly regeneration abundant and not heavily browsed.	Yes
112	Birch	Willow, Oak, Rowan, Alder	Yes	Considerable regeneration.	No
118	Oak	Birch			No
123	Oak		No		No
127	Oak		Yes	Limited regeneration present.	No
128			No		No
130	Oak	Birch			No
138	Oak	Birch, Holly, Rowan	No	Would need fencing to get any regeneration.	No
141	Birch	Oak, Willow, Hazel, Rowan, Ash, Beech	Yes	Birch regeneration is mostly invading the open hill. Most are browsed. Some willow regeneration in wetter areas but all browsed. Some hazel regeneration which was not significantly browsed. Oak, rowan, ash and beech only regenerated in inaccessible ravine.	Yes
74	Oak				No

85	Alder	Birch, Rowan, Oak, Beech	Yes	There is always some regeneration. It is more wooded than 30 years ago and it has been grazed in a similar manner all that time.	No
86	Birch	Alder, Other deciduous	Yes	Very little regeneration. Some birch and alder but it is mainly grazed off by cattle each year.	No
87	Birch	Alder	Yes	Lots of birch, and maybe alder, regeneration.	No
90	Beech	Willow, Corsican pine, Hawthorn, Alder, Birch, Ash, Scots pine	Yes	Only hawthorn and birch saplings present. They are browsed a little (probably by deer) but not enough to impede their growth too much. No Corsican pine, beech, willow or alder regeneration.	Yes
91	Willow	Alder, Birch	No	The only regeneration is of birch and this is more than 5 years old (when there were no cattle on the site) suggesting that cattle and rabbits can prevent regeneration. Resprouting willow and alder is browsed but not kept in check. There is not much gorse and broom regeneration happening although some may get through which is then treated with herbicide.	Yes
50	Oak	Birch, Hazel, Hawthorn, Ash, Willow, Rowan, Holly, Hornbeam	Yes	No oak seedlings or saplings found even in open areas next to mature trees. Some birch saplings and seedlings getting away. Quite a few hazel saplings and seedlings but none getting away from browsing. Frequent hawthorn saplings and seedlings, often in bracken patches. Many were getting away despite some browsing. Browsing was noticeably less on hawthorn than on the other tree species, even when not 'protected' by bracken. Ash and rowan saplings were rare and always browsed. Holly saplings were rare and browsed. Only birch and hawthorn were getting away.	Yes
20	Birch	Aspen	Yes	25-50 cm birch saplings were rare, localized and all browsed; the shorter ones by rabbits (sharp, diagonal edge) and the taller ones by cattle (frayed edge). There were no birch saplings smaller than this and only one browsed seedling (< 2 years old) was found. There were two patches of more than 100 40-60 cm aspen suckers about 20 m from adult trees in open areas. All suckers were browsed apparently by rabbits but also by cattle. There were no smaller aspen saplings /seedlings.	Yes
21	Birch	Aspen, Scots pine, Juniper, Holly	Yes	One patch of birch regeneration 40-50 cm tall on an area of disturbed ground. Browsing was common on these saplings and could have been by rabbits as well as by cattle. No aspen suckers were found. One browsed juniper seedling of 1 or 2 years old was found. No other regeneration.	Yes
39	Birch		Yes	Regeneration is establishing under the current regime. Birch in particular is regenerating despite being grazed every year by the cattle. Once it reaches 5 feet or so it gets away. They might grow 3-4 inches (after grazing) every year. The cattle don't eat the trees in summer.	No
51	Birch	Rowan, Willow	Yes	There is lots of birch regeneration and some rowan and willow. It is mostly on the heathery banks even quite far from woodland. The trees grew on average about 10 cm since between 2001 and 2002. Scots pine planted on a steep slope are not eaten because it is too steep.	No
64	Birch	Aspen, Willow, Alder, Rowan, Dog rose	Yes	Birch saplings >25 cm and seedlings <25 cm were occasional, evenly spread over the site and browsed lightly. Willow saplings and seedlings were rare and browsed lightly (seedlings browsed more heavily than saplings). There were some willow seedlings 1-2 years old. There were a few alder and rowan saplings >25 cm with no browsing seen. Aspen suckers of all three sizes were common in one corner of the site and were lightly browsed.	Yes
67	Birch	Scots pine, Juniper, Rowan, Ash, Alder, Larch, Willow	Yes	Birch saplings (>25 cm) and seedlings (<25 cm) occasional in boggy areas (2 and 3). Scots pine saplings and seedlings frequent in the same area (3).	Yes
88	Birch	Willow, Ash	?	Not sure if there's any new regeneration happening. There are lots of young birch and willow trees of 1,2,3 and 4 m height (aged 5 - 10 years) which regenerated before the cattle were put in.	No
104	Birch	Oak, Scots pine, Alder, Ash, Juniper, Holly, Blackthorn, Hawthorn	Yes	There is evidence of sporadic phases of successful regeneration, much of which is now tall enough to resist browsing damage. Most regen. is in the heathland patches. The vegetation on the upper part of the site is composed mainly of dry heath, with widespread regenerating young pine and downy birch up to 30 years old and small patches of bracken or grass.	No
105	Scots pine	Birch, Willow, Juniper	Yes	Regeneration of pine and birch is good.	No
107	Scots pine	Birch, Willow, Juniper	Yes	Regeneration of pine and birch is good.	No
121	Sitka spruce	Larch, Scots pine, Corsican pine	Yes	Where cloven hoof has been there has been a range of tree regeneration including Sitka spruce. In the absence of cloven hooved animals only willow, birch, alder and rowan will grow.	No
131	Birch	Juniper, Willow, Rowan, White Beam, Alder, Scots pine	No	Birch regeneration is not going well as the deer browse the birch. The Highlanders though have also been seen browsing the birch. Even the birch regeneration on the steeper parts, where the cattle don't go, is being knocked back so deer are probably having most of the impact. The same applies to the small amounts of juniper, rowan and Scots pine regeneration.	No
132	Birch	Rowan, Scots pine, Aspen, Willow	Yes	Prolific birch regeneration present.	No

139	Willow		Yes	There is some regeneration and the existing willow is increasing in height below cow height.	No
8		Broadleaf mix	No	Numbers of deer apparently preclude any regeneration.	No
133	Sitka spruce	Birch, Rowan, Oak, Holly, Alder, Willow, Hazel	No	Seedlings are present but do not manage to grow	No
134	Birch	Rowan, Oak, Holly, Alder, Willow, Hazel	Yes	Very good but this is of oak seedlings which have had 13 years with no stock or deer grazing so are above browse height. Too soon to know if there are any new seedlings.	No
108	Oak	Birch	?	May be some patches of regen.	No
122	Birch	Alder, Oak	Yes	There is limited regeneration occurring within the woodland	No
59	Scots pine	Birch, Willow, Alder	Yes	In summer they hammered the Molinia, left the heather and browsed the rowan and willow (but not overly). By the end of the summer trial, tiny birch seedlings were coming through in the summer-grazed area but not in the ungrazed area where the Molinia is knee-high.	No
68	Birch	Ash, Alder, Willow, Rowan, Elder, Holly, Norway spruce, Larch	No		Yes
17	Oak	Alder, Birch, Ash		?	No
66	Sitka spruce	Larch, Western hemlock, Pine, Spruce, Alder, Willow, Hawthorn	Yes	Inside the fence sitka spruce saplings (>25 cm) were common and evenly spread over the site. Seedlings (<25 cm) were found on the track and 1-2-year-old seedlings were common but confined to where the heather was shorter. All ages of sitka regeneration were occasionally browsed.	Yes
114	Birch		Yes	Birch and rowan seedlings present but rare.	No
117	Oak	Birch	Yes	Seedlings are prolific (mainly birch). Regeneration coming up nicely.	No
140	Birch		Yes	The birch seedlings are all kept in check by cattle, sheep and deer browsing.	No
89	Birch	Scots Pine, Oak, Hazel, Alder, Rowan, Willow, Larch, Beech, Sitka spruce	Yes	Tree regeneration of both pine and birch is currently happening. On higher ground it is largely clear of trees because it isn't as steep so the cattle go there more. Lots of regeneration on the steep ground. Lots of birch regeneration and frequent Scots pine regeneration from 1-2 years old to > 25 cm tall. Occasional alder, rowan, willow and sitka spruce regeneration. Oak, hazel, and beech regeneration rare. No larch regeneration. Browsing preferences on saplings >25 cm from most to least preferred were: Oak, Scots pine, hazel, willows, birch, alder, rowan, sitka spruce. Browsing preferences on saplings <25 cm from most to least preferred were: hazel, Scots pine, birch, willows, oak, sitka spruce.	Yes
47	Sitka spruce	Lodgepole, Japanese Larch, Silver birch	No	No regeneration noticed.	No
58	Scots pine	Sitka spruce	No	There were a few very small, unbrowsed Scots pine seedlings that were restricted to an old track running adjacent to the neighbouring conifer crop. These seedlings were probably missed by deer. No other regeneration present.	Yes

Table 9.3. Sites in Wales. Blank cells indicate where no information was provided.

ID	Main mature tree species	Other mature tree species	Is tree regeneration occurring?	Regeneration details	Site visit
94	Oak	Birch	No	Some regeneration does appear in the spring, but is soon grazed out. Until two years ago, the heath was grazed with sheep, which allowed extensive regeneration of birch on the fringes of the wet areas, where the sheep don't like to go. This has now been felled, and the coppice re-growth is being eaten by the cattle.	No
3		Broadleaf mix	No	Mixed broadleaves regenerating within tree guards.	No
55	Corsican pine				No
37	Oak	Birch, Ash, Rowan			No
38	Willow				No
76	Oak	Beech, Hornbeam, Ash, Sweet Chestnut, Horse chestnut, Lime, Larch, Spruce, Sycamore, Cherry	No		No
32	Oak	Birch	No		No
16	Willow	Birch, Alder			No



## Appendix 10. Relative browsing preferences for different species of sapling.

Table 10.1 Average number of browsing categories that the tree species in each row was above (more heavily browsed, positive value) or below (less heavily browsed, negative value) the tree species in each column. Values are only given where three or more comparisons were made (Table 10.2).

	Alder	Ash	Beech	Birch	Goat willow	Hawthorn	Hazel	Holly	Oak	Rowan	Scots pine
Alder				-0.40	-0.60		-0.33		-1.00		
Ash				-0.60		1.67	0.00	1.00			
Beech				-0.33					-1.00		
Birch	0.40	0.60	0.33		-0.14	1.00	0.22	0.86	-0.43	0.71	0.00
Goat willow	0.60			0.14			0.75		-0.33		
Hawthorn		-1.67		-1.00			-1.00	-0.40			
Hazel	0.33	0.00		-0.22	-0.75	1.00		0.57	-0.4		
Holly		-1.00		-0.86		0.4	-0.57		-1.25		
Oak	1.00		1.00	0.43	0.33		0.40	1.25			
Rowan				-0.71							
Scots pine				0.00							

Table 10.2 Total number of comparisons of browsing level from all 33 site visits.

	Alder	Ash	Aspen	Blackthorn	Beech	Birch	Dog rose	Goat willow	Hawthorn	Hazel	Holly	Oak	Rowan	Scots pine	Sycamore	Yew
Alder			1		1	5		5	1	3	2	3	2	1		
Ash					1	5			3	3	4	2	1	1	1	1
Aspen	1					2		1					1			
Blackthorn									1			1				
Beech	1	1				3		1		1	1	3	2	1		
Birch	5	5	2		3		1	7	5	9	7	7	6	5	1	1
Dog rose						1							1	1		
Goat willow	5		1		1	7			1	4	2	3	2	1		
Hawthorn	1	3		1		5		1		5	5	2	1			
Hazel	3	3			1	9		4	5		7	5	2	2	1	1
Holly	2	4			1	7		2	5	7		4	2	1	1	1
Oak	3	2		1	3	7		3	2	5	4		2	2	1	1
Rowan	2	1	1		2	6	1	2	1	2	2	2		2		
Scots pine	1	1			1	5	1	1		2	1	2	2		1	1
Sycamore		1				1				1	1	1		1		1
Yew		1				1				1	1	1		1	1	

## Appendix 11. Objectives of grazing with cattle: achievement, or otherwise.

Table 11.1 Sites where objectives were achieved.

ID	Comments
15	Objective: open park woodland. The site is slightly over-grazed but there has been continuity of grazing for hundreds of years, so this is not seen as too significant. There is some poaching near the cattle trough and at pinch points in normal years but this is more extensive in wet years. There is no regeneration except of coppice re-growth in short-term exclosures round coppice of less than 12 years old. There are dog's mercury (80% cover), violets (5% cover) and primroses (5% cover) under the coppice. The pasture contains 250 species including dwarf thistle and bee orchids. There are no bluebells in the coppice. There are fallow, muntjac and rabbits as well.
24	The Trust would like to restore wet heath flora within the site boundaries in contrast with the normal 'New Forest Management' outside the site boundaries. Cattle churn up the ground to mud. Cross-leaved heath and marsh thistles are coming back into poached areas. The stream has been canalized in the past. Bog myrtle, bracken and Molinia came right up to the edge of the stream. The stream has recently been dammed to bring back the meanders and wet areas. The cattle poach the wet areas and marsh plants are re-establishing. Cross-leaved heath is coming back further away from the stream.
47	Reason for having cattle: Diversification for Forest Enterprise and conservation of lapwings and black grouse by grazing off the in-bye. Production for the farmer. The hope is that the cattle will open up the wet flushes in the woodland. July 2002: cattle have been on for three seasons now. They graze mostly in the remaining in-bye and on the 2 m rides but he has seen the calves feeding in the furrows between the trees. They use the trees for shelter from weather and perhaps midges. The cows have about six favourite areas and they graze there most of the time, keeping them short but not poaching them. They now have small birds back and have ducks. Teal now use the bits that periodically flood. The cattle grazed these bits when they are dry in the spring. They also have golden plovers (c. 2 pairs), kestrels, black grouse, hen harrier and buzzards. No lapwings.
51	They are not fed bulk fed so they eat lots of roughage themselves when on the hill and do a good job of keeping the rough vegetation down.
59	Reason for having cattle: To break up the Molinia and stimulate natural regeneration. In summer they hammered the Molinia, left the heather and browsed the rowan and willow (but not overly). By the end of the summer trial, tiny birch seedlings were coming through in the summer-grazed area but not in the ungrazed area where the Molinia is knee-high.
62	Reason for having cattle: to eradicate Michaelmas daisy using various means while trying to conserve the natural flora and encourage the colonization of pepper saxifrage and fleabane. The daisy appears to have been reduced in vigour through grazing and there appears to be some evidence that the trampling rather than grazing has reduced the height/density of the grasses.
63	Reason for having cattle: The hope is that hoofprints will provide suitable regeneration niches for trees. Rowan saplings >25 cm, < 25 cm and 1-2 years old are common in open areas, under larch and in poached areas. There is some browsing on these.
70	The area has been grazed for five years under present management and for the last three the southern pasture has been included. The cattle are fed the species rich hay on this area to try to improve the quality and diversity of the pasture without the use of chemicals and fertilizers. It appears to be working and the manager is very happy with the results. The pasture is very free draining and is used extensively all year round.
77	The cattle keep any dense regeneration down and help to keep the cut /treated bracken under control. There is an old chestnut avenue where birch and oak scrub had come up. This was cleared and the cattle are keeping this down. There is more regeneration, bramble and bracken in the exclosure.
78	It is hoped that the cattle will keep the culm grassland open and their dung will encourage invertebrates. The cattle have improved the culm grassland.
81	Reason to have cattle: to reduce undergrowth, particularly bramble, to enhance natural regeneration. The site received a heavy thinning several years ago in the hope of encouraging increased natural regeneration. Bramble has become very dominant to the exclusion of most other things. The cattle have been allowed access into the wood over the last two winters from an adjoining field with limited success, principally due to cattle not moving throughout the woodland but rather remaining in certain areas. Moderate regeneration is occurring.
84	Reason to have cattle: to keep it more open and diverse and also historic. No regeneration obvious outside of fences. There is inside the fenced-off bits.
85	Reason for having cattle: production and shelter but this seems to be an example of a successful pasture woodland. Wet alder /birch woodland. Contains rowan, oak and beech. It has an open canopy and most of it is mixed scrub and open land. There is always some regeneration. It is more wooded than 30 years ago and it has been grazed in a similar manner all that time. There are 100-150 sheep on all year except at lambing. There is the odd hare but no rabbits. The cattle are not in in summer because of fluke. There are about 60-70 (0.86 - 1.0 /ha) cattle from November to March.
90	Reason to have cattle: to control scrub and graze grasses. The original reason was to keep down the reeds in the lochs. The first lot of cows did this but the second lot did not. It is also desirable that the cattle keep the rough grassland down and prevent any tree regeneration to keep the woodland surrounding the lochs open. There is poaching in a limited area but this is not considered a problem. The lack of any small saplings or seedlings and the lack of any larger saplings except for hawthorn and birch would suggest that regeneration is being prevented. However, there also appears to be no regeneration in the southern part of the reserve, which is not grazed by cattle. This might suggest that deer are responsible for the lack of tree regeneration. In neither part of the reserve did the vegetation seem too dense or the canopy cover too high to preclude natural regeneration. However, the lack of deer dung does not lend weight to this conclusion.
91	Reason to have cattle: to prevent tree regeneration and graze off the rougher grasses. They want to maintain dune heathland and marram grass dunes. To keep the lichen community on the sand dunes open and free from tree and scrub encroachment. The lack of regeneration of anything but birch, and the fact that the birch regeneration was all more than 5 years old, suggests that the browsing pressure is very high but this may be due to the rabbits as much as, or more, than the cattle. The lack of young trees would suggest that, once the larger birch scrub is controlled, the cattle and rabbits will prevent further tree encroachment. The cattle and rabbits are probably also preventing the regeneration of gorse and broom from seed.
94	Reason to have cattle: The woods are on rocky knolls, scattered around a wet heath, which is managed primarily for the rare butterfly, the silver studded blue. This species requires an open habitat with no shade, and with little tall vegetation. The cattle are used to graze the purple moor grass on the wet areas of heath, whilst not damaging the ling on the drier areas. Sheep are

	introduced for short bursts of grazing in winter periodically, to prevent rank growth of ling. Some regeneration does appear in the spring, but is soon grazed out. Until two years ago, the heath was grazed with sheep, which allowed extensive regeneration of birch on the fringes of the wet areas, where the sheep don't like to go. This has now been felled, and the coppice re-growth is being eaten by the cattle.
96	Weekly butterfly transects have demonstrated the importance of open areas for this taxon, with the target species' populations increasing or maintaining.
98	Grazing with cattle to maintain open areas and suppress shrub development under trees. Scuffing of cattle's' feet may activate heather seed bank to assist restoration of heath. Young (25 cm - 1 m tall) birch, oak, yew, Scots pine and hazel trees were common and sycamore, ash and holly occurred occasionally. All young trees of all species were browsed apart from holly, which was only occasionally browsed. The only young trees less than 25 cm tall were of holly. These occurred occasionally and were not browsed.
99	The grazing objectives refer to the grassland, scrub, bracken and butterflies, with little consideration to its impact on woodland. Scrub clearance is done on a long rotation, equivalent to coppicing. Grazing extends the coppice cycle and delays closure of the canopy. It also keeps the grassland areas open. Ash and hazel saplings (25 cm - 1 m) common, and birch saplings occasional, but all browsed. Holly and hawthorn saplings common and only occasionally browsed. No seedlings (< 25 cm) of any species except holly and hawthorn. These were common and occasionally browsed. Holly and hawthorn therefore seem to be the only tree species successfully regenerating.
100	The site had not been grazed for 70-80 years, which had led to a dominance of <i>Sesleria</i> grass. They want to hold back scrub encroachment and diversify the grassland. In 2001 they started to see impacts on the scrub. The Juniper was not touched which is a good thing and the holly is now browsed and sculpted as they wanted. There also appeared to be more violets in the grassland. This may have been because of the cattle grazing but they do not really know.
105	Reason to have cattle: Production although they are good for nature conservation as well. Any damage to trees seems to be more due to the deer or sheep. They do not see the cattle eat young saplings. Cattle will bend down older trees and eat the foliage. They will not touch the willow then will suddenly attack a tree then leave it alone. They only do this to the willow. There is no bark stripping. When the birch is cut they will eat the fine tips and buds. Cattle graze the heather patchily. In some place it is about 8 inches tall because of cattle grazing. There is almost too much birch regen. When cattle make tracks in the heather, blaeberry re-grows and this helps to break up the heather monoculture.
111	Reason to have cattle: production and ground improvement. Encouragement of regeneration is a secondary objective. There is a little oak, birch, goat willow and alder regeneration. Holly regeneration abundant and not heavily browsed.
117	Reason to have cattle: stimulate tree regeneration. Once the soil conditions were deemed good for regeneration, a deer fence was then erected around Black Riggs (except on the lochside) to exclude all of these animals as part of a Livestock Exclusion Annual Premium scheme. Black Riggs has been used as a demonstration site as it was clear that the impact of the cattle on the soil was assisting regeneration, with regeneration very successful following exclusion. Seedlings are prolific on Black Riggs as well, where stock are still excluded.
121	Reason to have cattle: The current owner bought it ultimately to provide shelter in winter for deer, to create opportunities for other wildlife and to reshape it with open areas for deer, birds and stock. Where the cattle graze, the Sitka are bigger because the dung fertilizes them. The cattle also 'brash' the Sitka, creating shelter for all animals as well as allowing light to reach the woodland floor and grasses to grow.
124	Reason to have cattle: to create ground disturbance to promote the Touch Me Not Balsam and Netted Carpet moth. Both are biodiversity action plan species. The Balsam is an annual species and thrives in woods with disturbed ground.
139	The area contains a black grouse lek site. They wanted to know if the black grouse would prefer the grass shorter at the lek site. There has been an increase in the number of birds using the lek site since cattle were introduced.

Table 11.2 Sites where objective were not achieved

ID	Comments
82	Reason to have cattle: to maintain the wood as wood pasture and to encourage regeneration in poached areas. No regeneration was occurring except a few holly under its own canopy despite some poaching being present but there were high numbers of roe deer.
96	Reason to have cattle: control of bracken and bramble. The site is managed primarily for wildlife (High-brown fritillary, Scotch argus); to control the density of the sward, increase herb richness and check scrub development after clearance by hand. The cattle also provide some animal production but not much. The focus is on providing an abundance of violets as food plant for fritillary, and retaining tussocks of <i>Sesleria</i> for the Scotch Argus. The stocking rate is too low to allow for consistent overall suppression of stump regeneration or seedlings, though the level of browse damage, especially on sycamore, appears to be significant. They tried Shetland ponies and Hebridean sheep before deciding that cattle were best. It has been the same regime for the last 4 years.
97	The aim of the cattle grazing is to prevent tree, bramble and other scrub regeneration. The lax grazing regime is not controlling development of scrub, which under organic certification is allowed to regenerate after manual clearance. Where rabbits have been excluded since 1996 and grazing with cattle is restricted to Sept/Oct, the growth of birch seedlings is very vigorous
114	Reason to have cattle: to encourage natural regeneration by breaking up the grass sward. However the grazing pressure does not seem to be high enough to achieve this. There is no regeneration in the experimental areas, which have been fenced to exclude deer and /or rabbits either. This suggests that browsing is not the reason for the lack of regeneration. It is probably either the lack of regeneration niches or the canopy is too dense and there is not enough light.
131	Reason to have cattle: production and birch regeneration. The cattle get access to some of the woodland in winter and this is used for shelter. Cows are also being used to encourage birch regeneration. Unfortunately the birch regeneration is not going well as the deer browse the birch. The Highlanders though have also been seen browsing the birch. The same applies to the small amounts of juniper, rowan and Scots pine regeneration

## Appendix 12. Observations on stock husbandry, cattle behaviour, tree regeneration and cattle impacts on ground vegetation.

Table 12.1 Observations on stock husbandry and cattle behaviour

ID	Observation
11	Horses get sick if they eat acorns. In June cattle get redwater fever from ticks so are taken off then.
13	There are no stock fences separating the grazed area from the ungrazed part. A herdsman is employed to encourage the cattle to stay in the 310 ha area. So far this seems to have worked with the cattle becoming hefted to the area.
28	Might have to take ponies off in heavy mast seasons to avoid acorn poisoning. Sheep are far too likely to get caught up on thorny scrub or holly thickets.
51	The good ground is rested in September/November while the cattle are on the hill to use the hill vegetation while it is still quite nutritious. There is still some growth on the good grassland during this time so they go back on it again in November. This saves on feeding costs since the cattle are fed concentrates while they are on the hill. They aren't fed bulk feed so they eat lots of roughage themselves when on the hill and do a good job of keeping the rough vegetation down. They are fed mostly in the woodlands for shelter but the feeding sites are moved around. The cattle move about 1 km from the feeding sites and spend only about an hour at the feed each day. The cattle are free ranging but are kept in the woodlands by the feeding. They are fed in groups of about 30. This is a new system that has only been in operation since 1998.
56	Records of cattle movements found that they moved 650 yards between days and 2-3 miles each day. The cattle distribute themselves evenly over the hill when there are enough of them.
63	Economics have forced people to overstock. Cattle kept outside are healthier. He reckons there are too many 'bad' i.e. dairy crosses, on the go.
65	There are hoof prints and dung throughout the site. Cattle seen roaming throughout the site (0.42 cattle /ha on 240 ha) on the day of the visit
67	The cattle are on the hill in November and December. They used to be on all winter but they calve in January and the calves have to be tagged and that can't be done on the hill.
69	Some of the cattle do not like dogs so are not any use in areas where dogs are walked.
70	Mix of Galloway, Angus, Sussex, Shorthorn etc. They do not want big animals because they want them to be easy to handle. They see them every day and they aren't difficult to deal with.
77	The freely drained, sandy soil means that the grass tends to dry out in the summer so cattle can't be kept on all the time.
85	Wet alder /birch woodland. The cattle are not in in summer because of fluke.
94	The cattle used here have to be born into a 'red water' area to be resistant to this otherwise fatal condition (which he thinks is carried by ticks).
96	The system relies on native breeds to store over winter and undergo compensatory growth on better land in summer. Significant amounts of yew are browsed every year by each new cohort of animals when they first encounter this species. There have been no confirmed losses from poisoning to date. They appear to develop tolerance very easily. There is no feeding of forage, only small amounts of concentrates at movable locations, sometimes amongst trees. They target areas with dense bracken and bramble.
108	The cattle have access to the wood all summer but do not use it probably because there is a lot of bracken. The cattle go in when the bracken dies down. Some of the woodlands are on steep ground so the cattle do not go there.
110	If there is a good oak mast year the cattle are taken out in the autumn so they don't get poisoned by the acorns.
118	Young cattle and sheep get acorn poisoning if they are in the woodland in autumn. He is worried that if the animals are let in after 10 - 15 years there will be a big tick problem. You need to use a native breed of cow - Highland or Galloway.
138	His opinion is the Highlands have their legs too far apart and their fringes are too long (so they can't see!) so they aren't any good at going along the sort of narrow paths that they have. They use the Simmental breed also because they can produce a more marketable calf. The calves are taken off their mothers very young so that the cows have less of a nutritional demand and can survive on the hill. He reckons that taking the calf off early means that the cows have no problem surviving the winter on the hill.
143	We now use electric fencing to prevent the cattle straying onto the nearby roads. The electric fencing is put round the open heath and into the denser wood pasture where possible so that the cows are encouraged to shelter under the pollards and to dung there, taking some of the nutrients off the open heath.

Table 12.2 Observations on tree regeneration

Site	Observation
12	Birch, Beech and Oak regeneration is confined to the shelter of Bracken, Bramble, Holly and fallen dead wood. Exotic conifers, mainly Scots Pine and Western Hemlock are virtually unaffected by the grazing levels.
29	Only get alder, willow and birch regenerating if have cattle and deer browsing but few seedlings are recruited as saplings. Birch regeneration is particularly abundant on the edge of mires and within Molinia areas. No oak, ash or hazel will regenerate with grazing present. Don't know if this is the effect of the cattle or the deer (or something else e.g. lack of light). With no cattle, lots of oak and hazel regeneration is starting but is being browsed off by deer. For the woodland grant scheme will have to do intensive roe deer control. Cattle have enriched some areas leading to a very productive sward. (But note that DH reckoned that lime and slag had been added in the past). Oak and ash might get through on these areas (competitive spp.) but not hazel, alder, willow or birch. Oak and hazel regeneration is now frequent in drier W11 areas.
30	From field visit: Almost complete absence of oak regeneration. However very different in one hillock zone where numerous oak saplings were getting away within protective cover of hawthorn scrub indicating the effect of browsing is severe elsewhere on site.
50	From field visit: Hawthorn saplings /seedlings were often found growing in bracken patches. Browsing was noticeably less on hawthorn than on the other tree species, even when not 'protected' by bracken.
56	There is now some rowan regeneration, which didn't happen when the site was sheep grazed. The cattle eat the birch regeneration, which is why there is only rowan regeneration.
65	Lower branches of mature pines also browsed, even where rowan is regenerating relatively unscathed. This is probably because the pines are grazed by stock in winter when the rowan has no leaves.
70	Hawthorn seedlings < 25 cm tall are common and localized in bracken patches
89	Just using stocking rates will not be sufficient to predict whether regeneration will happen or not since the grazing pressure isn't distributed evenly. They will concentrate on the flatter areas with better pasture e.g. the cattle here use the open area at the top a lot because it's flatter. From site visit: Hazel is the most conspicuously cattle grazed tree
91	The cattle do not eat the saplings when they get older but they do eat the seedlings and young trees.
105	Any damage to trees seems to be more due to the deer or sheep. They do not see the cattle eat young saplings. Cattle will bend down older trees and eat the foliage. They won't touch the willow then will suddenly attack a tree then leave it alone. They only do this to the willow. There is no bark stripping. When the birch is cut they will eat the fine tips and buds. There is almost too much birch regeneration.
121	Where cloven hoof has been there has been a range of tree regeneration including Sitka spruce. In the absence of cloven hooved animals only willow, birch, alder and rowan will grow. Where the cattle have been grazing the trees are bigger because the dung fertilizes them.
142	Even at high deer densities trees will eventually get away but it might take 10 or more years, even with competition with <i>Calamagrostis</i> . However, they do not want any more tree regeneration so they are happy to have high deer numbers. When a fence is put up it doesn't last long because badgers dig under it then muntjac can get in. If it holds then brambles build up and take over then die back in the centre of clumps. Trees can then regenerate in these patches of dead bramble. Where the conifers are clear-felled, the <i>Calamagrostis</i> takes over.

Table 11.3 Observations on vegetation impacts

Site	Observation
20	Sheep were fenced out in 2000. This resulted in blaeberry appearing. Before it looked like just moss
29	As soon as cattle went, bracken increased in dominance. Where the bracken has been sprayed it has changed to nettles.
50	Within the enclosure brambles are dense and waist high in places. Blaeberry 40 cm in, 15 cm out.
56	Cattle graze largely on the Nardus. The alternative is heather. When a burn went across the march with the neighbouring estate, there was good heather regeneration on the cattle side but not on the sheep side. The area used to have 150 - 200 sheep. 9 - 10 ha per cow on heather moorland is about right.
65	Vaccinium is browsed.
105	Cattle graze the heather patchily. In some places it is about 8 inches tall because of cattle grazing. When cattle make tracks in the heather, blaeberry regrows and this helps to break up the heather monoculture.
121	The cattle 'brash' the trees, creating shelter for all animals as well as allowing light to reach the woodland floor and grasses to grow. The deer have cleared 'knolls' and open areas which has made them visually attractive and wildlife friendly. Sheep have been used in the smaller areas of plantation to allow heather to regenerate