

Guidance Note on the Production of Grazing Plans for Controlled Livestock Grazing in Woodlands

1. Introduction

Over the last fifteen years there has been increasing interest in the use of stock grazing to encourage natural regeneration and to enhance the biodiversity of native woodlands. In Spring 2005, Forestry Commission Scotland launched the pilot Stewardship Grant S9 for Controlled Livestock Grazing in Woodlands to promote the sustainable management of farm woodlands. This scheme will operate through the Scottish Forestry Grant Scheme (SFGS).

This guidance note and the subsequent Woodland Grazing Toolkit have been developed in order to assist successful applicants of the S9 Pilot to write Grazing Plans for their sites. The anticipation is that the S9 Stewardship Grant will be made more widely available through the introduction of the Land Management Contract (LMC) Tier 3 scheme in 2007. Following its use during the Pilot stage, the first draft of the toolkit will be amended over the coming years in order to further refine it as a management tool for wider use.

1.1. S9 Stewardship Grant for Controlled Livestock Grazing in Woodlands

This note provides guidance on the preparation of Grazing Plans for ancient and semi-natural woodlands. Biodiversity, Recreation and Deer Management Plans are already incorporated into SFGS and recognised as a means of delivering objectives in relation to these areas. A Grazing Plan is now seen as an additional management tool in delivering conservation objectives. The pilot S9 Stewardship Grant for Controlled Livestock Grazing in Woodlands aims to “enhance biodiversity and...maintain archaeological & historic sites as visible/accessible areas in wooded ecosystems by the use of planned and controlled grazing by domestic livestock”.

Eligibility criteria for acceptance of sites under the S9 grant state that:

“Grazing regimes will only be agreed where specific biodiversity management objectives are met which improve the ecological condition of the woodland.”

1. 2. Aim of the Woodland Grazing Plan Toolkit

The Woodland Grazing Plan Toolkit has been developed in order to give guidance to those who will be drawing up and writing Grazing Plans for owners and land managers. It is intended that it should accompany and complement existing FC guidance on the drawing up of management plans for semi-natural native woodlands.

The aim of the toolkit will be to:

- Give guidance on how to develop appropriate Grazing Plans primarily in order to achieve one or more of the following objectives:
 1. To benefit biodiversity generally by;
 - Maintaining open habitats
 - Reducing over dominant or invasive plant species
 - Maintaining woodland plant communities

This may or may not include reducing undesirable tree/shrub regeneration
 2. To benefit individual species or groups
 3. To encourage tree and tall shrub regeneration through expansion of both woodland and montane scrub
- Suggest standardised monitoring techniques suitable for a range of site objectives.
- Develop monitoring protocols that can be carried out by farmers/land managers.

The Woodland Grazing Plan Toolkit is intended to be used by anyone writing a grazing plan for such woodlands, however, it is assumed that users will have some understanding of the impacts of grazing on vegetation, a knowledge of plant communities and experience of management planning. **Owners and managers of these sites are strongly recommended to seek expert assistance in drawing up the main Management Plan and the various appendices, including the Grazing Plan.**

2. Why Graze Woodlands?

“Grazing and browsing by large herbivores are natural features of woodland ecosystems and grazing management should be considered from the outset, in management of semi-natural and native woods” (Rodwell & Patterson, 1994).

Ancient and semi-natural native woodlands provide a range of habitats supporting a rich diversity of flora and fauna, many of which depend on the continual existence of these habitats for their survival. The ecological character of these woodlands owes much to their historical management and this includes grazing by domestic livestock. Past woodland grazing regimes featured cattle and sheep in particular, but also pigs, goats and ponies.

Changes within forestry and agriculture since the latter half of the 19th century have led to the decline of ‘managed’ domestic stock grazing in woodlands. Much farm woodland is currently unfenced and is therefore completely open to grazing by both domestic and wild herbivores. In general, high grazing pressures have led to over-browsing and limited natural regeneration causing a reduction in the structural diversity of woodlands and leading to a very open woodland structure.

Whilst poor natural regeneration rates may be attributed to overgrazing by domestic livestock and wild herbivores, at sites where stock and wild herbivores have been excluded completely the more aggressive plant species can become dominant, shading out smaller and less competitive herbaceous species, as well as seedlings of some tree species. Where a 'mat' of ground vegetation develops, seeds may be prevented from reaching the ground, or from establishing once they have germinated.

To maintain the characteristics of ancient or semi-natural woodlands, their distinctive bird communities and the abundance of bryophytes, some grazing is often desirable. Experience has shown that, in a wide variety of habitats, domestic herbivores can help to achieve nature conservation aims. They maintain diversity in the structure and composition of plant communities within native woodland, which in turn promotes diversity in dependent invertebrate and vertebrate communities. Differences in the resulting structure and species diversity are due to variation in feeding preferences (influenced by plant species composition and grazing pressure), feeding and dunging behaviour, and trampling..

Table 1 describes differences in feeding behaviour and preferences and the resultant effects in the habitats. The hooves of domestic stock, in particular cattle and ponies can cause trampling of the vegetation and the soil surface (poaching). Trampling may be particularly important in limiting or reducing the spread of invasive species such as bracken, and in knocking down tall vegetation and creating pathways that may be used by other mammal and bird species. Trampling can also break up thick turfs and mats of vegetation, helping to create niches for seedling establishment. Figure 1 illustrates that low to moderate grazing is likely to produce woods of the highest conservation interest.

TABLE 1: Method of feeding, dietary preferences and habitat effects of domestic stock species (source Mayle, 1999 & Stuart & Eno, 1998)

Species	Feeding Method	Selectivity	Min sward height grazed	Diet preference Major/minor species	Seasonal variation
Cattle	Bulk grazer i.e. require large amounts of roughage Tear-off long vegetation by wrapping tongue around and pulling. Grasp short vegetation between lower incisors and horny upper pad. Ruminants feeding for 60% of the day	Low	> 6 cm	High quality grasses, bent/fescue <i>Low quality communities: bog-rush fen, mat grass/ purple moor-grass, heather</i> More likely to eat rough vegetation such as mat-grass and purple moor than are sheep	Low Broadleaves bark stripped when forage availability low (winter), or in response to mineral deficiency (summer).
Horses & ponies	Bulk grazer Nip herbage close to ground with upper and lower incisors. Non-ruminant. Feeds for 75-88% of the day	High	2 cm	Bent fescue grasses <i>Purple moor grass, heather, gorse and holly. Sedges/rushes and ferns.</i> Generally prefer vegetation with a high digestibility, even if the sward is very short. Native breeds take more coarse grass.	High Bent/fescue grasses preferred. Purple moor grass, sedges, rushes and ferns taken late spring and summer. Bark stripped when forage low.
Sheep	Selective grazer i.e. generally grazers rather than browsers Nip herbage close to ground. Vegetation grasped between lower incisor and horny upper pad.	Very high Native and hardy breeds less selective.	3 cm	High quality grasses and forbs <i>Heather and coarse grasses.</i>	High Ash, holly, oak and birch browsed in summer. Fir, spruce, yew, juniper and bramble in winter. Bark stripped in severe winters.
Goats	Selective browsers	High	> 6cm	High quality grasses, sedges, rushes and dwarf shrubs <i>Mat grass, rushes, bracken, bog myrtle.</i>	High Grasses, sedges and rushes in summer, dwarf shrubs, gorse and browse in winter. Norway and Sitka spruce browsed in winter. Winter stripping of smooth barked broadleaf species (40-35 cm girth) and conifers (5-15 cm girth)
Pigs	Omnivorous Take invertebrates, tuber, fungi, fruits, seeds, grasses and carrion, much of which is obtained by rooting in the leaf litter.	Low	n/a	Anything tasty	Low Fruits and seeds (particularly acorns) taken in autumn.

Trees & shrubs	No regeneration due to competition from dense ground vegetation	Creation of regeneration niches	Loss of seedlings Damage to saplings	Loss of saplings Sever tree browsing	Barking of mature trees Loss of shrub layer	Creation of parkland or moorland
Higher plants	Reduced diversity dominated by a few vigorous species	Reduction in vigorous species Increase in diversity	Reduction in vegetation structure. Increase in grazing tolerant species	Loss of plant diversity, particularly of grazing sensitive species	Loss of cover and damage due to trampling Bare ground	Impoverishment due to net loss of nutrients from the system
Lower plants	Reduced cover and diversity due to competition from higher plants	Increase in cover of ground dwelling species as competition from higher plants reduced		Damage to ground dwelling species due to trampling	Reduction of drought sensitive bryophytes	Increase in epiphytic lichens associated with parkland
Small mammals	High small mammal populations, a few species predominate	Increase in diversity as structural diversity increases	Reduction in small mammal populations as ground vegetation structure simplified		Reductions of populations through competition for food	Loss of diversity and abundance Species of open ground predominate
Birds	Favouring birds of dense shrub layers	Increase in diversity as structural diversity increases	Increase in species favouring low shrub cover	Loss of ground nesting birds due to poor concealment	Loss of species dependent on berry-bearing shrubs	Reduction in raptors dependent on small mammals
Invertebrates	High populations of phytophilous species	Increase in diversity as sward structure diversified	Increase in dung utilising species	Decline in woodland species		Increase in parkland/ moorland species.

NO GRAZING

Increase in grazing intensity 

HIGH GRAZING INTENSITY

FIGURE 1: The impact of increased grazing intensity on the flora and fauna of woodland (shaded boxes indicate areas of highest nature conservation value) (Mitchell & Kirby, 1990)

3. Planning for Woodland Grazing

3.1 Writing a Management Plan

A pre-requisite to any grazing plan would be a Management Plan for the whole woodland area as set out in FCS guidance note 12: Management Plans for Semi-natural woodlands. The principles behind successful planning are that it should provide a vision for the future and allow for adaptation as circumstances change. If controlled livestock grazing is identified as a way of achieving certain management objectives for a wood, then a grazing plan can be written either as part of the management plan or as a separate plan to be added as an appendix. If the grazing plan is written separately it is important that it is integrated with the management plan and with any other additional plans such as recreation and deer management. The grazing plan would then be one of a number of appendices to the Management Plan. Management planning and grazing plans should involve the land manager/farmer/crofter at all stages.

When setting the area to be covered by the management plan (and subsequent grazing plan), it is important to include all open areas within the woodland and beyond the woodland edge, all of which will be within the total grazing unit. The open areas within the woodland are often the most important ecologically. Equally significant are the open areas out with the woodland, which may be important in terms of managing grazing within the wood i.e. to maintain a viable, sustainable grazing unit.

Management Planning can be divided in to two phases:

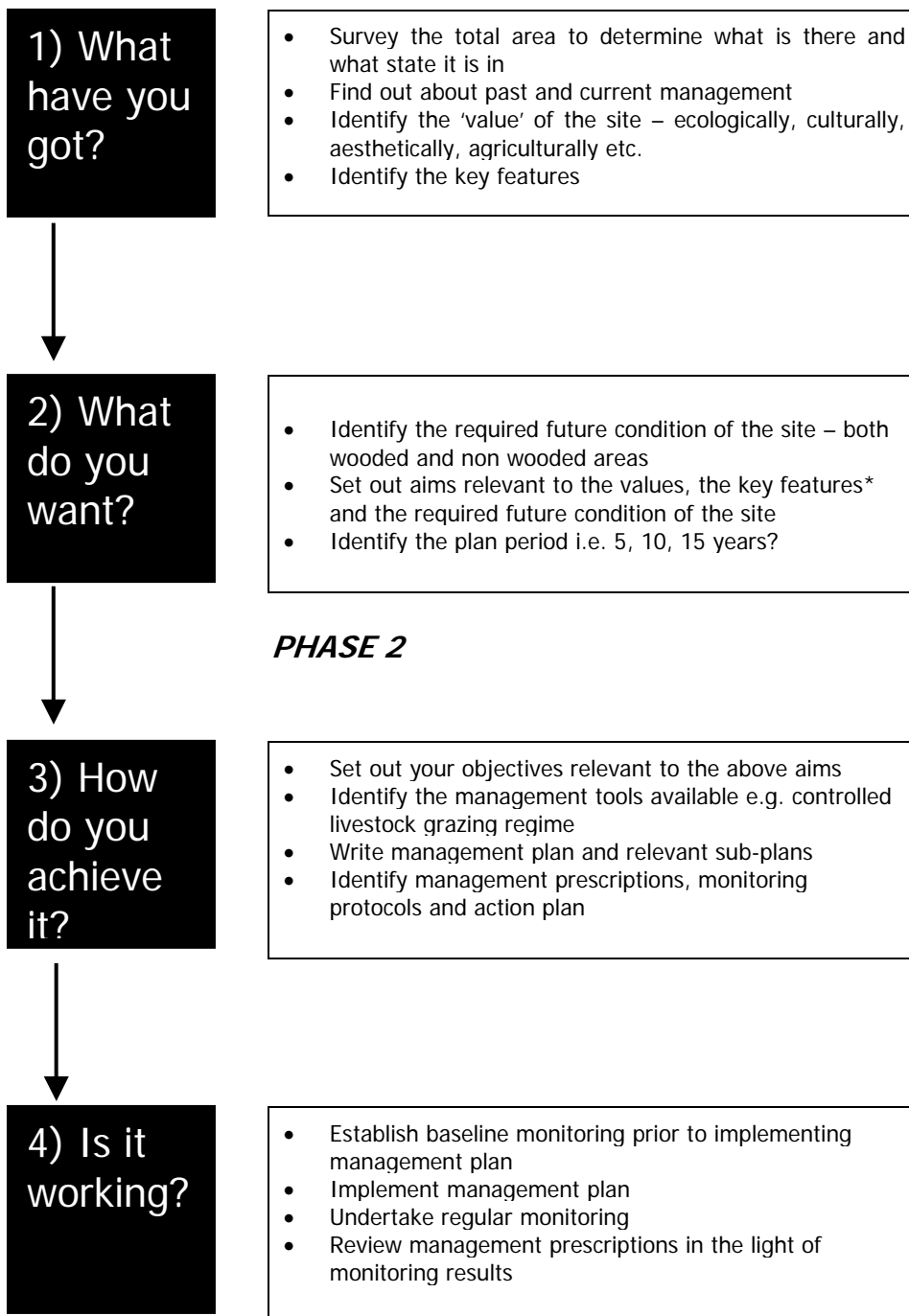
Phase 1 – background. This involves the collection of baseline information, which is vital for subsequent planning and monitoring. This is a process of taking time to record what is in and around the woodland and to establish past and present management. The availability of comprehensive survey data informs the process of identifying the key features for the site and deciding on the long-term aims for your woodland.

Phase 2 – action. This part of the process is where you decide what you want to do to manage the site i.e. set your objectives, and how you are going to achieve those objectives i.e. what are the required management prescriptions. All this information should be compiled in the format of a written management plan. Once you have written your management plan and decided what action is required you can set out the relevant information in a work plan. This will give you an 'at a glance look' of all that needs to be done to achieve your aims and objectives. To be sure that you are achieving your objectives it will be necessary to set up monitoring procedures prior to implementing the management plan. Results from the monitoring will indicate how successful or unsuccessful the actions have been.

It is not necessary to have all the information immediately available. Management planning is an interactive process and can usually carry on developing as you gather information. You can decide that the collection of some information will become part of the plan. This will particularly be the case in the writing of grazing plans, as much is still unknown.

Principles of Woodland Management Planning

PHASE 1



* Key features are those that are regarded as being the most important conservation features of the site in the context of the plan

A Management Plan should include the following detailed information:

- An introduction to the wood
- Description of the wood in its present state – including survey information on tree species composition, distribution, canopy cover, presence of natural regeneration, woodland ground flora and fauna, non-native and invasive species and accompanied by a baseline habitat map
- A description of the ecological history & past land-use
- A description of the present land-use & management – including the contribution of management to the current pattern of vegetation
- Overall long-term aim for the site
- Desired future condition of the woodland
- Overall management objectives – both primary and secondary
- Detail any constraints and/or obligations relating to the site and identify the resources available to carry out the management of the site
- Specify the required prescriptions necessary to fulfil the objectives
- Outline monitoring procedures – including the gathering of baseline data followed by subsequent monitoring techniques
- Make provision for a review of the plan – setting the date and stating those parties involved in the review
- Draw up a work plan – in which the prescriptions should be set out in a timetable covering the plan period, providing an "at a glance" table of the tasks committed to
- Include any appendices covering additional information – such as a grazing plan, deer management plan, recreation plan etc.

3.2 Writing a Grazing Plan

The Management Plan will have identified objectives in addition to those that can be delivered by controlled livestock grazing, e.g. in relation to legal obligations, recreation, etc. **The grazing plan will only deal with those objectives that can be delivered with controlled livestock grazing. These objectives should be extracted from the Management Plan and referred to within the Grazing Plan.**

Grazing can have both positive and negative impacts on features of conservation interest, but grazing can be used as a tool in order to meet specific conservation objectives. Grazing is manipulated via the management of domestic livestock and wild herbivores and a grazing plan would describe the process for determining the most appropriate management i.e. detailing the required **grazing regime**.

Processes of vegetation change are extremely complex, as are the effects of grazing on vegetation. There is no simple formula for grazing regimes for conservation of woodland. Any grazing regime will depend on the specific objectives of the site and will recognise that each management unit is unique (Kennedy, 1999). The availability of different types of forage will vary across every site and throughout the year and this variation influences livestock foraging behaviour. Even when planned to fulfil similar objectives, **grazing management regimes require to be site-specific in their detail as well as flexible and responsive in practice** (Rodwell & Patterson, 1994; Stewart & Eno, 1998; Kennedy, 1999).

Where domestic animals are used any plan must be practicable and achievable within an agricultural calendar and must satisfy demands of animal husbandry and welfare.

As described above the Management Plan will set the scene in terms of giving a description of the wood and providing background information. Any additional information not covered in the Management Plan, but specifically relevant to the grazing plan, can be included as an introduction to the grazing plan, which should be set out as follows:

Structure of the Grazing Plan

PART 1: Introduction & Description – the following includes information in addition to that detailed in the overall Management Plan, but which is specifically relevant to grazing of your particular site

- Introduction to the concept of controlled livestock grazing in woodlands
- Additional general information
- Biological Information
- Present Landuse and Management

PART 2: Objectives & management

- Identifying, selecting and evaluating the key features* of the site
- Setting out the relevant objectives
- Identifying the current condition and the impacts of grazing
- Identifying the factors affecting the management of key features (constraints & opportunities)
- Outlining the rationale and recommendations for grazing management – setting a grazing regime
- Identifying monitoring procedures
- Detailing the prescriptions relevant to the setting of a grazing regime

* Key features are those that are regarded as being the most important conservation features of the site in the context of the plan, and at which grazing management is aimed.

The approach described above should meet the requirements of most sites where controlled livestock grazing in woodlands is being proposed. It is intended solely as a guide to planning. Use should be made of those areas that are relevant to the site. Omit anything that is irrelevant and include additional sections where required. Plans should, whenever possible, be prepared for an entire site. However, for very large and complicated sites it may be necessary to divide the site into recognisable management units. These units may be based, for example, on tenure, site status, habitat distribution or recreational use.

3.3 Setting Objectives

There are a wide variety of potential site-specific objectives relating to grazing in woodlands, ranging from reducing the density of birch regeneration to allowing previously over-grazed woodlands to regenerate, and from reducing the dominance of competitive sward species to increasing the population size of a rare butterfly species (Smith, 2004). Additional non-woodland objectives may equally be valid such as integrating farming and woodland management, maintaining and maximising agricultural activity on the holding, increasing opportunities for local employment and providing much needed shelter.

Setting the objectives for woodland grazing at a site is critical to success. The land manager, farmer, crofter should be involved in deciding the objectives, along with any specialists interested in the biodiversity of the site. Table 2 outlines a range of objectives for sites where management is not directed at increasing populations of a specific species, but at managing

habitat structure. This table is not meant to be exhaustive; other management options may well be valid. Species-specific management (pearl bordered fritillary etc) requires specialist input to management plans and monitoring schemes.

TABLE 2: Possible Site Objectives, Management Scenarios and Monitoring Requirements.

Objective	Management scenarios	Monitor	Estimated LU days per ha*
Maintain wood pasture	<i>Continue grazing, plant trees and protect from grazing</i>	<i>Ground flora diversity, growth of protected trees</i>	<i>focus is sward; need estimate of site production</i>
Increase woodland cover, no intention to manage as grazed woodland in medium-term.	<i>'Mob-stocking' with cattle or pigs to create regeneration niches, followed by period of no grazing.</i>	<i>Trampling impact, seedling numbers</i>	<i>100 – 200 (many animals, short period)</i>
Increase woodland cover whilst still maintaining some open ground, including some patches of short sward.	a: Seedlings in short supply: create more regeneration niches through trampling (consider careful timing of trampling to coincide with seed-rain).	Trampling impact, seedling presence, browsing on seedlings, presence of areas of short sward, area of open ground.	10 – 60
	b: Seedlings present but browsed: reduce grazing pressure to allow seedlings to become saplings (grow above height of sward)	Seedling & sapling presence and browsing impact, presence of areas of short sward, area of open ground.	10 – 60
	c: Saplings present but browsed: reduce grazing pressure to allow 'get-away'.	Sapling browsing impact, presence of areas of short sward. Farmers could use forage availability to fine-tune stocking. Area of open ground.	25 – 60
Maintain dynamic mosaic of open ground (including some short sward) and woodland, keeping total area of each roughly constant in long term.	a: If canopy contains plenty of young trees, maintain grazing pressure as is until further regeneration desired.	Area of open ground, Amount of regen coming through. Presence of patches of short sward	40 – 80
	b: If young trees not frequent enough, see above.		
	c: If young trees too frequent, see below.		
Increase area of open ground, whilst still maintaining some woodland cover.	a: Fell some trees; some of the dead wood to be left on-site. Consider ring-barking or chemical thinning to create standing dead wood. Increase grazing pressure to reduce seedling/sapling vigour. If aim is to reduce broad-leaved species, summer grazing may be more effective. Avoid trampling in late-summer/autumn.	Area of open ground, browsing impact on seedlings & saplings, presence of patches of short sward.	80 – 200
Maintain archaeological/historic sites as open areas within wooded landscape.	a: See above, consider using sheep rather than cattle as possibly less damage to archaeology. Seek specialist advice.	Open ground, impact of herbivores on archaeology (specialist required)	?
Species-specific objective(s).	Specialist required to determine appropriate management.	Specialist monitoring required	?

4 Guiding Principles of Woodland Grazing Plans

The argument behind planning to maintain some degree of grazing by livestock in ancient and semi-natural woodlands is that their activities can be used to promote woodland regeneration, result in more natural plant communities and age-class structure of the tree and shrub component and enhance overall biodiversity, than would be the case if all livestock were excluded from the woodlands.

Management planning for grazed woodlands is complex. As the interaction between the animals' nutritional requirements and sward forage quantity and quality appears to determine browsing levels on saplings, any management should be carried out with an understanding of these factors (Pollock *et al.*, 2005). Biomass production by the sward and the nutritional requirements of the stock must be balanced in order to meet the site objectives.

To be of any practical use a grazing plan has to be achievable in relation to the management of domestic livestock and comply with animal husbandry requirements and practicalities. In addition a grazing plan has to take in to account the individual nature of a site and the present resources available – in domestic stock as well as in human terms. It is important that both stockmen and land managers are consulted on all aspects and in drawing up the grazing plans (Kennedy, 1999).

There will be practical issues relating to animal management and welfare that will need to be addressed. The numbers of stock used, the season of grazing and the length of time stock are grazed within the woodland should be suggested in the grazing plan, with the farmer given freedom to alter management in order to best achieve site objectives (Waterhouse *et al.* 1999).

Where tree regeneration is the management objective, it should be remembered that almost any level of livestock grazing will result in some browsing. Even in sites where alternative sward forage is plentiful, there may be localised heavy browsing on seedlings or saplings. As long as there is sufficient successful regeneration that is being only lightly browsed, woodland canopy cover can be maintained.

Proposals within the grazing plan should be as simple and as flexible as possible, these can then be updated in response to husbandry practicalities, and monitoring results.

4.1 Effects of Grazing

Grazing animals constantly influence vegetation, directly (by browsing and eating it) and indirectly (trampling, poaching and nutrient redistribution through urine and dung deposition). These effects will occur both at the time of grazing and increasingly over time.

The overall impact on vegetation of grazing animals on a site will depend on:

- the grazing species involved (and their particular foraging behaviour, diet selection and intake);
- the number of animals;
- the length and frequency of grazing periods;
- the time of year;
- the relative palatability and digestibility of different plant species;
- the susceptibility and response to grazing of different plant species; and

- the relative availability and distribution patterns of different species and communities in the vegetation mosaic at the time.

Natural Regeneration

In managing grazing animals for natural regeneration, both grazing pressure (i.e. stocking density and length of grazing period) and the season of any grazing period should ideally be targeted to:

- enhance seedbed conditions for the current year's seedfall, and
- maintain an element of control over damage to established seedlings and older saplings.

A balance will need to be struck between the potential advantages of enhanced germination and decreased competition (thus increased early survival), and the potential detrimental effects of browsing damage to saplings. When a sufficient proportion of regenerated seedlings can survive beyond damage by the grazers the grazing regime can be said to have achieved the objectives (Mitchell & Kirby, 1994).

Biodiversity

In many types of woodland grazing is necessary to maintain particular plant communities and the biodiversity interest of the site. Controlled grazing can sustain many important lichens and bryophytes for which Scottish semi-natural woodlands are internationally important. Whilst domestic stock can be used to enhance ground conditions to enable successful natural regeneration of trees and shrubs, they can also be used to maintain open space within woodlands, an important habitat for a range of flora and fauna.

Low intensity grazing and browsing is a natural feature of woodlands that helps to maintain diversity in composition and structure. The more structurally diverse a woodland in terms of tree density, age and growth form, the more niches are available and suitable for the large number of species associated with woodlands. High structural diversity, therefore, also promotes high biological diversity. The open tree-less areas, areas of low tree density and woodland edge habitats are essential in order to maximise the biodiversity potential of these woodlands.

Again a balance needs to be struck between allowing some regeneration of saplings as well as shrubs, dwarf shrubs (such as bilberry and heather) and other woody and tufted species (such as bramble, honeysuckle, wood rush etc) and the need to maintain some open areas and the integrity of the plant communities.

4.2 How to Control the Effects of Grazing

Because of the complex interrelationships between all the variables, if grazing management is to be used effectively to influence habitat succession, or in the enhancement of particular species, it is important to have as much influence as possible over the most significant controllable elements (Kennedy, 1999).

The most significant controllable features are:

- The Type(s) of grazing animals to be used
- Grazing pressure (number of animals and length of time they graze at any site)
- Timing or season of grazing period

It is important to remember that because every site is different, in practice, an assessment of the effects of a grazing regime is probably more important than manipulation of stock numbers (alone). The requirement for gathering baseline data, before commencing a grazing regime, along with monitoring and the ability to respond appropriately to monitoring observations is essential. No grazing regime should be adhered to rigidly if planned grazing periods, for example, appear to be too long for their stated purposes and damage (with respect to objectives) is seen to be occurring. In that event a grazing period should be curtailed earlier than planned. It is important, therefore, that there should be flexibility within the farming system to allow the removal of the stock to another site. Vice-versa, if actual results indicate that the affects of grazing are insufficient, in terms of meeting objectives at the end of the planned period, then grazing should be suitably extended.

Plans should also take account of the changing nature of habitats as a grazing programme continues, and be able to adapt accordingly. For example, where woodland begins to regenerate successfully under reduced grazing pressures, overall available biomass will increase from year to year as perennials, such as wood rushes and dwarf shrubs (e.g. bilberry) grow taller and bulk-up (Kirby et al, 1994). Thus objectives will need to be reviewed and lengths of grazing periods and/or the number of grazing animals (i.e. grazing pressure) adjusted accordingly.

4.3 Choices for a Grazing Regime

Taking in to account what is known about the site itself the task is to make decisions on the controllable features i.e. type of grazing animal, grazing pressure and timing/season. This will be done using your best understanding of how each choice is likely to affect progress towards achieving the objectives for the site.

The final choices will inevitably involve some sort of compromise, as no single regime will benefit all species at a site. There are bound to be certain conflicts between 'ideal' grazing species, numbers, lengths or timings of grazing periods for different individual objectives. The aim will not be to seek an 'ideal' regime for any one particular objective, especially where that is likely to unduly compromise another, but rather to seek a regime that is likely to progress all objectives positively to some acceptable degree. Such a regime is, therefore, likely to be less than perfect for any one objective, but on balance, potentially beneficial to them all. The only proviso is always that such a regime must be practical and achievable (Kennedy, 1999). The key to successful management will be the ability to link the target utilisation of biomass for the site to the daily intake rates of the livestock and stock the wood accordingly (Mitchell & Kirby, 1990).

4.3.1 Type of Grazing Animal

Tables 1 and 2 give details of the methods of feeding, dietary preferences and habitat effects of various domestic stock species (source Mayle, 1999 and Armstrong et al, 2003). This information, along with knowledge of the site and practical constrains, e.g. availability of stock and labour, handling facilities etc., will help you to decide what stock to use in order to achieve your objectives.

4.3.2 Grazing Pressure

Since grazing pressure is a combination of stock number and length of grazing period, within certain (imprecise) limits, stock numbers could in theory be at any level as long as grazing periods can be adjusted accordingly to produce the desired impacts and outcomes. There are a wide variety of options for management; low densities of livestock grazing for several months will consume similar amounts of biomass to a high density of livestock grazing for a short time. The outcomes of these two scenarios, however, in terms of the impact on the sward could be

considerably different. The objectives for the site and practical issues such as the number and type of livestock available will determine which option is most attractive.

It is perfectly reasonable to control or manipulate grazing pressures, preferably within any one season, by adjusting either the grazing period or the number of animals – essentially in proportion – to produce equivalent types of impact (and generally it should not matter which is adjusted). However, that process cannot reasonably be extrapolated towards either extreme without significantly altering the impacts, in increasingly indeterminate ways (Kennedy, 1999). In practice it is generally more straightforward for a grazier to manipulate the length of time of any grazing period than to vary the numbers of stock involved – both of which need to be accommodated pragmatically within the farming calendar.

When setting appropriate grazing regimes it must be remembered that not all of the site will be available for grazing. Depending on the site some parts of the wood will:

- (a) be inaccessible, even to sheep and particularly to cattle;
- (b) be naturally wet and unattractive to the grazing animal; and
- (c) have vegetation in poor condition due to previous grazing history.

Acknowledging these factors, it should be reasonable to accept that actual stocking densities will be somewhat higher than the theoretically acceptable figures for any specific grazing regime. So in the initial stages it is probably best to err on the side of caution, particularly if a 'sensitive' grazing regime is required i.e. for specific species management. This may not be so crucial where the required impact of grazing is to create regeneration niches i.e. poaching and trampling or to suppress/graze back unwanted regeneration of trees and shrubs i.e. to maintain open space.

In order to establish the optimum grazing regime a baseline vegetation survey will be essential, not only to describe the vegetation present before the start of management, but also to estimate the dry matter production of the vegetation both below the tree canopy and in the open habitats beyond. These estimates can then be used to determine the number of grazing animals present and the length of grazing period, based on their utilisation of the available forage. Detailed guidance on determining grazing regimes from this information is given in the Woodland Grazing Toolkit.

Whilst an initial vegetation survey is highly recommended in order to estimate the production at the site, the ranges given in Table 2 for different site objectives can be used as a starting point to decide stocking numbers. These values are derived from Mayle (1999) and Armstrong *et al.* (2003). It will be necessary to decide whether the site has high (non-*Molinia*, non-*Nardus* grassy swards predominate), medium, or low productivity (site dominated by *Molinia*, *Nardus* or wet/dry heath). If the site has low productivity, choose a value at the low end of the stocking density range and *vice-versa*.

In summary the best estimate of the most appropriate grazing period will rely on regular assessments of forage availability, prevailing conditions and of the actual effects of grazing, both as any period progresses, and retrospectively in the longer term as monitoring results become available.

4.3.3 Season of Grazing Period

Year-round grazing can be appropriate if stocking densities are low. On small sites (<50-100ha), however, it may well be difficult to achieve year-round stock grazing 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. If a seasonal grazing regime is planned, autumn is often the most appropriate grazing season, for the following reasons:

Spring – is the least appropriate time of year to graze a site heavily for flowering field-layer plants in general and in particular for spring-flowering, butterfly nectar-source plants. Heavy spring and summer grazing will reduce overall plant species-diversity and encourages dominance of the most resistant or robust species in all plant communities. Light grazing, however, may be appropriate on certain sites.

Summer (May-Oct) – heavy grazing in the summer imposes the greatest potential for severe, or irrecoverable damage to tree seedlings and saplings. Grazing domestic stock remove biomass from the system and, especially in spring and summer, deplete resources of a wide range of nectar, pollen and other invertebrate food sources, reduce structural diversity and consequently the number of many habitat types and niches for a range of organisms. Recent work suggests that the impact of livestock is worse if they are present in summer than if they are present in winter (Welch, 2003).

Autumn – Biomass will naturally be at its annual maximum by autumn (if the area has not been heavily grazed during the summer). In general the autumn offers most, if not all, of the potential benefits of maintaining a controlled large herbivore presence in semi-natural woodlands to occur, while minimising potential disadvantages associated with grazing in such woodlands. Precise timing will depend on the objectives and the desired outcomes.

Winter – winter-only grazing may perhaps offer benefits in reducing bracken (and other) litter and may be relatively benign in terms of many short-lived flowering plants. However, it is likely to lead to increased selection of browse, to dwarf shrubs, regenerating trees and larger shrubs, as grassy forage becomes less available and less attractive. Winter grazing offers little benefit in terms of seedbed enhancement, since entire spring and summer growth periods will intervene before seed of most trees and shrubs (and flowering plants) is ripe and ready to disperse. In addition, winter is the season in which soils are most vulnerable to damage, especially in the wettest and most sensitive plant communities – which require the most sensitive grazing regimes.

The above is intended only as a guide to choice of grazing season; always relate to the objectives for the site and consult with the farmer and/or grazier when making the final decisions. In some instances there may well be benefits of grazing in spring, summer or winter.

4.3.4 Setting a Grazing Regime

The aim of any particular grazing regime will not be to prescribe precise dates, which would be theoretically 'ideal' for all of the objectives. It should be feasible, however, to state fairly wide time intervals for grazing, which should result in positive outcomes. Indeed it is this very fact that enables a reasonably flexible approach to the precise timing of a grazing period (within limits) to be used. This can be achieved by adjusting the actual timing of grazing periods within the broad season, albeit in response to observed effects and vegetation change, as time goes on (Kennedy, 1999).

In setting initial grazing regimes, the best approach is to keep the prescriptions as simple as possible, whilst always being aware of the practical aspects of implementation. In practice it is

often best to incorporate any proposed grazing regime into the stock management calendar of the farm (or grazier), rather than attempt to dictate precise grazing periods and dates, which for practical reasons cannot be incorporated into the overall agricultural operations.

Decisions can be taken based on monitoring results for sward and trees following the introduction of a controlled grazing regime. Dwarf shrubs, young trees and shrubs and certain other plants can act as 'Indicator Species'. Surveillance of these plants, combined with surveillance of the animals themselves and their preferred habitats at different parts of the grazing period, will help in deciding when a grazing period should cease. Only real on-the-ground experience will confirm whether proposed stocking densities are too high or the grazing period too long.

4.4 Practicalities

In reality it will be the range of practical factors involved in managing stock to achieve a broadly defined grazing regime that become the most significant of all - over and above the actual types of animal, numbers, timing and length of grazing periods etc. It is important that graziers are clear about the overall aims and objectives of a proposed grazing regime and are able to maintain sufficient sustainable numbers of healthy stock, controlling where and when they graze.

The successful integration between stock and woodland management depends on both elements having the opportunity to derive benefit. In order for any conservation scheme to be truly sustainable there should be the opportunity for both agricultural and conservation objectives to be met – and one should not be mutually exclusive to the other.

The following factors relating to the management of all stock will need to be taken in to consideration:

- Quality of grazing and agricultural productivity of the site
- Access to the site for management purposes
- Availability of drinking water
- Handling facilities
- Fencing requirements
- Animal welfare and husbandry
- Availability of a grazier to supply the stock
- Availability of grazing during the remaining months of the year when stock are not in the woodland
- Feeding arrangements (if relevant)

Some of the following factors relating to the management of the whole site may also need to be considered:

- Public access
- Controlling wild herbivores
- Sporting interests
- Land tenure
- Grants already in place e.g. WGS, FWPS, LEAP, ESA, CPS, RSS etc
- Monitoring

4.5 Some Specific Issues

4.5.1 Using Cattle – potential constraints

From a ‘purist’ ecological perspective, since cattle are native to our semi-natural woodlands (while sheep are not), cattle are likely to be the most ‘natural’ choice of domesticated large herbivore. However, in certain circumstances, such as on small sites or very rocky, steep, or wet woodlands, cattle may not necessarily be the best choice of grazing animal.

Breeding cattle provide the greatest conservation advantages when they are extensively managed in herds of some 10-20 adult animals with large home ranges. This is also often the most practical breeding herd size to have from an agricultural perspective. Such low livestock densities, ranging over extensive areas, provides intense grazing (as well as trampling and dunging) impacts over small areas for short periods – before the whole herd moves on to other preferred locations in their range. This patchiness of use creates a high level of diversity. It is mainly this attribute that makes cattle the preferred stock for large woodland ecosystems, but it is (mainly) that very same attribute which makes them less than ideal, for management of smaller areas, especially if they are confined. This is not to say that cattle cannot be used on smaller sites they can, but it might be more appropriate to choose smaller numbers of young stock rather than a larger breeding group.

Whilst the hardy native breeds are often the breeds of choice in these semi-natural woodlands, mainly because they are likely to be outwintered, other breeds can also be considered. However, 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 (Armstrong *et al*, 2003).

4.5.2 Mob Stocking

A grazing strategy often suggested to encourage natural regeneration is to have a short period of ‘mob-stocking’, followed by the complete removal of grazing animals for some period of years (generally described as the ‘pioneer phase’), followed by the reintroduction of stock at some later date. However, this approach should be adopted with caution. Use of mob-stocking types of densities can induce significant changes in foraging behaviour among sheep. Impacts become less predictable or controllable, timings become increasingly critical and flocks difficult to manage (Kennedy, 1999).

In addition, the total exclusion phase may mean the farmer or crofter temporarily giving-up stock or significantly reducing stocking rates for a period of years. This not only introduces the attendant problems and imperfections from an ecological perspective, but may also be impractical in terms of sustaining the farm or crofting enterprise. Once the decision is taken to reintroduce grazing, it may be that stock are just no longer available on the holding (or even locally).

4.5.3 Out-wintering

Many farmers and crofters use semi-natural woodlands for out-wintering stock, as they provide much needed shelter. As mentioned previously controlled livestock grazing of these semi-natural woodlands during winter is not ideal. Cattle can potentially cause serious poaching problems in woodlands in winter, particularly when concentrated round feeding sites. In general supplementary feeding should be avoided on sites with a high species-richness, including semi-natural woodlands.

Where the woodland area is extensive (i.e. greater than 100 ha), including large areas of additional open ground and/or where all year-round conservation grazing is being proposed, out-wintering of cattle can be considered. If necessary supplementary feeding can take place on open areas out with the woodland, either by feeding hay or concentrates. Ideally feeding sites should be rotated on a daily basis and effective use can be made of bale un-wrappers, this can be beneficial particularly where it is targeted at areas of bracken. Feeding silage in ring feeders is the least preferred option, as this can lead to considerable problems with localised poaching and diffuse pollution. Cattle, in particular, tend to congregate and spend a considerable amount of time around ring feeders, for these reasons the use of ring feeders with silage should be avoided when grazing livestock in semi-natural woodlands.

4.5.4 Use of Avermectins

Livestock dung supports a diverse community of invertebrates. Although a number of species of dung insect are of conservation interest in their own right, in general the larger species (such as *Aphodius* dung beetle adults and larvae and yellow dung fly adults and larvae) are more widely recognised as being important food for a range of birds and mammals.

Avermectins is the collective name given to the active ingredients in a range of animal health products used to control internal worms and other parasites affecting farm livestock. After an animal has been treated with an avermectin, residues of the chemical are excreted from the animal in its dung. The highest residue concentrations occur in dung that is excreted in the first days after treatment, while smaller residue levels can be present in dung excreted up to several weeks after treatment. The avermectin residues retain their insecticidal properties in the livestock dung. It is well documented that exposure to these residues can adversely affect dung insects colonising individual dung pats (through either killing the adult insects or their larvae or impairing the adult insects ability to reproduce) (Webb *et al*, 2006).

Dung insect populations are dependent upon dung being available to colonise. Hence, wherever there is a conservation interest in dung insect populations (or in the birds and mammals which forage on such insects), the first concern must be to ensure that dung from grazing livestock continues to be available at the times of year most appropriate to the species involved. As has already been identified this is one of the many benefits of livestock grazing in woodlands. This may, therefore, mean accepting the need to use livestock that have been treated with avermectin products as part of a parasite control strategy. However, the overall objective should be to maximise the amount of avermectin-free dung that is available in and/or around a site at any one point in time during the spring and summer.

The ways this could be achieved will depend on the individual situation, as suggested by Webb *et al* (2006) this could involve, for example, one or more of the following:

- treating livestock only when necessary and avoiding treating older animals if they are not susceptible to the parasite of concern;
- treating livestock with an appropriate non-avermectin product or moxidectin (a less toxic avermectin);
- altering (if relevant from an animal health perspective) the timing of avermectin treatment in the spring (to change the period when residues in the pats coincide with key foraging periods of the vertebrates);
- restricting the use of products containing doramectin, ivermectin or eprinomectin to housing of the livestock or in the autumn (when the main dung insect breeding season is over).

Veterinary advice should, however, always be sought when designing or seeking to change a livestock parasite control regime.

4.5.5 Deer Management

The decision to exclude and control wild herbivores i.e. red and roe deer should be taken in the light of knowledge about their numbers and use of the site and the size of the enclosed area. Some of the factors that need to be considered when deciding on a deer management regime would be:

- Assessment of deer numbers and usage of the woodland
- Ease of culling – availability of stalkers and access to the woodland
- Siting and erection of deer fences – consider the potential risk of bird strikes by vulnerable species e.g. woodland grouse

The species, numbers of deer present and the level of impact will probably determine whether a separate Deer Management Plan is required as an addition to the Management Plan and Grazing Plan.

5. Monitoring

Vegetation is not static; it changes continually. It is therefore important to review the site objectives and management to meet those objectives regularly, to check that both are still appropriate. The management needed to bring a site into a favourable condition may not be the same as the management subsequently needed to maintain the site. Alternatively, if a regime appears not to be working satisfactorily, in any or all of its aspects, it will obviously need to be adjusted.

Thus, whether the grazing regime proves to be the most successful scenario, mediocre or entirely unsuccessful, no grazing regime should be 'cast in stone' in the hope that it might remain 'correct' over the long-term. In the light of monitoring results regular review and modification has to be an ongoing process, reflecting the processes of change as they occur.

5.1 Monitoring implementation

Initial Survey

- This will be undertaken prior to the commencement of controlled livestock grazing
- It will assess the woodland condition and help to identify the key features of interest
- A vegetation survey will describe the vegetation present before the start of management
- Rough estimates will be made of sward production

Assessment of wild herbivore numbers

- Essential to determine the wild herbivores present and to estimate their numbers
- This should be followed by on-going monitoring of wild herbivore numbers

Management Recording

- The management diary should be used to record all site management and associated costs, including:
 - Stock movements into and out of the site, and supplementary feeding provided
 - The costs associated with management of livestock
 - The time spent monitoring

- A copy of the Management Diary and associated costs should be submitted to FC annually
- A Stock Health Plan should be in place and standard animal welfare requirements adhered to

Baseline and 5-yearly monitoring

- The baseline and 5-yearly monitoring should be done by a surveyor
- Which aspects are monitored depends on the site objectives. At all sites, vegetation and grazing impact will be measured. At some sites, the impact of browsing on young trees, and/or the impact of grazing and trampling on aggressive/invasive species will be measured.
- Fixed-point photography will be a useful monitoring tool to highlight gross changes in habitat structure
- The baseline survey will include a Life Level II Survey. This should be repeated after 10 years of management, and where encouraging regeneration is an objective, used to determine whether the number of young trees has increased.
- Monitoring results are required by FCS to verify that management has been appropriate, after years 5 and 10
- See Woodland Grazing Toolkit, Appendix ? 'Monitoring for S9 pilot: advice for surveyors and farmers' for more information and copies of the monitoring forms

Ongoing Monitoring

- The ongoing monitoring should be done by the farmer/crofter/grazier. This gives the farmer the opportunity to adjust management as necessary
- The greater the involvement the manager has in the site, the more likely it is that the objectives will be achieved
- As with the baseline and 5-yearly monitoring, the on-going monitoring required depends on the objectives. At all sites, vegetation and grazing impact will be measured. At some sites, the impact of browsing on young trees, and/or the impact of grazing and trampling on aggressive/invasive species will be measured.
- If grazing is seasonal, it is useful for the farmer to check any seedlings/saplings for level of browsing before the livestock are allowed in – this will help to flag up any wild herbivore damage.
- See 'Monitoring for S9 pilot: advice for surveyors and farmers' for more information and copies of the monitoring forms
- Copies of the completed monitoring forms should be sent to FC annually.

Farmer training

- Training will also be required in identification of grazing sensitive plants, including seedlings & saplings, and signs of recent browsing. The surveyor who does the baseline survey should give the farmer some training in identifying the plants to be monitored, and in where the monitoring plots are.

Controls

- 'Control' areas within sites, where the previous management is maintained, are desirable as they illustrate the effects of the new management
- Where pilot sites have been deer fenced and not grazed by domestic stock in the recent past, it would be useful to create controls by erecting exclosures and leaving these ungrazed
- However, where woodlands have been grazed in the recent past by domestic or wild herbivores, it may not be feasible to maintain control areas under the previous management.

6. Conclusion

In summary maintaining some degree of grazing by large herbivores in these ancient and semi-natural woodlands can promote woodland regeneration, result in more 'natural' plant communities and age-class structure of the tree and shrub component and enhance overall biodiversity than would be the case if all large herbivores were excluded from the woodlands. In addition, careful timing of grazing periods can be deliberately targeted to promote particular plant species (or groups of species) regarded as especially important at a site, and thereby the fauna that depend on them (Kennedy, 1999).

This will all depend, however, on the objectives identified for the management of any particular woodland and the proposed grazing regime to achieve these objectives. Proposals for a grazing regime should consider actual types of animal, numbers, timing and length of grazing periods etc. along with consideration of other practical factors involved in managing stock.

At most sites where stock graze in woodlands, they also have access to land adjacent to the woodland. How the stock graze these open areas out with the woodland will need to be considered. This requires knowledge of animal behaviour, seasonal forage availability and the seasonal requirement for shelter.

On small sites (<50-100ha) it may well be difficult to achieve year-round stock grazing 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.

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SUMMARY OF REQUIREMENTS AND PRIORITIES FOR CONTROLLED LIVESTOCK GRAZING IN WOODLANDS (source Waterhouse et al, 1999)

Stage	Process	Comments
1	Consult with land manager (farmer or crofter)	Consider broad management regime that continues to meet their requirements for stock management, financial income and for continued eligibility of land for tenancy. Consider the impact of the Single Farm Payment and other grant incentives.
2	Devise management strategy with land manager	Should set out to achieve the desired broad conservation objectives i.e. tree/shrub regeneration and/or maintaining open space. Ensure that the land manager of the scheme is aware of general aims, and the most useful targets to achieve this. Identify the total area to be managed (wooded and non-wooded).
3	Consider any specific biodiversity objectives for the site	Assess how likely they are to be achieved with the strategy adopted from one and two above. Ensure farmer is aware of these issues
4	Undertake initial woodland survey	Woodland Condition Survey Cards
5	If necessary, specialist biodiversity surveys	e.g. lichens, mosses/liverworts, invertebrates
6	Assessment of wild herbivore species & numbers	Write a separate Deer Management Plan if required
7	Identify key features and set objectives	Farmer involved. Where woodlands currently unfenced, decision needs to be made as to whether to ring fence woodland and small area adjacent to woodland, or to manage the site as woodland with adjacent open ground.
5	Vegetation production survey	Estimates of the area of each of the habitats (e.g. wet heath, dry heath) in the site, estimate of sward production from each habitat. Note to be made of grazing sensitive species present, especially those simple to ID
6	Draw up Management Plan	Use standard FC methodology but with additional elements to take account of grazing i.e. Grazing Plan. If the site has been grazed in the recent past, it will be useful to know the numbers of livestock and duration of grazing.
7	Grazing plan written	Identify key features, required future conditions and grazing pattern. Set the required grazing regime with guidance on season, duration and numbers and type of stock grazing woodland.
7	Farmer training	To facilitate farmer's monitoring. ID of grazing sensitive species including tree species on-site and an estimation of sward utilisation.
8	Management implemented	Dates, numbers of stock recorded in management diary, copy to be submitted to FC annually.
9	On-going monitoring by farmer to aid management – review annually	Quick but robust method to facilitate changes to management if necessary.
10	Monitoring carried out by FC or their agent	Monitoring to determine whether site objectives being met, <i>at 5 & 10 years</i>
11	Be patient	The impacts of changed grazing regimes are not instantaneous. It is important to devise a scheme and then give it ample time.
12	Review	Review Management Plan in respect to monitoring results. Re-set targets if necessary (3-6 years into scheme)

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