Woodland Grazing Toolkit

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Argyll and Bute Local Biodiversity Partnership

The Woodland Grazing Toolkit was developed with support from:

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Foreword

This toolkit is the main output from the West Highland Woodland Grazing Project (WHWGP). The project was set up in January 2004 and operated under the umbrella of the Argyll & Bute Biodiversity Partnership. The project was co-ordinated by the Farming &Wildlife Advisory Group in partnership with Forestry Commission Scotland, Scottish Agricultural College, Scottish Executive Environmental & Rural Affairs Department, Scottish Native Woods and Scottish Natural Heritage, who all contributed to the delivery of the project.

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 toolkit has 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 LMC Tier 3 scheme after 2007. Following its use during the Pilot stage, this 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.

This Toolkit has been designed to be used on any woodland in Scotland. As a result it needs to cover every possibility, which makes it quite long. This does not necessarily mean that your grazing plan will need to be long or that you will need to include all the components. The Toolkit has been designed for you to only use the parts that suit the scale of your site along with the objectives and management of your site. Management plan structure and content will always be evolving in response to changes in legislation, policies and priorities. Over the next few years we do expect the format of the toolkit to change in light of experience and knowledge – this is a starting point!

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The format proposed by this toolkit is based on the approach described by the National Trust for Scotland in "Grazing Management Planning for Upland Natura 2000 Sites: A Practical Manual." (Stewart & Eno, 1998). The majority of the text and accompanying Information boxes and charts have been taken from this source unless otherwise stated. The authors of the Woodland Grazing Toolkit would like to acknowledge the extent that this manual has been used to develop the Toolkit, with additional information added to cover the particular aspects of writing grazing plans for ancient and semi-natural woodlands.

In addition, the Grazing Plan drawn up by Donald Kennedy for the Camusnagaul & Achaphubuil Woodlands, as part of the Highland Birchwoods Native Woodland Demonstration Project, and the Forest of Spey Report drawn up by Tony Waterhouse, Ron Graham and George Baikie have been extremely useful and informative. In 1999, when these reports were being complied, they were pioneering in their approach to woodland grazing and in the recommendations made. There have been other projects, too numerous to mention, which have also been formative in the production of this toolkit and we would like to thank all of the site mangers involved with those for their assistance and sharing of information.

In particular we would like to thank the following who have contributed to/commented on the toolkit – and apologies if we have missed anyone out! – Helen Armstrong, Bob Black, Brian Eardley, Diana Gilbert, Gordon Gray Stephens, Kate Holl, John Holland, Donald Kennedy, Ross Lilley, Graham McBryer, Mike Smith, Richard Thompson, Tony Waterhouse.

A. 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 wells 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 vegetation 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, dunging and trampling behaviour.

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** *Low quality communities: bog-rush fen, mat grass/ purple moor-grass, heather* 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** *Purple moor grass, heather, gorse and holly. Sedges/rushes and ferns.* 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** *Heather and coarse grasses.*	**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** *Mat grass, rushes, bracken, bog myrtle.*	**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)

B. Introduction to the Toolkit: its Purpose and Aim

Purpose of the Toolkit

This Toolkit 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."

Aim of the 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**.

C. Planning for Woodland Grazing

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 and grazier at all stages.

When setting the area to be covered by the management plan (and subsequent grazing plan), it is important to include <u>all</u> open areas <u>within</u> the woodland and <u>beyond</u> 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:

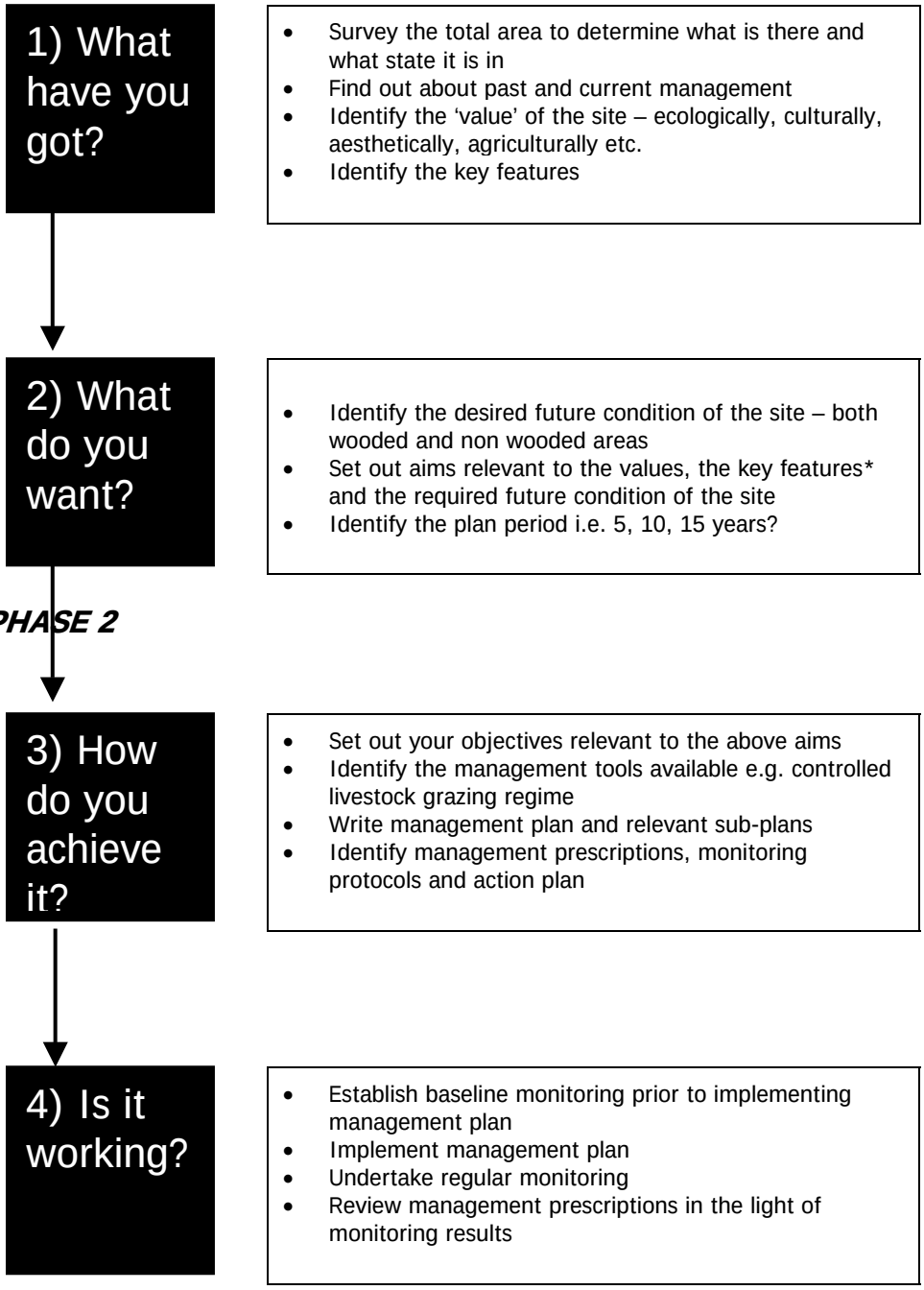
Phase 1 – background. This involves the collection of baseline information, which is vital for subsequent planning and monitoring. This is a process of taking time to record what is in and around the woodland and to establish past and present management. The availability of comprehensive survey data 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 complied 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 should be 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.

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 it will be this variation that will determine 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. The Grazing Plan 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 livestock management on your particular site.

1.1 Introduction to the concept of controlled livestock grazing in woodlands
1.2 Additional general information
1.3 Biological Information
1.4 Present Landuse and Management

PART 2: Objectives & management

2.1 Identifying, selecting and evaluating the key features* of the site
2.2 Setting out the relevant objectives
2.3 Identifying the current condition and the impacts of grazing
2.4 Identifying the factors affecting the management of key features (constraints & opportunities)
2.5 Outlining the rationale and recommendations for grazing management – setting a grazing regime
2.6 Identifying monitoring procedures
2.7 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 only 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.

Writing the Grazing Plan

Part 1: Introduction & Description

Part 1 of this toolkit describes the Introduction and Description for a grazing plan. The plan should always start with an Introduction that summarises its purpose. The Description includes summarised background information and detailed information that is used to help make decisions about grazing management. This information may or may not have been included in the overall Management Plan, but can be included here to set the context of the grazing plan. The level of detail on each subject will depend on its relevance to grazing management.

Part 1 Introduction & Description

1.1 Introduction
1.2 General Information
1.3 Biological Information
1.4 Present Land-use & Management

1.1 Introduction

The introduction should set out the purpose of the grazing plan and set the scene in relation to controlled livestock grazing in woodlands relevant to your particular site. The level of detail here will depend on its relevance to grazing management.

1.2 General Information

A grazing plan should focus on the characteristics important to grazing management; background information about the site should have been covered in the overall Management Plan. Decisions about how much detail to include here need to be made for individual sites, but some additional points to consider are described below.

- **Farming operations**

  If the site is part of an agricultural holding it would be useful to give some general background information on the farming operation e.g. tenant farmer, crofter, in-hand estate farm, mixed livestock etc. Also of particular interest would be the types, breeds, and total numbers of livestock, the way in which they are managed e.g. away-wintered, out-wintered or in-wintered and the labour force available to mange the stock. More detailed information on fencing, water access, numbers of stock specific to the particular site, grazing issues etc can be included in the 'Present Landuse and Management' section 1.4 and further discussed in sections 2.3, 2.4 & 2.5.

- **Historical and archaeological interest**

  Structures of archaeological interest or any historical value of the site should be mentioned. The amount of detail required here depends on the potential interaction with grazing management. Any implications for management can be further discussed as factors affecting the management of the key features (2.4).

- **Landscape and cultural value**

  A site may have landscape value even if it does not have a national landscape designation e.g. wood pasture. The site may be particularly valued in a local context for its landscape or it may have other cultural interest to local people. This should be described briefly and any implications for management should be discussed as factors affecting the management of the key features (2.4).

1.3 Biological Information

Much of this information should be included within the overall Management Plan; however, it is worth emphasising the key features that controlled livestock grazing will impact on. Grazing will have a direct impact on the woodland, flora and an indirect impact on the fauna through its effect on the vegetation structure and composition. The management of grazing is aimed at achieving objectives for key features, which may be plant species, plant communities, habitat structure and/or animal species. Grazing management will always be directed initially at the vegetation. For an animal species, the aim of grazing management will be to maintain its habitat in terms of the structure and composition of the vegetation.

The key features of the site are a subset of the total collection of biological features. Select the key features (described in 2.2) before writing the description of flora and fauna to ensure that the appropriate information is included here and to avoid repetition between plan sections. Information on the key features will be included in section 2.2.

1.3.1 Woodland

After an initial survey using FCS methodology for assessing native woodland condition (see FCS Guidance Note 7 'Native Woodland Condition Survey' and Native Woodland Condition Survey Cards), it may be appropriate for other specialist surveys to be conducted. Where sites are designated SSSIs or SACs, SNH will be involved in site condition monitoring, and this information should be made available. Further information on undertaking monitoring is given in 2.6 and Appendix 7.

1.3.2 Flora

A full account of the vegetation at the site, both below the tree canopy and in the open habitats within and out with the woodland area is essential for any grazing plan. The distribution and extent of vegetation types at the site determines the foraging patterns of livestock. This information is essential for predicting the incidence of grazing across the site and in determining how to manipulate grazing patterns.

This section should include an account of :

Plant communities

Describe the distribution and extent of plant communities. Aim to give a general account of the nature of the vegetation of the site, supplemented by maps produced in vegetation surveys. All of the major vegetation types should be described, including:

- those that cover large areas
- those of particular nature conservation value
- those which will influence decisions about grazing management because of their forage value; for example large areas of vegetation of little nutritional value, or areas of high forage quality
- the presence and location of grazing sensitive species. These include wild hyacinth (bluebell), ivy, honeysuckle, blaeberry (billberry), bramble, raspberry, greater woodrush, wood anemone, and wood sage (Grime *et al*., 1990; Smith, 2004; John Holland, pers com). More than one visit to the site may be necessary to complete the survey of grazing sensitive species, as some are visible in different seasons.

Estimates of dry matter production of vegetation types

A baseline vegetation survey is essential to describe the vegetation present before the start of management and to estimate the dry matter production of the vegetation both below the tree canopy and in the open habitats beyond. This information will be used later to determine the stocking regime to achieve the ideal grazing pattern for the site (2.5.2). An example of how to estimate the dry matter production for a site is given in Appendix 6.

Approximate values of annual dry matter production of ground vegetation in different vegetation types are given in Table 2 (source Waterhouse, Graham & Baikie, 1999):

TABLE 2: Approximate values of annual dry matter production of ground vegetation

VEGETATION TYPE	ANNUAL DRY MATTER (DM) PRODUCTION (tonnes/ha)	RANGE OF ANNUAL DM PRODUCTION (tonnes/ha)
Agrostis-Festuca grassland	5	3 – 6
Acid grassland	4	3 – 5
Rank grassland	3	2 – 4
Mosaic & flushes	4	3 – 5
Wet rushy pasture	2	1 – 3
Heath	2	1 – 3
Bracken (ignoring bracken biomass)	0.3	0.1 – 1
Shrub woodland	1	0.5 – 1.5
Mature birch woodland	0.5	0.3 – 1.5
Oak woodland	0.3	0.1 – 1

The values provided for annual dry matter production of the different vegetation types are ballpark estimates, and should be used only as a guide to setting initial stocking rates.

A map showing the approximate areas of the different vegetation types should be drawn, and an overall estimate of dry matter production calculated.

Plant species of particular nature conservation value

Individual plant species of note are those that have particular nature conservation value, in an international, national or local context.

1.3.3 Fauna

A description of fauna provides information on the biological interest of the site and details of wild herbivores.

This section should include information on:

Wild Herbivores

Ideally a deer management plan should be undertaken as a separate plan, albeit integrated with the Management Plan and the grazing plan. If no separate deer management plan exists aim here to give an account of all mammalian herbivores, or at least all large mammalian herbivores.

It is essential to determine the wild herbivores present (see Appendix 5: Guidance table for determining species of grazing animal present.) and to estimate their numbers. This information will be needed later in the planning process to make management decisions or to try to determine the relative contribution of various herbivore species to the current grazing pressure at the site. Note that any management of wild species on the site should be described in section 1.4 'Present Landuse and Management. Estimates of population size may be made as part of the management of such species, so to avoid repetition; details of these species should be provided in 1.4 and cross-referenced here.

Where possible, the description of unmanaged herbivores should include:

- estimates of population size
- a description of distribution, including seasonal, altitudinal and other spatial variations

Smaller species such as voles should at least be listed, but estimates of population size are unlikely to be available. Although it can be difficult to predict their impact on vegetation their impact on trees is well documented, where high-density vole grazing is known to

devastate tree seedling numbers (McVean, 1996; Mitchell & Kirby, 1990; Shaw, 1974). It has been demonstrated that livestock grazing, however, can restrict vole activity and subsequent tree damage in woodland situations (McVean, 1990; Shaw, 1974).

It is also worth mentioning invertebrate herbivores, but note that their impact on vegetation is poorly understood, except for a few species, normally pest species e.g. heather beetle. Provide details only of those known to be significant herbivores at the site.

Species of particular nature conservation value

Animal species of particular nature conservation value will include those listed below, and they may or may not be treated as key features in the grazing plan:

- birds cited in an SPA designation
- Annex II species listed in the Habitats and Species Directive
- Red Data species
- species that are scheduled in the Wildlife & Countryside Act
- species listed either in the UK or Local Biodiversity Action Plans

For most species, information on population size, distribution and breeding status should be included if available. Details of species threatened with disturbance or persecution, such as certain birds of prey, should be treated as confidential.

Species expected to be influenced by changes in grazing management

Certain changes in grazing regimes may strongly affect animal species, some of which may not have been covered in the two categories of fauna described so far and should therefore be mentioned separately. Examples are species of high nature conservation value that occur outside the area covered by the plan. The expected impact of changes to the grazing regime should be discussed in 2.4 'Factors Influencing the Management of Key Features'.

A list or description of other species can be included at the discretion of the planner. The level of detail required will vary, but estimates of population size should be included where available.

1.3.4 The contribution of grazing to the current pattern of vegetation

This section aims to identify what is known about the impact of current and past grazing on the site and the role that this has played in extent of woodland cover and the development of the range of vegetation types that now occur.

This discussion will help to:

- identify whether the impact of grazing is currently positive or negative, and whether changes are required
- identify how much is known about spatial variations in the impact of grazing across the site
- identify vegetation types degraded by inappropriate grazing which might be restored as part of the grazing plan.

This description should summarise existing survey or anecdotal information on how grazing has influenced the development of the present vegetation. This should not be confused with detailed assessments of current condition of key features, or the current impact of grazing on the key features, which should be included in section 2.3 of the plan.

In this section include:

- accounts of any existing vegetation type that indicates the impacts of grazing. For example development of grass-dominated swards as a result of heavy grazing on heath vegetation or invasion of heath vegetation by regenerating trees or shrubs may indicate a low grazing pressure.
- any existing knowledge of spatial variations in grazing pressure on the site; there may be observational evidence or notes may have been made during vegetation surveys or caused by changes in farming operations e.g. change of breed, reduction in numbers etc.

A discussion of such trends is sufficient here; an assessment of how the grazing pressure relates to the objectives is made later in section 2.5.

1.4 Present Landuse and Management

This section describes the main land-uses and management activities of owners or occupiers of each management unit. These may conflict with the nature conservation aims for the site, and the implications are discussed as factors affecting the management of the key features (2.4). Again much of this information should have been covered in the overall Management Plan, however, it may be useful here to emphasise the current management of domestic livestock, wild herbivores and vegetation.

For the purposes of the grazing plan, information about the management of herbivores (domestic and wild) and management for nature conservation is essential and is described further here.

1.4.1 Domestic stock management

Where possible the following details should be included for each management unit for the stock grazed on the site:

- type of animal e.g. sheep, cattle
- breed, sex and age of stock
- numbers of animals grazed on each management unit, which is wholly, or partly within the area covered by the grazing plan; densities can be calculated but these may not be accurate unless the units are separated by physical boundaries restricting animal movements
- seasonal variations in numbers of animals
- distribution of stock – this information will help the planner to predict where grazing pressure is likely to be high and low. Animals will not be evenly distributed, and as a result, the impact of grazing on vegetation will also vary. Note physical boundaries within or around the site that restrict stock.
- stock management practices such as tupping, lambing, calving, finishing, replacements, wintering arrangements etc
- supplementary feeding; where and when

1.4.2 Wild Herbivore Management

If a Deer Management Plan is not being produced separately as part of the Management Plan then the following information should be included in the grazing plan. Details of the populations of wild herbivores should be included where these are available. Describe herbivores which are managed in some way by the landowners or occupiers, but information on other wild herbivores should have been included as part of the description of 'Fauna' (1.3.2). Include here:

- estimates of population size and sex ratios, including a description and evaluation of the methods used to estimate these parameters
- details of distribution across the site and seasonal raging patterns
- details of how these animals are managed, cull figures, how culls are set, numbers shot for sport etc.

1.4.3 Nature Conservation

Prior to setting objectives it is necessary to assess any obligations or policies that apply to the site. You should identify any external polices or obligations that may restrict the options for practical management. Designations, obligations and policies can be allocated to two main categories, which influence the management of the site in different ways:

- Nature conservation designations – consult with the relevant statutory agencies e.g. SSSI, SAC, SPA
- Policies or designations that affect landuse

In addition you should describe any current site management that is aimed at meeting nature conservation objectives, such as exclosures to protect vegetation from grazing, participation in a WGS/SFGS or other agri-environmental scheme (e.g. ESA, CPS or RSS).

PART 2: Objectives & Management

Part 2 of the grazing plan is the 'working document'; it is this part that will be most frequently used because it discusses the recommendations for grazing management and an analysis of some of the options. This part of the plan should be viewed as an active document because the planning process is not static and it is most likely to change during the review process.

Recommendations made in the plan are based on currently available information, but over time, new information should be fed back into the process to improve proposals for grazing management. This part of the plan defines the following:

- what is required for the site; the objectives
- what needs to be done to achieve the objectives in terms of a grazing management strategy
- how this strategy can be implemented

This part of the toolkit leads the user through the decision-making stage of planning in which the information collated and described in the overall Management Plan and in Part 1 of the Grazing Plan is interpreted and used to make those decisions.

Part 2 Objectives & Management

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

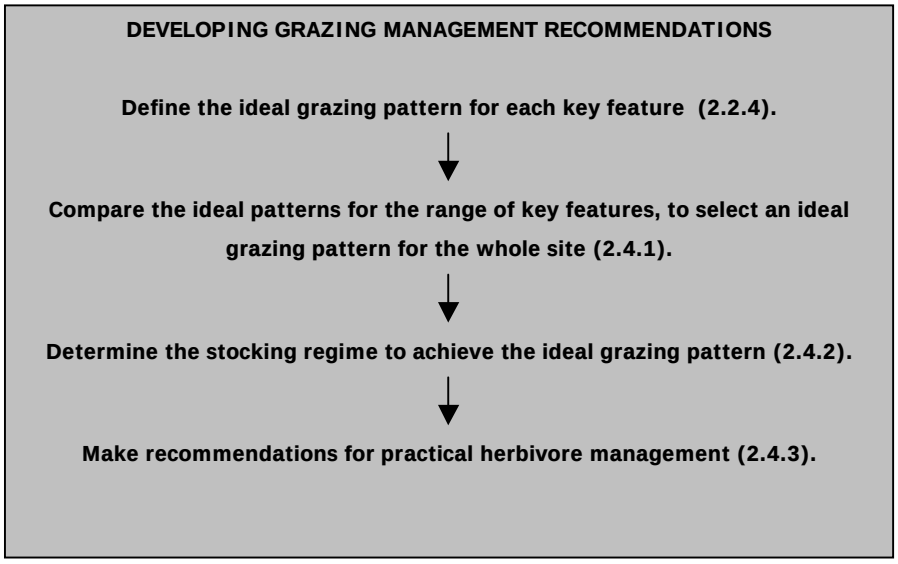
In these stages it may become evident that there are gaps in information that need to be filled before decisions about grazing management can be made with any degree of confidence. This is not to say that new information must be gathered before the plan can be completed, but the plan must note the need to gather this information. New information can then be used to feed into the decision-making process for later drafts of the grazing plan, improving upon earlier predictions and recommendations.

Throughout Part 2, any need to collect new information or data should be defined and then listed in 2.7 'Prescriptions' as part of the work programme, along with herbivore management and monitoring.

The Thought Process Leading to Recommendations for Grazing Management

Recommendations for grazing management are developed in several stages. Firstly, the key features have to be selected because these define the reasons for the management. Objectives for these key features are written next, which specify what is required. Grazing management is aimed at achieving these objectives. There are various steps in the process of making decisions about grazing management shown in the box 'Developing Grazing Management Recommendations' along with the number of the relevant section of the toolkit.

The level of detail required here i.e. whether you need to go through the complete process, will very much depend on the scale of the site and the number of key features identified. In relation to the grazing plan the key features are those at which controlled livestock grazing is aimed as a management tool. For example if the site is relatively small <50-100 ha and there are only 1-2 key features identified then you will not need to go through all the stages. Only include the level of detail you think necessary and do not overburden the plan unnecessarily.



INFORMATION BOX 1: Grazing Pattern

For this planning process, it is crucial to understand the difference between a grazing pattern and herbivore management/stocking regime or grazing regime. In this toolkit, a grazing pattern describes where, when and how much grazing is required. It does not include any specification of a number, density or type of herbivores.

Grazing animals should be viewed as tools used to achieve a desired or 'ideal' grazing pattern. Animal management is constrained by a number of practical problems that will determine whether an ideal grazing pattern can be implemented. Considering the animal management necessary to achieve this grazing pattern is the final step in the planning process.

Throughout this text, the term 'grazing pattern' will always mean the intensity/distribution/timing of grazing rather than the number/species/type of animal.

'Grazing regime' is also used, but with a more general meaning, incorporating any aspect of grazing management such as herbivore numbers or grazing pressure. More specific information on grazing management and setting grazing regimes is given in 2.4.3 and Appendix 1.

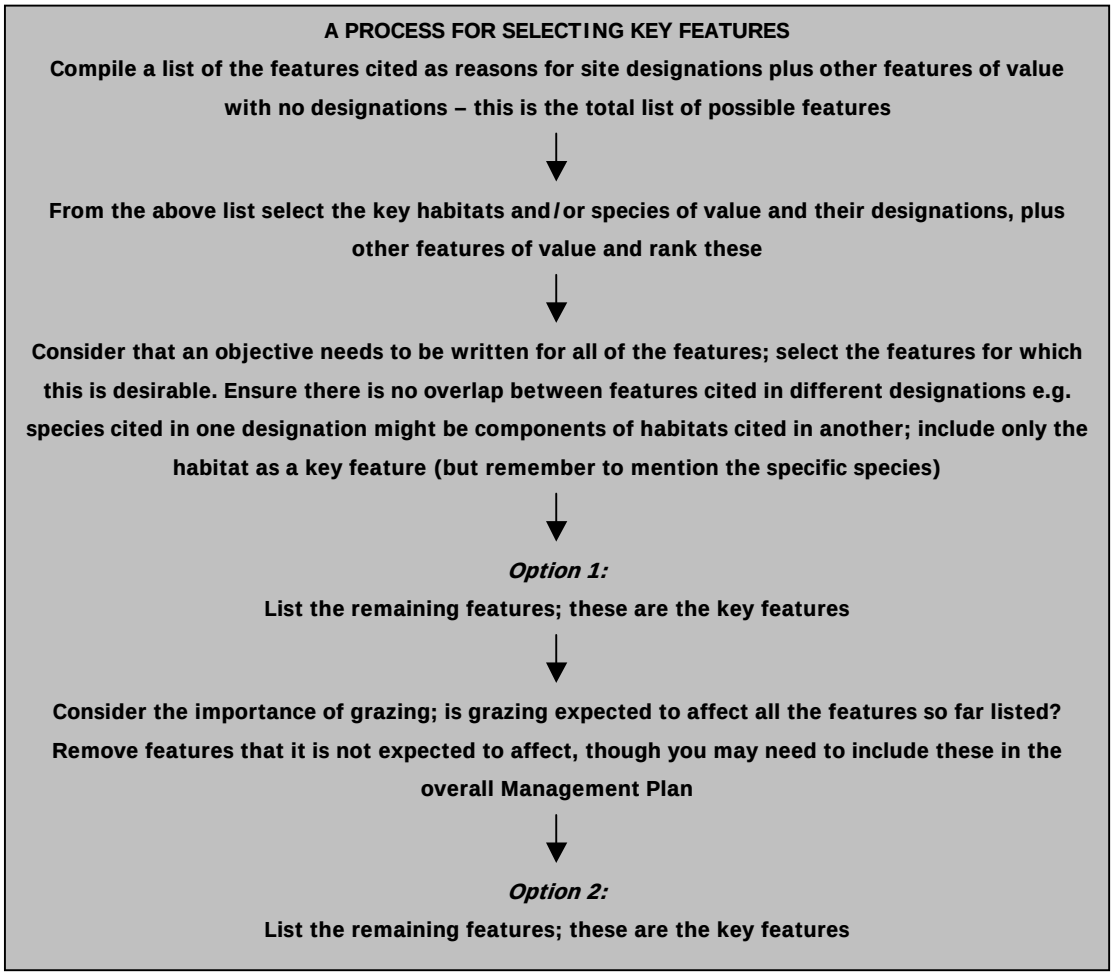
2.1 Selection & Evaluation of the Key Features

- ***Select the key features***
- ***Describe how the key features are represented at the site***
- ***Evaluate and rank the key features, in terms of their status***

This section of the toolkit describes the selection of key features. **Key features are those that are regarded as being the most important features at the site in the context of the plan, and at which grazing management is aimed.** These features drive the decisions made about the grazing regime for the site. You may need to seek expert advice in order to identify the key species and habitats present on your site. See Appendix 9 'Sources of Information', but also make use of people with local knowledge.

2.1.1 Selecting & Evaluating the Key Features

Key features are those features for which an objective will be written. For the purposes of the grazing plan, they are a sub-set of the range of biological features at the site, selected on the basis of conservation value as well as features identified for their archaeological or agricultural value. Along with a list of the key features some evaluation information should be presented in the plan. The process for selecting the key features is shown in the box below.



2.1.2 Describing the Key Features in the Plan

Detailed information of the key features, where available, should be included in the plan. This supplements the information on the biological interests of the site provided in 1.3. Specific details are included in Part 2 of the plan because this information is of value when writing objectives. It is also more logical to describe the key features after they have been identified in the plan.

To compile this section, first list the key features with an indication of their status and, for plant communities, vegetation classification information. Basic information on the key features can be included in tabular form. **Where available**, more detailed information about the key features should be included to indicate how the features occur. Details of distribution may be required to make decisions about grazing management.

Plant Community/Habitat Features

Describe how these occur at the site. This information should be taken from surveys or other site records and could include the following:

- information on extent, distribution, altitudinal range and communities the features tend to occur in association with
- species of note that occur within the habitat, i.e. those which have not been listed as key features but are of conservation value

Species Features

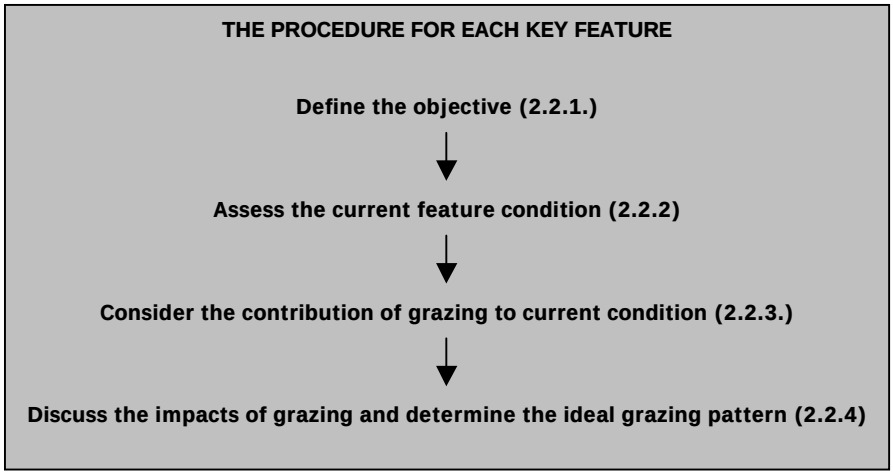
Include the following:

- Details of population size, distribution, altitudinal range over which the species occurs
- For plant species, vegetation types in which the species usually occur

2.2 Objectives, Current Condition and the Impacts of Grazing

- ***Describe what is required for each key feature; the desired future condition***
- ***Assess the current condition of each key feature in comparison with desired future condition***
- ***Discuss the predicted impacts of grazing on the key features***
- ***Describe the ideal grazing pattern to achieve desired future condition for each key feature***
- ***Assess the current impact of grazing***

This component of the grazing plan comprises several stages, which describe what is required for the key features and determine the grazing required to achieve this ideal. The plan should work through this process at the feature level; where applicable, this means that the series of steps here should be presented in full for the first key feature, followed by the same procedure for the subsequent key features. The procedure is summarised below, indicating the corresponding section in the manual.



2.2.1. Defining the objectives

Setting the objective(s) of woodland grazing at a site is critical to success. The farmer/land manager should be involved in the decision process, along with any specialists interested in the biodiversity of the site. Appendix 2 outlines a range of objectives for woodland 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. An example of species-specific monitoring is provided in Appendix 8.

The 'objective' defines what we want of the key feature. The style of objective used in this toolkit is defined in Information Box 2. In this toolkit, objectives are defined in several stages. In the most simple case there will be an 'ideal' or 'long-term' objective which describes desired

future condition (see Information Box 3) of the feature. Short-term objectives may also be needed in addition to the main objectives. The steps described are summarised below.

THE PROCESS FOR DEFINING OBJECTIVES

Describe desired future condition for the feature; this is the ideal or long-term objective

Consider current condition of the feature and if necessary add short-term objectives as described here

INFORMATION BOX 2: Objectives

The objective for a feature describes what is required. The ideal long-term objective will be to achieve desired future condition (see **Information Box 3**), which ideally should be defined in terms of a **target value** and **limits of change**, for a selected range of **attributes** for the feature. Attributes are characteristics of a feature that are considered to be essential and inherent to the feature. The target value defines a specific condition, which is considered to be optimal for an attribute. Limits of change set quantifiable boundaries to the attribute, which if exceeded, indicate a move into unfavourable condition. The feature is therefore, in desired future condition if the attribute is at the target value or between the limits of change. It is the limits of change for each attribute that will be used for monitoring.

INFORMATION BOX 3: Desired Future Condition v Favourable Condition

DESIRED FUTURE CONDITION

- Is the habitat condition that is expected to result if aims and objectives are fully achieved
- Should help managers envision what the future state of the habitat should be in under any proposed management regime
- Should be based on outcomes
- Targets set will be aspirational, but may include aspects of favourable condition as defined below

FAVOURABLE CONDITION

A habitat or community will be taken to be in favourable condition when:

- The area/s that it covers within the site is stable or increasing
- The specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and
- The condition of its typical species is favourable

A species will be taken to be in favourable condition when:

- Population dynamics data on the species indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and
- The natural range of the species, within a site, is neither being reduced nor is likely to be reduced for the foreseeable future, and there is, and will probably continue to be, a sufficiently large habitat to maintain its population on a long-term basis.

(CCW, 1996)

Long-term, Ideal Objectives: Defining Desired Future Condition

Objectives describe the desired future condition of key features so that management can be implemented; this indicates the desirable state of a feature at individual site level. For sites of high nature conservation value nature conservation organisations, such as SNH, use the term favourable condition (See Information Box 3). For many sites, with no conservation designations, this may not be an appropriate term to use; again it will be up to you to decide which you use.

Every key feature should have one objective. Each objective comprises several components which together describe either the desired future condition or favourable condition of the feature; i.e. **attributes** and **target values.**

The purpose of using these terms is to provide set criteria for the monitoring protocols that you are going to adopt. The choice of monitoring protocols will be determined by what your objectives are for the site (See Appendix 7 for further information). Attributes are measured and the results are compared with the limits. The feature is in favourable condition if the attribute, when measured, is at the target or within various set limits.

The relative nature conservation value of your site will be determine the level of detail that you will need to aim your monitoring at. For high value sites selecting attributes and defining target values and limits of change may require considerable knowledge of the feature. Information and advice should be sought from staff in the country agencies and may also be available from site managers, rangers, local people, botanical recorders, ecologists and scientific resources.

Attributes

Any one key feature will generally have several **attributes** that describe favourable condition. For habitat features, these may be:

- quantity: its area or number of discrete locations
- composition: typical desirable species; undesirable species; rare or scarce species; communities
- structure: age classes; vertical structure such as ground, shrub and tree layers; horizontal layers such as habitat fragmentation, vegetation mosaics

Attributes for species:

- quantity: population size
- population dynamics: recruitment, mortality, emigration and immigration
- population structure: sex, age, fragmentation, isolation
- habitat requirements for feeding and breeding: area, type, structure

For each feature choose the minimum number of attributes that best describe favourable condition and/or will be useful indicators of divergence from that condition. Information box 4 gives a selection of possible attributes for woodland and for other associated habitats.

It may be helpful to think of these questions when selecting attributes:

- In what directions might adverse change occur? Will this suggest some easily recognisable indicator?
- Are there easy positive or negative indicators of condition that would substitute for more complex measures?

INFORMATION BOX 4: Suggested Attributes for Different Vegetation Features

Feature	Attributes
Woodland	quantity; percentage canopy cover of tree species; species composition, such as frequency of exotic species, native species and/or rare species; age structure of the woodland, including abundance of dead wood
Heathland	quantity; species composition such as cover of ericaceous dwarf shrubs or presence of one or more undesirable species like agricultural weeds; ratios of shrubs:graminoids and other species; tree saplings; structural attributes such as cover of different age classes of shrubs
Grassland	quantity; species composition such as cover and frequency or abundance of one or more typical desirable species or undesirable species such as shrubs, tree saplings, weedy plant species such as thistles, rushes; physical structure of the sward as inter-tussock height, or tussock frequency
Flush communities	quantity; types of NVC communities; rare species presence; percentage cover of vegetation and/or bare soil
Tall herb communities	quantity in terms of discrete locations, (although the feature may be widespread, each area tends to be very small); typical species and rare/scarce plant species
Blanket bog	quantity in terms of area of intact surface; cover of peat-building sphagnum species, presence of other important species; water table height; surface patterning

Target Values and Limits of Change

Each attribute is bounded by **limits of change** and ideally the attribute also has a **target value**. The target value describes the best possible condition and provides a starting point for setting limits of change. However, with the information available it may not always be possible to set specific targets. Limits of change are used because habitats and species are naturally dynamic and will fluctuate in quantity, composition and structure. The limits are designed to take account of this variation be defining the degree to which an attribute can fluctuate around a target value without giving cause for concern. The target value, whilst somewhere in between the limits of change, may not necessarily be mid-way between the upper and lower limits.

Limits should be set so that they are reached some time before there is a significant threat to the viability of a feature. The limits are a trigger so that if exceeded the site manager will be alerted to investigate well before the point of irrecoverable change is reached.

To monitor a feature, the target value and the limits of change for the attributes should be measurable. It is also important that they are ecologically realistic and not guesses. However, quantitative targets and limits may be difficult to define, either because of lack of reliable information or because of the nature of the feature e.g. boundaries between habitats may be difficult to measure when within a habitat mosaic. In this case, the limits and target condition for quantity are therefore defined in a qualitative manner and monitoring can be targeted at parts of the boundary where change is expected to take place.

When thinking about targets and limits of change, it may be helpful to ask these questions:

- are the attributes measurable?
- how much of something is desirable; how high can the limit be either ecologically or before it starts to conflict with another feature?
- how little of something is desirable: how low can the limit be before its viability is threatened?
- how is the attribute to be monitored, i.e. what are the practical problems of monitoring the feature?

For the feature to be in favourable condition and the objective achieved, all the attributes, which taken together give an overall picture of the feature, should meet or be moving towards the target values. The limits to the attribute act as 'flashing lights' that alert a site manager to undesired changes. This initiates a process of assessing the causes so that management can be changed where necessary.

The toolkit has so far described how to define favourable condition. The following sections on setting short-term and alternative objectives describe the circumstances in which it is not possible to have an objective for favourable condition.

Short-term Objectives

If the assessment of current condition (2.3.2.) indicates that a key feature is unfavourable and it needs to be restored, this may have to be built into the objective for the feature if the restoration process exceeds the time covered by the grazing plan. This situation will cause difficulties for monitoring because, in the short-term, the feature will continue to fail to meet the criteria for desired future condition, even if it is improving as a result of management. In these cases, short-term objectives should be developed to determine if restoration is working. These short-term objectives should be indicators of progress towards desired future condition. Short-term objectives can be included as time-limited attributes within the long-term objective; simply add the attributes that are indicators of the success of restoration work and note the time period that these objectives cover. Ensure that in the short-term, monitoring projects record these restoration attributes.

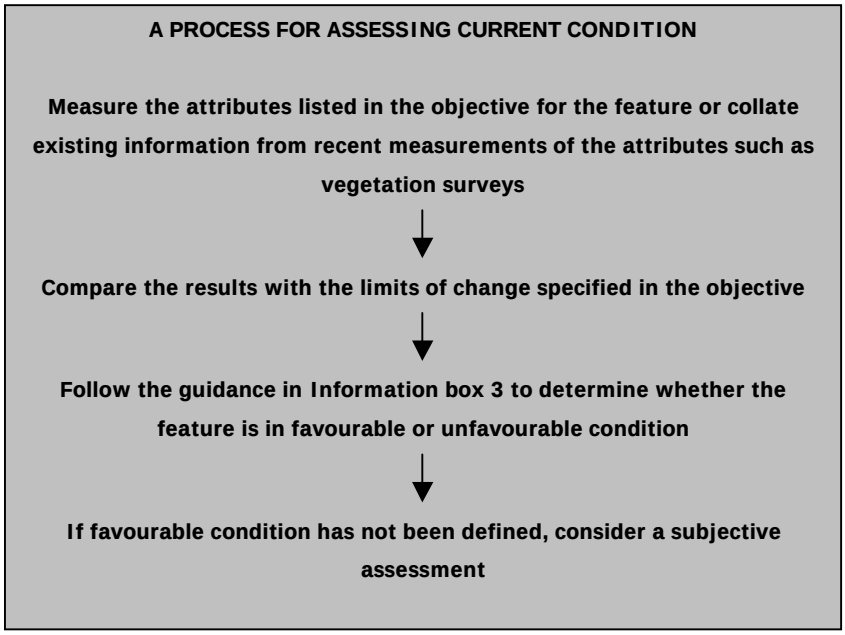
2.2.2. Assessing Current Condition

This section includes the following:

- A definition of current condition
- How to assess current condition

The current condition of a key feature is an assessment of whether the feature meets the criteria for favourable condition set out in the objective. This means that current condition can only be fully described if favourable condition has been defined for the objective. Assess current condition for each of the key features for which there is a set of attributes with limits of change defining favourable condition.

To assess current condition – follow the process summarised in the box below.



The assessment of current condition is used as an indicator of whether a change to the current management is required; if the feature is in unfavourable condition management will need to be reviewed. Note that current condition is not the same as impact of grazing (see Information box 4), and it should not be assumed that inappropriate grazing is the cause of unfavourable condition. The assessment of the impact of grazing is described later (2.3.3 'The Influence of the Current Grazing Regime on Condition').

INFORMATION BOX 4: Current Condition cf. Impacts of Grazing

It is crucial to understand the difference between assessments of **current condition** and the **impacts of grazing**. Current condition is used as an indicator of whether a change in management is required to meet the objective for a feature. The condition of a feature is influenced by a range of factors, of which grazing is only one. So, if a feature is unfavourable, it does not necessarily follow that a change to the grazing regime is required. This should prompt an investigation into the range of factors that have an impact on the feature, to find out why it is unfavourable. An assessment of the current impact of grazing on the feature would be made as part of this investigation to determine the role of grazing. Only then can changes to grazing management be proposed.

2.2.3. The Influence of the Current Grazing Regime on Condition

Following the assessment of current condition, for features found to be in unfavourable condition, it is essential to determine the cause. Grazing is only one of several potential causes. For the purposes of a grazing plan, it is necessary to determine whether grazing management should be changed to meet the objective for the feature.

The impact of domestic stock on woodland ecosystems is broadly similar to that of wild herbivores (Mayle, 1999). There is, however, variation between species and even between breeds of the same species (Table 1). Thompson *et al* (2004) in Appendix 5 also give more information on determining species of grazing animal present. It may be relatively easy to determine the species responsible for the impact in a particular wood if only one species is present. However, up to 4 species may commonly be impacting, albeit in different seasons.

Determining the relative contribution of sheep/deer to the impact will be difficult and may be not possible in some instances (Thompson *et al*., 2004).

Table 2 summarises the impact of different grazing intensities in woodlands. Specific impacts by domestic stock species to particular parts of the woodland ecosystem, such as ground flora, tree regeneration, vegetation structure and impacts on invertebrates, birds and mammals can be found in Forest Information Note 28 'Domestic Stock Grazing to Enhance Woodland Biodiversity' (Mayle, 1999).

In addition Scottish Natural Heritage (MacDonald *et al*., 1998) and English Nature (Jerram & Drewitt, 1998) have both developed methods to assess the impact of grazing on upland vegetation. These manuals may be useful to determine whether current grazing regimes are appropriate for vegetation types that appear as key features, or are important habitats for animal species listed as key features, out with the woodland areas.

TABLE 2: Grazing level indicators (source Mayle, 1999)

Grazing level	Indicators
Low	Saplings frequent in canopy gaps, well developed shrub layer, no obvious browse line. Ivy present (on the right site types), ground vegetation dominated by grazing sensitive species (blackberry, honeysuckle) or limited by dense shrub layer, mats of wavy hair-grass may develop in base poor sites (which should eventually revert to blaeberry)
Moderate	Saplings present although localised, shrub layer developed in parts, signs of grazing/browsing, few bare soil patches. Ground vegetation >30 cm high, mixture of grass/herbaceous/dwarf heath vegetation.
High	No tree regeneration >20 cm, generally no shrub layer, pronounced browse line on shrubs and trees, ground vegetation up to 20 cm, dominated by less palatable grasses, bryophytes and bracken, some bare patches, palatable and grazing sensitive species (blackberry, bilberry, honeysuckle) confined to inaccessible areas.
Excessive	No tree regeneration, barking of mature trees and branches on the ground, no shrub layer, extensive bare ground and soil disturbance, invasion of weed species (docks, annual meadow-grass).

2.2.4. The Impacts of Grazing on the Key Features and Ideal Grazing Pattern

- a discussion of current knowledge on the ecological impacts of various possible grazing regimes on each key feature
- a description of the 'ideal grazing pattern' for each key feature

Purpose & Content

This section of the plan comprises a discussion of the ecological impacts of grazing on the key features. The main purpose is to determine the pattern of grazing which will best meet the objectives for each key feature; this is referred to as the 'ideal grazing pattern (see information

box 5). The result will be to present in the plan an ideal grazing pattern for each key feature. This is the first step in deciding how the objectives could be achieved via grazing management. This section of the toolkit provides guidance on how to assess the impact of grazing on vegetation and write the discussion for a grazing plan.

INFORMATION BOX 5: The Ideal Grazing Pattern for a Key Feature

An **'ideal grazing pattern'** for a key feature defines what pattern of grazing is needed to maintain the feature as described in the objective. This pattern includes the timing and pressure of grazing that would best achieve the objective, but does not define stocking densities or herbivore species. It may also be useful to specify the degree of selectivity in grazing for some features. For example, some vegetation types may benefit from non-selective grazing and this should be considered when selecting the appropriate grazing animal. For further information on grazing patterns see Information box 1 (page ?).

How to Determine the Impact of Grazing on Key Features

In order to describe the impact of grazing on a key feature, collate and summarise existing knowledge about the impacts of grazing animals, using this section of the toolkit as a guide. For those features that are poorly understood, identify gaps in the existing knowledge, so that this may be considered later as a factor affecting the management of the key features. The different types of key feature should be treated as follows:

For woodlands, discuss the impacts of grazing as described. Appendix 1 gives an overview discussion and additional sources of information include Rodwell (1991); Mayle (1999); Armstrong *et al*. (2003); Thompson *et al*. (2004).

For other habitat/plant community features discuss the impacts of grazing as described. Sources of information include Jerram & Drewitt (1998), MacDonald *et al*. (1998), Rodwell (1991a, 1991b, 1992, 1995).

For animal species features requirements in terms of habitat/food plant/habitat for prey species should be discussed, and the impacts of grazing on the vegetation that provides these requirements should then be dealt with as described for plant communities.

Where plant species have been selected as key features use published information of the impacts of grazing where available.

In the discussion for each vegetation type/habitat, follow the guidance in the box below and use Chart 1 (Appendix 3) for information on the factors that determine the impact of grazing on vegetation.

The impact of grazing on pant communities depends on how the species within the community respond to grazing as shown in Chart 1. Further details of utilisation rate, the importance of herbivore foraging behaviour, plant tolerance to grazing are given in the Information Boxes 6 – 8 and Appendix 6.

FOR EACH KEY FEATURE CONSIDER THE FOLLOWING QUESTIONS:

- **What are the predicted impacts of broad categories of grazing pressure, such as 'high', 'moderate' and 'low'?**
- **What are the predicted impacts of variations in the seasonal pattern of grazing?**
- **Can grazing have both positive and negative impacts, depending on the regime applied?**
- **What are the impacts of trampling and poaching, particularly on the structure of the vegetation?**
- **How preferred is the vegetation in question compared with other types present, i.e. how likely are the herbivores to graze it? Consider this in relation to the foraging behaviour of the particular herbivore species present at the site, or of species that could occur in the future.**

ANSWER THE QUESTIONS IN TERMS OF THE FOLLOWING IMPACTS

- **Consider impacts of grazing in terms of direct effects on survival, growth and reproductive capacity of individual species.**
- **Consider the impact of grazing on species composition of the vegetation.**
- **Note the effect of grazing on species of particular importance, such as those which are selectively grazed or avoided, and those of high conservation value.**
- **Consider how grazing affects the attributes used to define the objectives for plant community features.**

INFORMATION BOX 6: Herbivore Foraging Patterns and Predictions of Impact

In general, selective herbivore species will choose to graze vegetation types of highest nutritional value first and their use of other vegetation will depend on the availability of preferred vegetation. There is a basic order of preference that applies to most selective herbivore species, but this varies with season. Note also that herbivores can choose only from the vegetation available at the site, so foraging behaviour will depend on the range of vegetation and will be site-specific to some degree.

Highly preferred vegetation types will usually be most heavily grazed of the available vegetation and other vegetation types will tend to be grazed much less until the preferred type has been depleted. This means that the availability of preferred vegetation affects the grazing pressure on other types. Availability varies with site and with herbivore density so a reduction in herbivore densities may not reduce the grazing pressure on preferred vegetation types; grazing pressure on the less nutritional vegetation will decline first.

Vegetation types of poor forage value will generally be avoided by selective animals. This vegetation may not be grazed at all, unless herbivore densities are very high and/or the availability of good quality forage is low.

It should be possible to predict, depending on the vegetation types present at a site, which types will be most and least heavily grazed at different times of the year. This is easiest for the extreme examples mentioned; communities that are either highly favoured or mostly avoided. However, there are 'intermediate' communities which are neither strongly preferred nor selectively avoided and utilisation of these vegetation types will fluctuate considerably with the availability of preferred vegetation, and hence with herbivore numbers. It is difficult to predict how these communities will be grazed with different densities of animals.

INFORMATION BOX 7: Utilisation Rate

Utilisation rate is the proportion of the annual vegetation production removed by grazing animals and is a strong determinant of impact.

INFORMATION BOX 8: Tolerance to Grazing

Individual plant species and plant communities vary in their tolerance or response to grazing, due to direct impacts on the reproductive success, growth and survival of species and also to indirect impacts on the relative competitive ability of the species within communities. For example, grass species tend to be highly tolerant to grazing, while small herbs can easily be damaged when grazing inhibits flowering and growth.

Describing the Ideal Grazing Pattern

It should now be possible form the information collated, to determine an ideal grazing pattern for the key feature, which is expected to meet the objectives for the feature. Compile as detailed a description as possible of this pattern in terms of:

- Grazing pressure
- Timing
- The degree of selectivity required

For some features there will be a lack of scientific information and it may be possible to make only general conclusions, such as 'some' grazing required.

2.3. Factors Affecting the Management of the Key Features

- ***Describe practical constraints on the options for management***
- ***Discuss opportunities for achieving the desired grazing management***
- ***Identify conflicts of interest between conservation and other factors***

Content & Purpose

In this component of the plan, the discussion returns to the whole-site level. 'Factors affecting the management of the fey features' (referred to here as 'factors') are also called 'opportunities and constraints' in management plans or planning guides In this section of the plan you need to describe the range of factors that determine how a key feature or the whole site may be managed. For grazing plans it is necessary to describe only factors relevant o the grazing management. Factors can be:

- positive or negative in terms of their influence on the management options
- relate to the practicalities of managing the site; such as lack of resources, degree of control over grazing, livestock available
- biological requirements of the features; for example if an animal species is the feature, its habitat, in terms of the vegetation to be managed, would be a factor
- biological processes, such as succession or regeneration, which need to be considered or managed
- a lack of knowledge about the site, the features, the wild herbivores
- physical aspects of the feature or site that need to be noted but cannot be managed, e.g. hydrology on a bog
- current management prescriptions e.g. WGS, FWPS, ESA, CPS, OAS or RSS agreements
- designations for the site

2.3.1. How to Compile the List of Factors

Information collated for preceding parts of the plan, particularly the 'Description', should be used to compile a list of factors. Discuss the implications of each factor for the management of the site or for individual key features, and indicate whether the effect on management is positive or negative if relevant. Problems associated with the factors should not be resolved in this section they should only be described. Factors most likely to be relevant to a grazing plan are discussed below; MP indicates the overall Management Plan, DMP indicates the Deer Management Plan and the number in brackets indicates the grazing plan component in which the original details are included.

Tenure and Owners'/Occupiers' Objectives (MP)

Consider the interests and land management practices of the current owners and occupiers of the site. These may conflict with the stated nature conservation objectives and therefore have a potential negative impact on the options for management. Conversely, the objectives of the owner may include nature conservation and this is a factor with a positive influence.

Grazing Right/Tenancies (MP)

If there are legal agreements permitting stock grazing on the site, the options for changing current limits should be discussed. The discussion should interpret the details such as the nature of the tenancy agreement to indicate how strongly this factor will influence decisions made about grazing management.

Knowledge of Current Grazing Animals (MP; 1.2; 1.3; 1.4)

Information on the current numbers and distribution of both livestock and wild herbivores should be available in the 'Description'. The quantity and quality of the information available influences the accuracy of predictions that can be made about the effects of herbivores on the features. If there is little information, or if details are based on assumptions or poor estimates, it is more difficult to make the link between grazing patterns and the condition of the site. This creates problems when trying to determine what a more appropriate number of herbivores might be. Describe any gaps in knowledge as factors and explain where estimates have been made.

Herbivore Foraging Patterns

Herbivore foraging behaviour will be a factor because most species are selective to some degree, although this varies between species. This can be an advantage where sufficient open space out with the woodland area exists, dominated by grassland communities, where these are likely to be preferentially grazed to the woodland area, thereby releasing the grazing pressure on the wooded area. Although if animals are using the woods for shelter, grazing pressure can still be high. The broad foraging patterns of the herbivore species present should be discussed in relation to the vegetation present.

Information on Grazing Resource (1.3)

Any gaps in knowledge of the distribution and extent of vegetation should be discussed here. This will influence the accuracy with which predictions of grazing behaviour can be made and will also limit the accuracy of management proposals.

Physical Features (MP)

Important geological, geomorphological, historical or archaeological features of the site can influence the options for grazing management. The status of such features should be noted in the 'Description', but the implications for management and any conflicts with the objectives of the grazing plan should be discussed here. The status of such features will determine their priority, relative to the key features of the grazing plan.

Recreation (MP)

Any conflicts between current recreational use and the objectives should be discussed. For example, if access is important, this put constraints upon options for erecting fences to control herbivore movements. Heavy visitor pressure may also limit the options for culling wild deer populations. There can also be potential conflicts between cows with calves, young cattle and dogs; signage may be needed to make the public aware of these areas of conflict. The new Scottish Outdoor Access Code gives considerable guidance to dog owners about acting responsible when exercising their access rights.

Biological Features (1.3)

There may be biological features of interest that were not selected as key features and therefore are not included in the objectives. However, these features can be considered in the grazing plan by treating them as factors. In this case, the features should be mentioned and knowledge of their ideal grazing regimes may be summarised. Then the impact on these additional features of proposed grazing regimes for the site can be discussed in 2.5 'Rationale and Recommendations for Grazing Management'.

Knowledge of the Key Features (2.1)

There may be a lack of clear definition of favourable condition for some of the features, so objectives will be incomplete. This should be discussed here because decisions about grazing management are likely to be short-term and will change as further information becomes available.

Conflicting Objectives (2.2)

The discussion of grazing impacts for each of the key features may have revealed a direct conflict between some of the features in terms of the ideal grazing pattern required to maintain them. This is an important factor.

Practical Livestock Management (MP; 1.2; 1.4)

This covers a wide range of possible factors. Consider the ideal grazing patterns suggested in 2.3 and determine any immediate constraints on achieving them that so far have not been covered. Particularly consider any practical restrictions on managing livestock, such as access to the site and handling facilities for livestock, moving them, availability of alternative summer/winter grazing, access to water, access to suitable livestock, supplementary feeding requirements, quality of grazing available, animal welfare issues and availability of labour to manage the stock.

Wild Deer Management (DMP)

The presence of free-ranging wild deer will also be an important factor to consider. There are practical difficulties with accurately identifying the species present and assessing deer numbers both within and out with the woodlands. There may also be difficulties associated with controlling the number and distribution of these animals, which do not apply to the management of domestic livestock.

Biological Processes (2.2)

Biological processes should have been mentioned in the discussion of 'grazing impacts' as trends associated with different grazing patterns. The potential effect of succession and the importance of regeneration should be discussed here, noting that it needs to be considered when developing the grazing regime. Regeneration may be limited by poor availability of seeds and/or germination niches and this should be discussed.

Availability of Resources

The implementation of management recommendations is likely to cost money. Resources will be limited and this is an important factor, constraining the range of options for changing the current management practices. Availability of skilled labour may also be a limiting factor and needs to be addressed.

Obligations, Designations & Policies (1.2, 2.1)

The restrictions imposed by any obligations, policies or designations described in 1.2 and 2.1 should be discussed, with specific details of the way in which they may influence management. Particular reference should be made to any potential for 'double funding' or incompatibilities between woodland and agri-environment schemes.

Community Objectives/Public Interest

Some sites may have particular value to the local community in the area; for example a site may be valued for its 'openness'. This should be described if there is likely to be conflict with such interest and the objectives of the grazing plan.

Socio-Economic Concerns

The social aspects of agriculture or other land-uses on the site must be considered, particularly in rural communities dependent on such land-use. There may be conflicts between proposed management for nature conservation and the economics of the local community. Equally grazing for nature conservation benefit could help to sustain farming incomes, maintain stock on the holding and sustain or generate local employment.

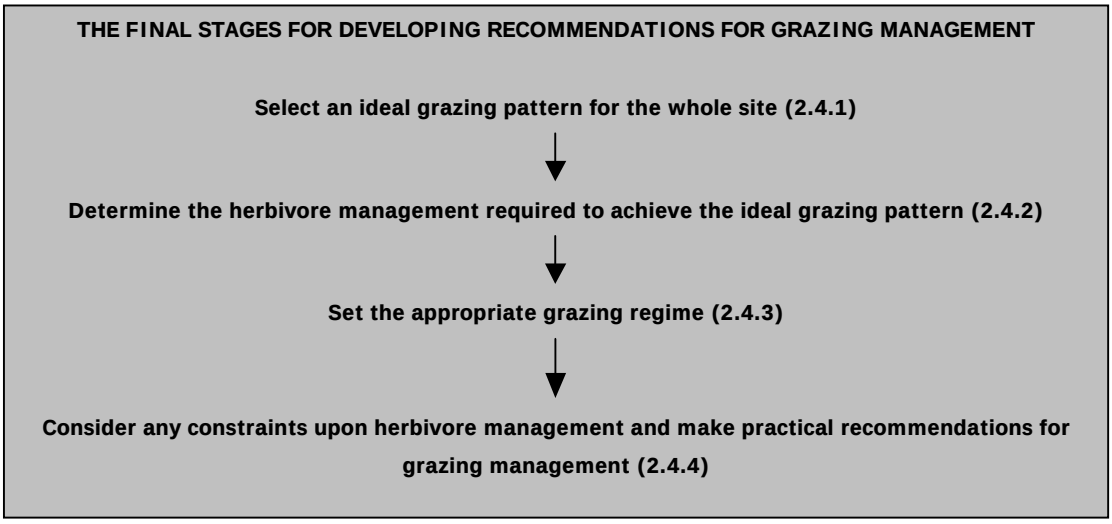
2.4 Rationale and Recommendations for Grazing Management

- ***Select the ideal grazing pattern for the whole site***
- ***Discuss how herbivores could be managed to achieve the ideal grazing pattern***
- ***Consider any constraints on implementing grazing management***
- ***Make recommendations for the practical management of grazing animals on the site***

Content & purpose

This component of the grazing plan incorporates the final stages of making decisions about grazing management for the site. The discussion includes determining how objectives could be achieved with grazing management, the options for managing grazing and the practical problems. This concludes with recommendations for practical herbivore management.

The box below shows the basic stages; the full process is shown in detail in Chart 2 (Appendix 3).



2.4.1. Choosing the Ideal Grazing Pattern for the Site

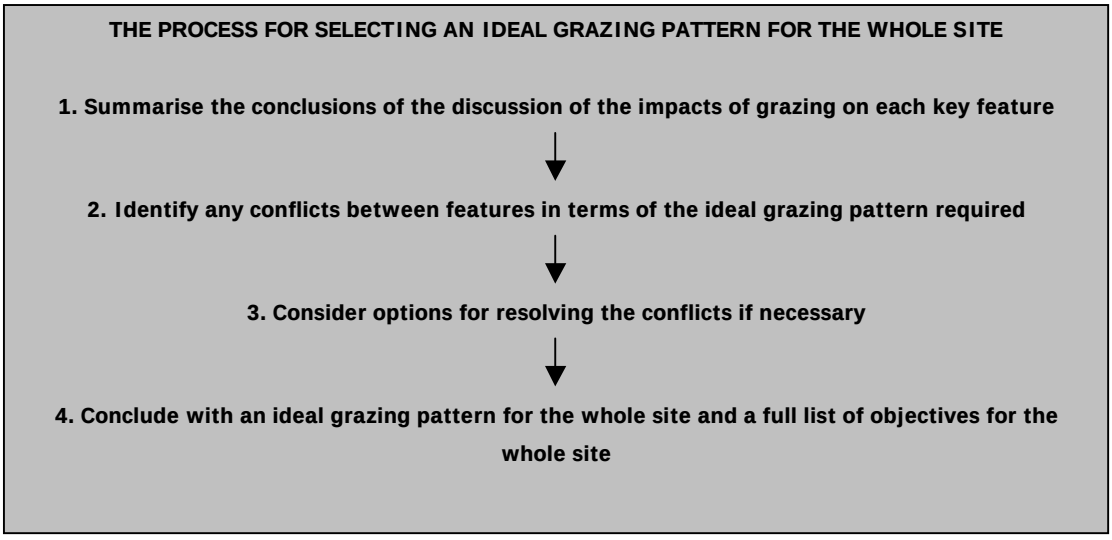
The ideal grazing pattern for the whole site defines the grazing required in terms of the grazing pressure, timing, location and the degree of selectivity (see Information box 9).

INFORMATION BOX 9: Ideal Grazing Pattern for the Site

Once an ideal grazing pattern for each key feature has been determined, the ideal grazing pattern for the site must be selected. This involves comparing the range of ideal patterns for the key features, contrasting them and reaching a compromise where necessary, to conclude with a grazing pattern for the site which will best achieve the objectives. It may not be possible to find one grazing pattern to meet every objective, but the grazing pattern selected should be the best option or compromise for the whole site.

Grazing management will be aimed at meeting objectives for individual key features, but will be implemented at a site or management unit level. So the first step to making decisions about grazing management is to consider the objectives at site level. This involves looking at the objectives for the key features as a group of objectives for the site. Some sites may have more than one key feature and different features may require different grazing patterns. Conflict of this nature is a factor affecting the management of the key features. This conflict must be resolved to select a range of objectives for the whole site.

The process is outlined in the box below in four steps and further details of each step are given on the following pages. However, on small sites and/or sites with few key features it may not be necessary to go through the complete process. It may be possible instead to identify a general pattern and go straight to step 4.



1. Summarise the conclusions of the discussion of the impacts of grazing on the individual key features

- aim to identify the main impacts of grazing on each feature; include the ideal grazing regime, grazing patterns which are expected to be damaging and any grazing pattern which, although not optimal, is not expected to cause significant loss or damage to a feature

- note any uncertainties in the impacts of grazing, or any features for which the ideal grazing pattern is unknown; in these cases, use what is known about the current impacts of grazing to indicate the required direction of change to the grazing regime
- compare the options for changing the grazing regime with the current grazing regime and present this in a table as shown in Example Box 1. The column headings refer to broad categories of grazing pattern and the best option for each feature is shown.

EXAMPLE BOX 1: The Predicted Impacts on Key Features of Broad Categories of Grazing Regime, Compared with Current Regime (example)

Feature	Increased Grazing	Decreased Grazing	No Grazing	Late Summer Grazing Only
1	continue to decline	unknown	**positive, best option**	no change
2	unknown; very heavy grazing negative impact	unknown	probably negative	**positive, best option**

2. Identify any conflicts between the features in terms of the ideal grazing pattern required:
   - describe the conflicts; what features require different grazing patterns?
   - indicate the extent of conflict; focus on the different grazing patterns required and the options for achieving a compromise: is there one pattern that favours some features and although not optimal for others, would not be damaging, at least in the short-term?

3. Consider the options for resolving conflicts between the features. At this stage there is a collection of individual feature objectives. If objectives have been prioritised (see Information box 10) in resolving the conflicts then certain objectives may have been rejected in favour of higher priority objectives. Compile a new list of the revised objectives; these are the objectives that the plan aims to meet to the site level. A range of options are described in Information Boxes 10-13. Think about each option and select the best. During this process, think about the factors (opportunities and constraints previously identified) affecting the management of the key features, to assess how feasible each option would be. There may be constraints that make certain options impossible and these can then be rejected at this stage.

4. Conclude the discussion with:
   - a list of objectives selected for the site, or for each management unit as appropriate
   - an ideal grazing pattern for the whole site, or for management units, aimed at meeting the objectives. Include details of the required grazing pressure, distribution of grazing, seasonal variations in grazing and the degree of selectivity required.

INFORMATION BOX 10: Option 1 for Resolving Conflicts Between Features

Prioritise the Features

For most plans, it should be possible to priorities the key features, based on their conservation status. The order of priority is dictated by the decisions made for section 2.1. Allocate the features to categories of similar status and consider whether one grazing pattern could be implemented to meet the objectives for the highest priority features. Is there conflict within the groups of features? If not, decide whether features from the next level of priority can be maintained with the same grazing pattern.

The aim of prioritising features is to find out if there is one grazing regime that will meet the objectives for all of the most important features, but this means that objectives for lower priority features will not be met. This approach will not work if there are conflicts between features of the same status.

If one grazing pattern would meet the highest-ranking objectives, discuss the impacts on the remaining key features; would this be acceptable?

With this option, only the objectives for a group of high priority features will be met.

INFORMATION BOX 11: Option 2 for Resolving Conflicts Between Features

Vary the Grazing Regime Spatially on the Site

The option of varying the grazing regime spatially should be considered at different scales.

Key Feature Scale

Discuss the possibility of varying the grazing regime according to the distribution of the key features, with each feature receiving its optimal, or next best, grazing regime. This will require a good knowledge of the distribution of features on the site. This option could be constrained by the distribution of the key features; for example if there are mosaics of key features that require different grazing regimes, this option will not be practical.

This option would attempt to meet all of the feature objectives on the site.

Larger Scale

If grazing cannot be varied at the feature scale, options for varying it at a larger scale should be discussed. For example, it may be possible to vary grazing between management units. It is likely to be more practical to attempt to vary grazing with management unit than with features, because herbivore management may vary at this scale anyway. To determine how practical this option is, consider whether the distribution of the features allows the division of the site into areas that support features that require similar grazing patterns. The herbivore species present could constrain this option; it may be more difficult to control the distribution of wild animals than domestic stock. Consider also how practical it would be to sub-divide the site. Would fences be needed and if so, is this a likely option (ease of fencing, access etc)?

This option would mean that different objectives would be met on different parts of the site. Loss or decline may have to be accepted for some features in some areas. It may be possible to meet all of the objectives over the site as a whole, while accepting loss in some places.

INFORMATION BOX 12: Option 3 for Resolving Conflicts Between Features

Vary the Grazing Regime Temporally

It may be possible to introduce a short-term grazing regime that would favour certain features, with a view to changing the grazing regime in the future to favour other features. This approach could be used if a short-term change were sufficient to permit the restoration of a degraded feature and would be unlikely to result in damage to other features. The grazing pattern would need to be changed before other features were lost or damaged.

This option would aim to meet all of the objectives in the long-term.

INFORMATION BOX 13: Option 4 for Resolving Conflicts Between Features

A Combination of Options 1, 2, and 3

It may be necessary to combine elements of several of the above options to find the best solution for a site. For example, the plan may prioritise the features and meet the objectives for each priority feature on only parts of its range. Some loss or decline of even the highest-ranking features may have to be accepted.

N.B. The options given in Information boxes 11, 12 and 13 may offer the greatest opportunity to integrate agricultural and woodland objectives, allowing some areas of compromise.

2.4.2 Determining the Grazing Regime to Achieve the Ideal Grazing Pattern

The steps so far described have led to a proposed ideal grazing pattern. The next step is to decide how herbivores should be managed to produce this pattern. To do this, it is necessary to consider:

- how existing or introduced herbivores can be managed positively to achieve the objectives for the site.
- how existing herbivores should be managed to minimise or eliminate any negative impact

The ideal grazing pattern for the site defines what is required from the grazing animals. This section deals first with positive management of herbivores to achieve this ideal; controlling damaging impacts of existing herbivores is treated as a factor affecting the management of the key features.

The ideal grazing regime should be defined in terms of a set of characteristics, as listed in the box below, and decisions taken should relate to the management objectives set out for the key features. Further details of how to make decisions for each element are given in Information boxes 14 – 22.

DEFINE THE IDEAL STOCKING RATE IN TERMS OF:

herbivore species:

can existing herbivores be used to achieve the grazing pattern?

herbivore breed

herbivore sex/age class

seasonal distribution

spatial distribution

number/density/duration

consider first the existing herbivores

INFORMATION BOX 14: Selecting the Appropriate Herbivore Species

Herbivore species vary in their foraging behaviour and distribution. Consider the foraging behaviour of different species in terms of how selective they are and which vegetation types they are most likely to graze. As far as possible, try to choose the species that best suits the requirements for the site, using either existing herbivores or domestic species that are commonly kept in the area and could be introduced. Gather information on the herbivore species within your area to determine the best species for the site and also to predict the impacts of existing species. Specific details of the foraging behaviour of sheep and cattle are given in Table 1 and Appendix 1.

INFORMATION BOX 15: Selecting the Appropriate Herbivore Breed, Sex and Age Class

Foraging behaviour and distribution will vary to some extent between different breeds of the same domestic livestock species and may also vary between sexes and age class. For example, different breeds of sheep and cattle will range differently and will often select different forage. Constraints on having cows calving, on a site should also be considered, as should the ease of handling young stock. Consider these variations to select the most appropriate type of herbivore or to predict the impacts of existing herbivores.

INFORMATION BOX 16: Describing Seasonal and Spatial Elements of the Stocking Regime

The distribution of herbivores across the site will vary with factors such as herbivore species and time of year. Consider existing knowledge about the herbivores present at the site to predict how they will be distributed across the site an overlay this with the spatial and seasonal distribution required in the ideal grazing pattern for the site. Seasonal variation of forage availability and species preferences will also determine how the herbivores utilise the site. Knowledge of the way the animals graze or browse and the vulnerability of the vegetation to this grazing or browsing will help you to select not only the appropriate herbivores but also the time of year to graze the site.

Recent work suggests that the impact of livestock on saplings is worse if they are present in summer than if they are present in winter (Welch, 2003). Initial monitoring results from the Island of Rum 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 (Armstrong *et al*, 2003).

INFORMATION BOX 17: Estimating the Appropriate Number/Density of Herbivores

To make decisions about herbivore density, consider first what density of existing herbivore species would be desirable, before thinking about the options for introducing new species or breeds. Work within practical limitations on stock availability and ease of management.

Information box 18 gives recommendations for estimating the sward production and utilisation targets for field layer vegetation and is the methodology that is being recommended as being the starting point for setting livestock numbers/densities for controlled livestock grazing in woodlands.

Some of the other tools available for estimating density are described in Information boxes 19 – 21, but these must be used with care. Their use and some of the limitations of each are discussed. Note that in general it is possible only to estimate the density of herbivores required and changes should be made cautiously at first, allowing for further change in the future, depending on the results of monitoring.

INFORMATION BOX 18: Sources of Information for Determining Appropriate Herbivore Densities

1. Estimating Sward Production and Utilisation Targets for Field Layer Vegetation

As the interaction between animals' nutritional requirements and sward forage quantity and quality appears to determine browsing levels on saplings (Pollock *et al.*, 2005) any management should be carried out with an understanding of these factors. Biomass production by the sward and the nutritional requirements of the stock must be balanced in order to meet the site objectives. It is clear that as there is much variability in the grazing resource (including grazing outside the woodland), in the supplementary feeding provided and in the dietary requirements and preferences of the livestock (depending on species, breed, size, pregnancy and lactational demands). The nutritional value of standing biomass will differ dramatically depending on previous management, upon plant community type, level of shading by trees and in particular it will depend upon season.

To be able to use this methodology baseline vegetation survey information is essential in order to describe the vegetation types present, before the start of management, and to estimate the production of the vegetation communities both below the tree canopy and in the open habitats beyond.

The setting of livestock numbers should involve the farmer or land manager. It should link the target utilisation of biomass for the site to the daily intake rates of the livestock. 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. Further guidance on relating stock requirements and target utilisation rates is given in Appendix 6.

INFORMATION BOX 19: Sources of Information for Determining Appropriate Herbivore Densities

2. Published Figures

In the absence of a vegetation survey to estimate the production at the site, the ranges given in Appendix 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. 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*.

For plant communities, as features or habitats for animal species, there may be published figures that indicate the density of herbivores required to maintain the habitat. This information is more likely to exist, however, for the non-wooded habitats and the objectives for these areas will need to be balanced with the woodland objectives in order to determine the ideal grazing pattern for the site as a whole. This will depend, however, on whether the site is to be managed as a whole or if fences are to be used to divide the area up in to smaller management units.

These figures are based on scientific research, and although valuable they are not ideal and should be used in association with other information, for the reasons discussed below:

- This information is a useful starting point, but it will be available for only some vegetation types. As far as possible, use information from similar sites in terms of location, altitude and climate.
- Research is often limited to a small number of sites and results are not widely applicable so should be treated as broad estimates.
- Animals will not be managed at the level of the individual feature and other vegetation present will vary between sites. The utilisation of a plant community will vary depending on the foraging behaviour of herbivores and this will vary between sites, even with the same herbivores. This means that with a standard herbivore density, utilisation, and so grazing impact, will vary between sites. Grazing pressure will correspond most closely with animal density for highly preferred vegetation types because these types will always be preferentially grazed. For poorer quality types, grazing pressure will depend on a range of site factors.

INFORMATION BOX 20: Sources of Information for Determining Appropriate Herbivore Densities

3. Current Grazing Regime

A good knowledge of the current (or recent) grazing regime and the current (or past) state of the vegetation is one of the most useful tools for determining what stocking rate would be appropriate. Even basic information can be useful, at least to indicate whether a change to the current regime is needed and in what direction a change should be made. Obviously this method applies only to sites that are currently (or recently) grazed.

- Attempt to determine, from an assessment of condition and grazing impacts for each feature, whether a change to the current pattern of grazing is needed and to estimate how drastic the change needs to be; it should be possible to say a 'large' or 'small' reduction in grazing is needed.
- Use existing knowledge of animal numbers and distribution in addition to the information above to estimate how much of a change in animal numbers is needed, bearing in mind foraging behaviour of the animals currently present.
- Avoid recommending very large changes at first; any change should be accompanied by monitoring and should be reversible.

INFORMATION BOX 21: Sources of Information for Determining Appropriate Herbivore Densities

4. Anecdotal Information

- Speak to the farmer/land manger and managers of other sites about their grazing management and its impacts; bear in mind the difference between sites. Look for examples of 'best practice' elsewhere.
- Speak to 'experts' in the grazing field who can give you guidance.

The tools discussed in Information Boxes 14 - 21 can help to guide decision-making, but none is ideal. There is no instant formula to determine the stocking densities for the ideal grazing pattern. For many features, and in particular woodland grazing, a lack of scientific knowledge about the impacts of grazing mean that it is not possible to produce a detailed proposal for an 'ideal' grazing regime anyway. For most sites, the proposals for herbivore densities cannot be accurate. For all of these reasons monitoring must be seen as an integral part of grazing management, which will feedback into the development of grazing prescriptions in the future. Any grazing management proposals must be seen as experimental in the first instance, with careful, targeted monitoring to establish whether the management is working and the key features are being maintained or enhanced (see 2.5).

2.4.3. 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 a fairly wide interval of time, within which if grazing periods are concentrated positive outcomes should result. 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 it to keep the prescriptions as simple as possible, whilst always been 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 the availability of the preferred forage in the first instance in addition to continual monitoring of the extent of browse damage on the woody plants following the introduction of a controlled grazing regime. Thus 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 possibly confirm whether proposed stocking densities are too high or the grazing period too long.

2.4.4. Recommendations for Practical Herbivore Management

The aim of this section of the plan is to determine whether it is practically possible to achieve the ideal stocking regime. To do this, work through the discussion described in the box below, at the management unit level. Remember that what is possible at one unit may not be possible on another.

PROCESS FOR DETERMINING HOW TO ACJIEVE THE IDEAL STOCKING REGIME

Follow this process for each management unit.

Consider the ideal stocking regime

↓

Is it possible to achieve the ideal stocking regime?

- **Review the full range of factors affecting the management of the key features**
- **Discuss the factors that are relevant to the management unit in question**

↓

If it is not possible to achieve the ideal, propose an alternative stocking regime and decide how this could be achieved.

CONCLUDE WITH

Recommendations for practical herbivore management

The predicted impacts on any key features for which the objectives are not being met

Discuss any uncertainties in terms of impact on key features

Discuss possible long-term solutions to any problems that have prevented achievement of the ideal stocking regime

In reality there will be a range of practical factors, involved in managing stock over the whole site to achieve that 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

2.5 Monitoring Protocols

Monitoring is an essential part of site management. It is required to determine the success of management and to feedback into the process of making decisions in the future. If public funding is being claimed for any aspect of the grazing plan monitoring of results will be a requisite of the funding body e.g. FCS or SEERAD, to verify that management has been appropriate; in the case of FCS normally after years 5 and 10, in the case of SEERAD this may be annually.

Note that recording condition of the features will not necessarily indicate the impact of grazing on them, but the effects of a new grazing regime will have to be assessed. A range of factors, of which grazing is only one, determines condition so monitoring this alone will not indicate the impact of grazing management.

A complete monitoring programme would aim to record the following:

- the condition of each feature, using the attributes defined with the objective
- the impact of grazing on each feature, in particular the impact of any change in grazing

Ideally, a monitoring project will be linked to each attribute within each objective for the key features in the grazing plan. In practice, the large number of projects generated by this process may exceed the resources available. In this case, it will be necessary to priorities projects, targeting monitoring towards recording information of most value in the management of the site.

Monitoring commitments can be reduced in one of two ways:

- prioritise monitoring projects (see below)

- record grazing impacts and indicators in a more subjective way, rather than measuring each attribute; this could be based on assessments by eye of obvious indicators, or grazing impacts could be assessed using the methods described by MacDonald *et al* (1998) and Jerram & Drewitt (1998).

The protocols for monitoring the effects of controlled livestock grazing in woodlands are detailed in Appendix 7 This includes monitoring that will be done in years 1, 5 and 10 to satisfy the requirements of the FCS. In addition there will be annual monitoring undertaken by the farmer/land manger in order for them to make informed decisions about modifying the grazing regime as a response to sward production and grazing/browsing impact. Finally there is a Management Diary that has to be completed by the farmer/land manger/stock person that will require them to record relevant information relating to the livestock, e.g. breeds, numbers, age, movements on and off site, supplementary feeding, medications etc.

As this toolkit is targeted at drawing up woodland grazing plans the monitoring protocols described in Appendix 7 have been set up with the monitoring of the grazing impact on the woodlands as being the main objective. If, however, there are additional non-wooded habitats that have been identified as key features within the site or management unit and/or resources are limited, it may be that subjective assessments as described above could be adopted for these areas.

Priorities in Monitoring

In order to prioritise monitoring projects for each management unit, the following aims should be considered:

- Aim to determine whether the objectives for each unit are being met; i.e. whether the features are in favourable condition. If objectives vary between units, it is a priority to monitor the condition and impact of grazing on the features that are favoured on each unit. Other features may be allocated a lower priority.

- If the objectives are the same for each unit, target monitoring at features that are expected to change, either too improve or degrade with the new grazing regime.

- Aim to monitor the success of any restoration management by measuring the short-term restoration attributes used in the objective.

- Aim to record the condition of features for which there was little information; if the impact of grazing on some features was unknown, these features should be monitored as a priority to ensure that serious damage does not occur.

N.B. If the site, or part of it, has a nature conservation designation the relevant agency responsible should be undertaking site condition monitoring. If this is the case all monitoring protocol proposals should be discussed with them to ensure that there is no duplication or omissions.

Appendix 8 gives an example of species specific monitoring.

2.6 Prescriptions

- ***Summarise the recommendations for herbivore management***
- ***List monitoring projects***
- ***List other projects***

In this section of the plan, present a summary of the proposed work – the prescriptions. These will then be developed further to create a work programme that lists specific tasks to be undertaken at the relevant time of year. The information listed below should be extracted from the grazing plan and summarised here. This can be presented in a table. Identify the following for each individual management unit:

- objectives to be met for that management unit (as identified in 2.5)
- recommendations for grazing management, for example, include the following
    - The species, breed, sex, age and number of livestock
    - Seasonal variations in livestock management
    - The location of any fences
    - The proposed culling regime for wild herbivores
- monitoring projects; show the priority of the projects indicating essential projects and rank the others
- other projects identified in the grazing plan, such as where there is a need to collect more information about a key feature

EXAMPLE BOX 2: Prescriptions for Each Management Unit

Management Unit	Objective	Grazing Management Prescriptions	Monitoring Projects	Other Projects
A	1	Autumn cattle grazing	Monitor sward productivity, grazing sensitive species and browsing damage	Monitor open space and Pearl-bordered Fritillary Population
B	2	Complete exclusion	Monitor tree regeneration & field layer vegetation diversity	Monitor Pearl-bordered Fritillary Population

Appendix 4 gives a summary of the planning procedure for writing grazing plans for managing woodlands with livestock. You can use this as a useful checklist to confirm that you have covered all the relevant steps.

APPENDIX 1: Grazing Behaviour and Impacts of Domestic Livestock in Woodlands

(Source Stewart & Eno, 1998 and Kennedy 1999)

Grazing Behaviour

Grazing by livestock in woodlands can be a major factor determining the structure and species composition of the woodland. The manipulation of grazing regimes by farmers and land managers can be a powerful tool in the management of the woods and associated habitats. To predict the effects of grazing at a particular site, an understanding is needed of the foraging behaviour, diet selection and intake of the livestock involved. Table 1 in the Toolkit summarises the differences in feeding behaviour and preferences of the main domestic livestock species and the resultant effects in the habitats.

Foraging Behaviour

Ancient or semi-natural woodland sites are not uniform but can often consist of a mosaic of both woodland and vegetation types differing in altitude and aspect. Each vegetation type will represent a food resource for grazing animals and each has a feeding value, which not only differs from that of the other vegetation categories but also varies throughout the year.

The feeding value of a vegetation type has three components:

1. The nutritional content of the forage
2. The ease with which this can be extracted by digestion
3. The ease with which it can be grazed

The attributes of vegetation that affect feeding value include:

- the proportion of live and dead material available to the animal in a bite,
- the digestibility off live and dead plant material,
- the presence of chemicals that are hard to breakdown in the gut,
- the content of mineral nutrients,
- the size of bite possible,
- the rate at which biting can occur,
- the presence of spines or thorns, and,
- the presence of silicates in the vegetation, which make it harder to bite through.

The area that livestock graze is determined by a number of factors including feeding value of different vegetation patches, shelter from wind or rain, impact of flies and biting insects, accessibility, social behaviour and human disturbance or management. In general livestock will spend most of their time on vegetation types that have the highest feeding value. In practice, the other factors influencing herbivore movements generally cause them to be distributed over all vegetation types, but with a bias towards those which give the highest nutritional return. The differences in the grazing attributes of each large herbivore (Table 1) together with differences in the other factors determining movement, will lead to each type of livestock using the available forage area in a different way.

Sheep – typically group together in flocks, during the day they will tend to graze on favoured vegetation types. At night time, if possible, they will tend to move uphill. In summer, sheep may move uphill or out of the woodland to avoid flies and/or biting insects, to cool down or to exploit later growth of grasses at higher altitudes. In winter they will use the woodland and

dykes to find shelter from inclement weather. Sheep, like cattle, will congregate around winter-feeding sites, where these are provided.

Cattle – tend not to be able to graze short grassland as efficiently as sheep but, because of their larger gut size, have a greater ability than sheep or deer to digest poor quality forage. As a result they are more likely to graze the less palatable vegetation types, such as mat-grass or purple moor grass. Hardy native breeds or their crosses can be successfully outwintered in woodlands, although particular attention will need to be paid to the sitting of supplementary feeding sites and the amount of 'poaching' in order to minimise negative impacts of diffuse pollution through water runoff and soil erosion. Cattle tend to move around their range as a herd, although they are usually not found on very steep slopes and on particularly rocky or scree covered ground. They will move off the more nutritious vegetation and use their range as fully as do sheep if they are on a site for enough of the year to become familiar with all of it.

If stock run out of good quality feed and are forced on to poorer vegetation their body condition may well suffer. Stock health and condition should be evaluated regularly and any signs of significant loss of condition should be acted upon. This may involve giving supplementary feeding to enable them to survive.

Interactions between grazing species can be positive or negative. All species compete for the available vegetation. Smaller herbivores, with smaller mouths, are able to graze grass swards to a shorter sward height and still gain the daily intake of digestible material that they need. The larger mouth sizes of larger herbivores restrict the efficiency with which they can graze short swards. Large herbivores also have a higher daily intake requirement, which they are unable to satisfy from short swards. In theory, large herbivores will move of grasslands before smaller ones as the swards become shorter. Large herbivores are, however, better at digesting rougher vegetation and can survive where vegetation quality it too low to support smaller herbivores. Cattle can graze mat-grass or purple moor-grass to a level that allows more nutritious grass species to increase in abundance, thus increasing the overall livestock productivity of the hill.

Diet Selection

Just as grazing pressure at the landscape scale is not uniform, so grazing pressure within a vegetation type is also not uniform. If a vegetation type contains a mix of plant species and a mix of live and dead material, an animal will select the most nutritious diet permitted by the size and shape of its mouth in relation to the size and distinctness of the different components of the vegetation.

Most herbivores grazing vegetation containing a high proportion of dead material are capable of selecting a diet that contains a lower proportion of dead material than is in the sward. The ability to select live material depends on the size and shape of the herbivore's mouth and on the distribution of live and dead material in the sward. As the proportion of dead material builds up in a sward, an animal's ability to select live material declines and the digestibility of the diet also declines.

At low densities, animals grazing on good grass concentrate on a few patches, thereby creating a mosaic of patches of different sward height. By doing this, they ensure that they always have access to patches where there is no build-up of dead material and digestibility remains high.

Many plant species can have a variety of growth forms depending on environmental conditions and grazing history. Selection, or avoidance, by herbivores of a particular plant species can depend on the plants' growth form in a particular patch and on grazing pressure.

Food Intake

The amount that an herbivore can eat when there is unlimited food available is directly related to the digestibility of the diet and the animal's size. When the digestibility is low, the gut takes longer to digest the food so less can be processed. Large animals have larger guts so can process more food. Information on the food intake of herbivores coupled with information on sward quality and quantity can be then used to estimate the number of livestock that can be sustained on any given site. See Appendix 6 for utilisation targets for field layer vegetation.

Impact 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.

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.

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).

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.

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.

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 that 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 in 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.

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.

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

Some Specific Issues

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).

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 taking to reintroduce grazing, it may be that stock are just no longer available on the holding (or even locally).

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. grater 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.

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 to 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.

APPENDIX 2: Site objectives, management scenarios and monitoring requirements

Objective	*Management scenarios*	*Monitor*	*Estimated LU days per ha**
Maintain wood pasture	*Continue grazing, plant trees and protect from grazing*	*Ground flora diversity, growth of protected trees*	*focus is sward; need estimate of site production*
Increase woodland cover, no intention to manage as grazed woodland in medium-term.	*'Mob-stocking' with cattle or pigs to create regeneration niches, followed by period of no grazing.*	*Trampling impact, seedling numbers*	*100 – 200 (many animals, short period)*
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-turn 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. b: If young trees not frequent enough, see above. c: If young trees too frequent, see below.	Area of open ground, Amount of regen coming through. Presence of patches of short sward	40 – 80
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	?

APPENDIX 3: Decision Charts

CHART 1: Factors That Determine the Impact of Grazing on Vegetation (source Stewart & Eno, 1998)

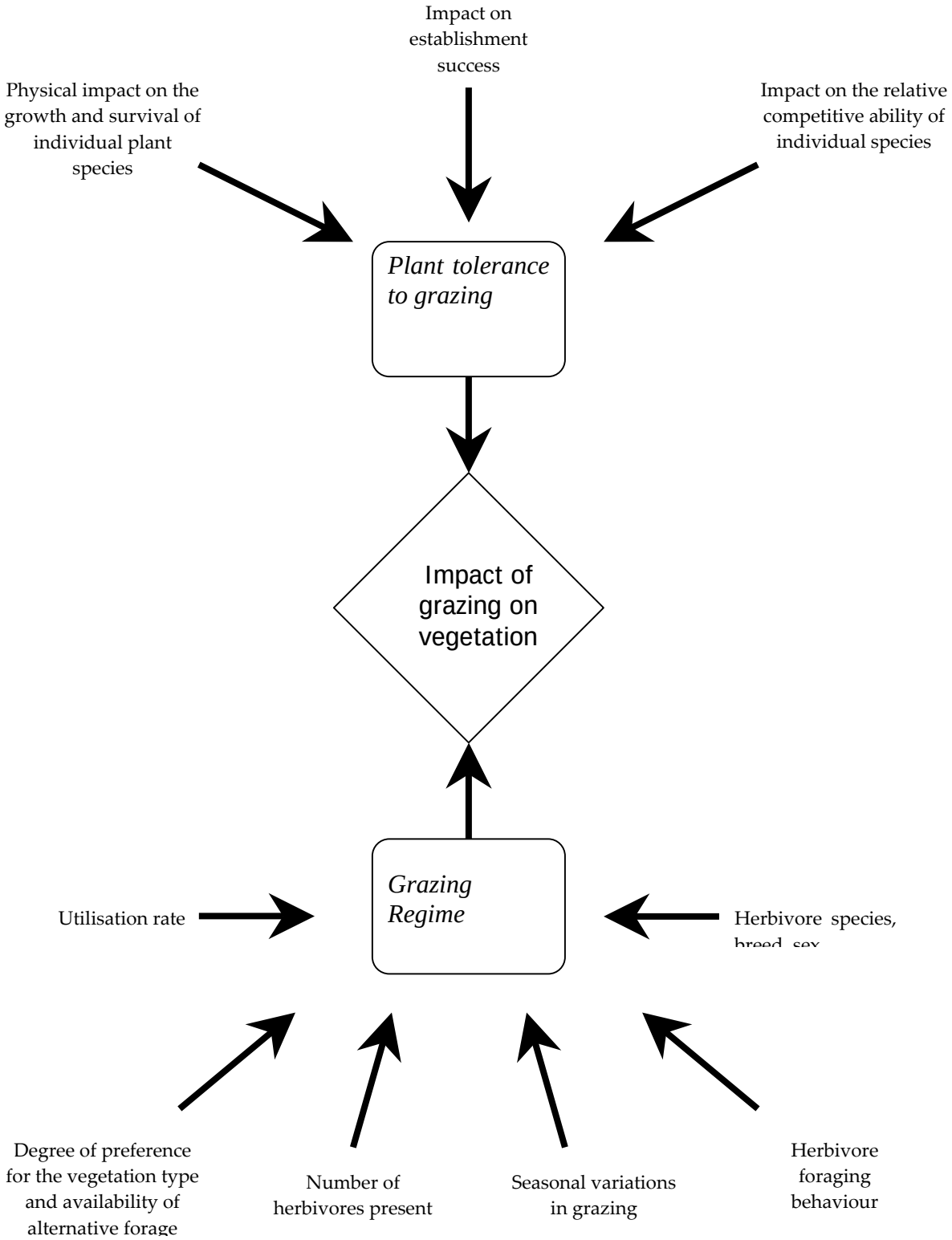
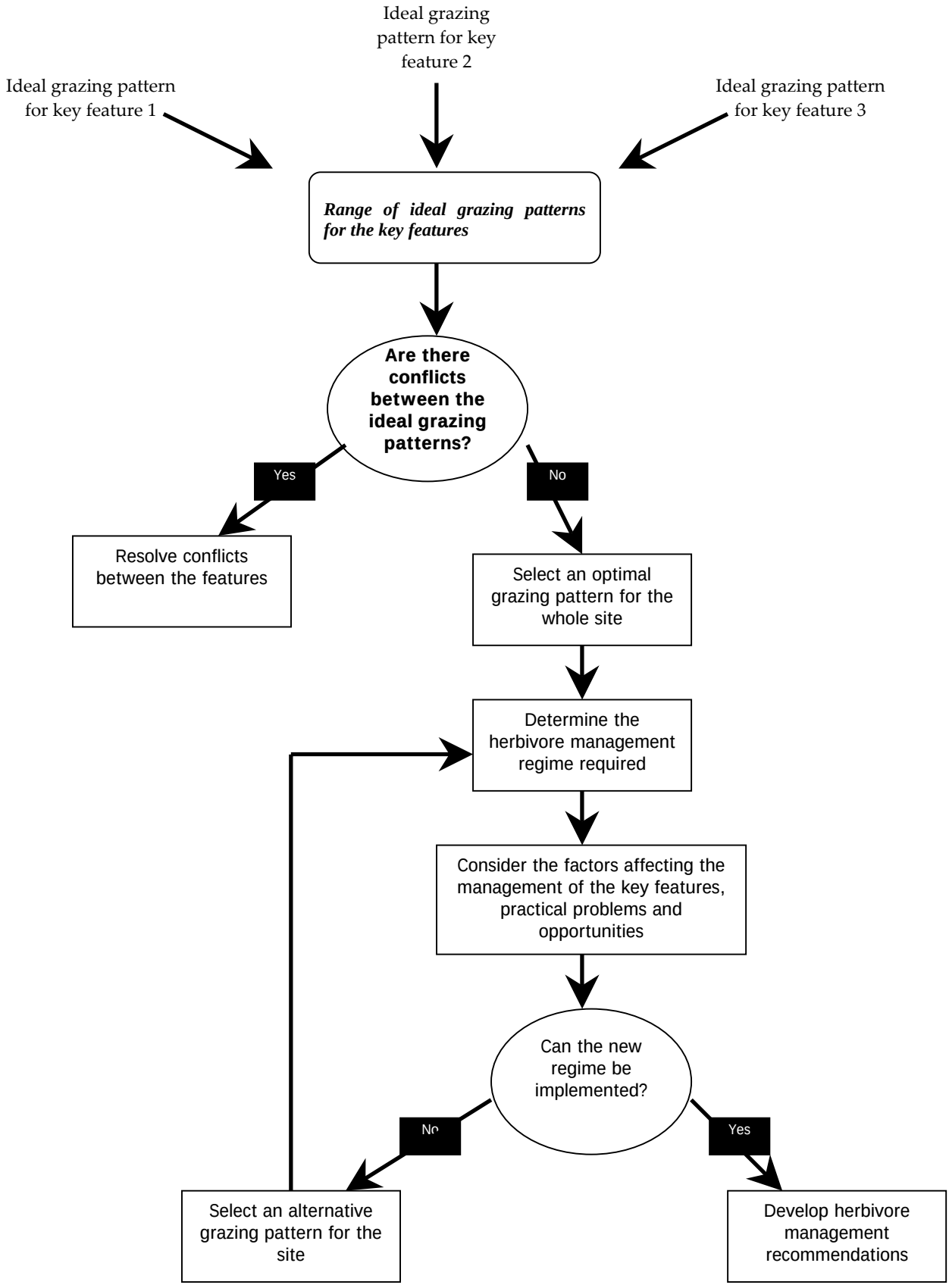


CHART 2: The Process for Making Recommendations for Grazing Management (source Stewart & Eno, 1998)



APPENDIX 4: Managing Livestock in Woodlands

***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 un-fenced, 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	Write Grazing Plan	Identify key features, required future condition 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, tree species and signs of browsing, 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, *at 5 & 10 years*
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)

APPENDIX 5: Guidance Table for Determining Species of Grazing Animal Present

(Source Thompson *et al., 2004.)*

Animal (plus code)	Signs	Dung (droppings)	Tracks and Pathways	Minimum height of grazed sward	Browsing characteristics (a)	Bark stripping characteristics (b)	Maximum height of (a) and (b)	Comments
Sheep (S)	White wool snagged on fences/shrubs.	Roundish but angular and irregular shape. Smooth surface, shiny when fresh.	Slots rounded at tips. Broader and more rectangular than for deer.	3cm	Ragged ends to bitten-off shoots which are always eaten.	Occasionally. Young to pole stage trees. Can be severe in seriously over-grazed woods. Diagonal incisor marks.	1.5m	Avoids less palatable species in spring (eg rushes). Impact can be uniformly spread over large areas in most regions.
Goats (G)	Black and white wool snagged on fences.	As for sheep.	As for sheep.	6cm	As for sheep.	Can be severe with small/ medium sized trees/shrubs killed. Diagonal incisor marks.	1.5m	Confined to very few areas. Rocky outcrops/ledges are required for shelter and foraging. Can negotiate most fencing with ease.
Cattle (C)	Trampled tall vegetation. Rubbed trees. Poaching.	Large round pats.	Widely splayed deep slots. Pathways 0.3m wide.	6cm	Roughly torn and pulled up vegetation. Trampled standing areas for ruminating.	Rubbed trees only	2.0m	Are often sheltered in woodlands in winter where poaching of soil surface around supplementary feeding stations can occur.
Ponies/ horses (P)	Trampled vegetation. Rubbed trees. Barked stripped trees.	Coarse fibrous heaps.	Rounded hoof marks. Pathways 0.3m wide.	2cm	Nipped favoured vegetation close to ground. Less woody growth.	Individual trees of any age can be stripped in patches.	2.0m	Rarely found or sheltered in close-canopied woodland.

Animal (plus code)	Signs	Dung (droppings)	Tracks and Pathways	Minimum height of grazed sward	Browsing characteristics (a)	Bark stripping characteristics (b)	Maximum height of (a) and (b)	Comments
Roe deer (RO)	Frayed young trees. Hair in barbed wire fencing.	Short blackish cylindrical and pointed at one end. Smooth surface, shiny when fresh.	Well used narrow pathways. Slots pointed and together at tips.	4cm	As for sheep. New bramble and birch shoots favoured.	Rarely strips but frayed stems (ie young bendy trees with bark rubbed off by antlers) frequent on edges.	1.1m	Most likely deer species in the uplands. Impacts may be acceptable where other herbivores absent, due to social spacing.
Fallow deer (F)	As for roe, and chewed/ thrashed plastic tree shelters.	As for roe, but larger with striations and less uniform shape for older males.	As for roe, but pointed tips more splayed (seen at wet muddy crossings).	4cm	As for sheep. Bramble leaves in winter, shoots in spring. Ash also favoured.	Young pole sized trees or stools of favoured species. Bark eaten. Vertical incisor marks. Some frayed young trees.	1.8m	Less likely than red or roe in the uplands. Impact may be heavy but variable due to social spacing, use of favoured traditional areas and degree of disturbance.
Red deer (RE)	As for roe and wallows in wet hollows.	As for fallow, but larger and more fibrous and brownish.	As for fallow but more poached pathways in places.	4cm	As for sheep/roe.	As for fallow.	1.8m	Common in some upland regions. Impacts may be uniformly heavy over large areas. Favours wet, boggy woodlands.
Rabbits (R) and hares (H)	Holes, dunging tumps. Very short vegetation in patches.	Roundish and fibrous. Deposited in favoured areas.	Narrow vegetated pathways. Pad marks evident in snow/frost.	1cm	Sharp angled, knife-like cut ends to bitten shoots which can be left uneaten (NB always left uneaten in hares).	Areas of young/medium aged smooth barked trees and shrubs. 3-4mm wide diagonal incisor marks in pairs. Bark patches removed often not eaten.	0.5m	Locally at very high densities on dry, calcareous free draining slopes mostly on the east side of the Pennines.

N.B. It will be relatively easy to determine the species responsible for the impact in a particular woodland if only one species is present. However, up to 4 species may commonly be impacting, albeit in different seasons. Determining the relative contribution of sheep/deer to the impact will be difficult and may be not possible in some instances.

APPENDIX 6: Utilisation Targets for Field Layer Vegetation *(Source Waterhouse et al, 1999)*

Introduction

It is clear that as there is much variability in the grazing resource (including grazing outside the woodland), in the dietary requirements of the stock (depending on size, pregnancy and lactational demands) and the supplementary feeding provided. The nutritional value of standing biomass will differ dramatically depending on previous management, upon plant community type and level of shading by trees and very much will depend upon season. It is possible to provide target stocking rates for **fields** of predictable productivity for particular parts of the season. These targets are to maintain a uniformly well-grazed sward. To achieve structural diversity in field layer vegetation in fields or woods requires the level of utilisation to be reduced below 50 %. At very low levels of grazing utilisation, the impact of grazing will also be low. For different sites it is possible to estimate dry matter production of field layer vegetation and equate this with animal requirements. Target utilisation levels could be set relatively easily for summer grazing. It is considered likely that target utilisation will be between 25 and 50 % for grassland vegetation and less than 10 % for heather dominated vegetation, both within open ground.

As [field layer production] is an estimate, then certain leeway can be provided to meet the practical requirements of the farmer. A figure of +/- 50 % [of cattle numbers] seems reasonable…Based on some initial calculations and the views of others, upper limits on stocking rates during the whole summer (May to September) are likely to be between 0.1 and 0.5 cows (and calves) per hectare. For shorter periods the densities will be increased proportionately.

For autumn and winter grazing, where supplementary feeding is provided then numbers of cattle to achieve offtakes (in this case predominantly of standing vegetation of low quality) will be very different. Grazing forage intake will be reduced by quality of grazing, by level of supplementary feeding and, for larger areas, by position of feeding points. It is conceivable that stocking rates higher than 1 cow per ha for the whole winter will meet criteria for achieving regeneration and maintaining structural diversity in field layer vegetation. …Cattle commonly receive most of their winter feed requirements from supplementary feeding. …Estimates of appropriate ranges of cattle numbers must therefore be set by taking into account the level and location of supplementary feeding and the size of the wood together with areas of better ground and shelter conditions for camping.

Two worked examples for calculating Utilisation Targets are given below.

Example 1: Calculating Utilisation within a Birch Woodland

Area of site 100 ha – with approx. 10 ha open acid grassland, 10 ha heath, 5 ha mosaics, flushes, 5 ha shrub woodland, 70 ha mature birch woodland with full canopy

PRODUCTION OF GROUND LAYER VEGETATION

	Area (ha)	Estimate of DM Production (tonnes/ha)	Total Production (tonnes)
Open acid grasslands	10	4	40
Heath	10	2	20
Mosaics, flushes	5	4	20
Shrub woodland	5	1	5
Mature birch woodland with full canopy	70	0.5	35
TOTAL PRODUCTION	100		120
Target summer/autumn utilisation: 25% TARGET UTILISATION			30 tonnes (30,000 kg DM)

Cattle requirements per day

Lactation, cow and calf = 10 kg DM per day

Therefore cow grazing days = 3,000

Options for farmer

OPTIONS	ACCEPTABLE RANGE
100 cows (+/- 50 %) for 30 days	50 -150 cows
30 cows for 100 days	15 – 45
20 cows for 150 days	10 – 30

Modified if target utilisation rate is going to be exceeded.

Example 2: Calculating Utilisation within a typical Oak Woodland

Area of site 30 ha - with approx. 10 ha oak woodlands, 10 ha grasslands, 5 ha bracken, 5 ha rushy pasture

Habitat	Area ha	Annual production (edible) tonnes per ha per year	Annual Production tonnes per year
Oak woodland	10	0.3	3.0
Grassland	10	3.0	30.0
Bracken	5	0.3	1.5
Wet rushy pasture	5	2.0	10.0
	30		**44.5** t per yr

Round to 44 tonnes = 44,000 kg

Livestock Requirements

livestock requirements:	kg per day
Beef cow & calf	10
Heifer	**8**
Ewe	1
Pony	5

Utilisation options (depend on aims)

	Amount of production to be consumed by animals		
	10%	20%	30%
kg	4400	8800	13200
Heifer grazing days	550	1100	1650

If aim is to remove 10 % of production using heifers, options include

2 heifers for 275 days
10 heifers for 55 days
20 heifers for 28 days

If aim is to remove 20 % of production using heifers, options include

4 heifers all year round
10 heifers for 165 days
20 heifers for 80 days

These are ballpark estimates, to be used only as a starting point for management. Remember the S9 is a PILOT - we need to try the methods out to see whether they work!!

APPENDIX 7: Monitoring for S9 Pilot: advice for surveyors and farmers

Monitoring needs to relate to the site objectives – look at the management plan and Appendix 2 to check what these are. Different objectives use different monitoring forms – see the table below to decide which forms need to be used. Surveyor's Form 1 a & b and Farmer's Forms 1 & 4 should be filled in for all sites. Depending on the site objectives, some or all of the other forms may need to be filled in. The forms are designed to be largely self-explanatory, but these notes contain extra definitions, and the farmer's management diary.

Site objective	Use Surveyor's Form:	Use Farmer's Forms:	Repeat of Life Level II after 10 years*
Manage sward	1 a & b	1 & 4	yes
Control browsing level on existing regeneration (Requires at least 10 distinct patches of at least 20 individual trees under 2 m tall)	2 a & b	2	yes
Control aggressive/invasive species	3	3	yes
Encourage more tree regeneration			yes; especially important as will determine whether objective met

*Life Level II Survey should be done as a Baseline Survey at all sites under the S3, and then repeated after 10 years.

Advice for surveyors – see Surveyor's Monitoring Forms 1a, 1b, 2 & 3 (published separately)

- It's important to select species of biodiversity interest on sward management sites; ensure that the farmer is trained to identify these species and when to look for them.

- All monitoring plots should be set up in areas accessible to livestock (i.e. not excessively steep), and should be spread as evenly as possible through the site. To decide how far apart plots should be, use this formula:

$$D = \sqrt{\frac{A \times 10{,}000}{n}}$$

  where D is the distance between plots, A is the area of the site in hectares and n is the number of plots. The plots are permanent monitoring plots; take care over recording their location.

- The initial surveyor monitoring should ideally be done during summer and before the new grazing regime is put in place. The S3 Native Woodland Survey should be carried out at the same time as the initial surveyor monitoring. After 5 years, repeat the surveyor monitoring, but not the Native Woodland Survey, which is too broad to detect changes over just 5 years. Repeat the Life Level II Survey after 10 years. The monitoring is spit into 10 plots that are targeted at areas where the object of monitoring interest occurs, and 10 further plots spread evenly through the rest of the site.

- At sites that currently have little tree regeneration and where there is an objective to increase tree regeneration, the Life Level II Survey after 10 years should be used to assess

whether there has been an increase in numbers of young trees. If tree regeneration occurs within the first few years of management, so that the site starts to meet the criteria for Controlling browsing on existing regeneration (see next bullet point), it would be helpful to fill in Surveyor's Form 2 a & b and Farmer's Form 2.

- At sites where abundant tree regeneration (at least 10 patches of at least 20 individual trees under 2 m tall) already exists in areas accessible to livestock, and there is an objective to control the level of browsing, Surveyor's Form 2 a & b should be used to help set up 10 transects in patches of tree regeneration. Surveyor's Form 1 a should then be used, with a plot located at each of the start stobs of the regeneration transects, and 10 additional plots (Surveyor's Form 1 b) spaced evenly through the site.

- Recent browsing (i.e. since start of the last growing season) can be distinguished from old browsing by comparing the browsed shoot with an unbrowsed shoot. Recently browsed shoots have the same bark colour and texture as unbrowsed shoots, and any remaining buds on the shoot will still be alive. Shoots browsed some time ago will look withered and the bark will have a darker colour than unbrowsed shoots; shoots may be brittle, and the buds will either have withered and died, or have sprouted.

- At sites where aggressive or invasive species (e.g. bracken, *Molinia caerulea*, *Deschampsia caespitosa*) are present, and there is a management objective to control them, Surveyor's Form 3 should be used to help set up 10 plots in areas with invasive vegetation. In addition, Surveyor's Form 1 a should also be recorded for these 10 plots, and a further 10 plots set up (Surveyors Form b), evenly distributed through the site in areas accessible to livestock.

- At sites without an objective to control browsing or aggressive species, there should be an objective to manage the sward to promote biodiversity. The surveyor should set up 10 plots where species of biodiversity interest occur, or are expected to occur in future using Surveyor's Form 1a. For example, at sites with an objective to manage for marsh fritillary butterflies, 10 plots should be set up in areas where their food plants (e.g. devil's bit scabious) occur, and 10 further sites (Surveyor's Form 1b) set up through the rest of the site. In sites where there is a little regeneration, but not enough to monitor using Form 2 a & b, tree species can be recorded as grazing indicator species on Form 1 a & b.

- At sites where the objectives include sward management, controlling browsing on trees and controlling aggressive species, set up 10 plots targeted at tree regeneration (Surveyor's Form 2 a & b), and 10 plots targeted at aggressive species (Surveyor's Form 3). Then use these plots as monitoring sites for sward (Surveyor's Form 1a & b).

- On sites with a history of heavy grazing, grazing sensitive species (or the best areas for them), may not be obvious at the baseline stage and additional plots for this purpose might need to be identified after a year.

- Surveyor's Form 1 uses terms such as 'ungrazed and rank'. The definitions of these terms are given on page 5.

- Each site should have 20 plots, marked by 20 half-length stobs. Number the stobs using 1 to 20 notches. For the tree transects (Surveyor's Form 2 a & b) use a notched stob as the start stob, a stob with 1 nail as the second stob, and a stob with two nails as the last stob.

- The tricky part is deciding where to put the plots so that the impact of management can be measured most effectively.

Advice for farmers – see Farmer's Monitoring Forms 1, 2, 3 & 4 (published separately)

- Farmers are expected to monitor five of the 20 plots set up by the survey four times per year, and to monitor the remaining 15 plots once per year.

- All farmers should complete Farmer's Forms 1 & 4. Farmer's Form 4 only needs to be filled in once per year, either at the end of the summer in year-round grazed sites or at the end of the grazing period in seasonally grazed sites. Whether Farmer's Forms 2 and 3 are filled in or not depends on the site objectives.

- Visit each of the plots with the surveyor so you know where they are; get the surveyor to help you identify the species you'll be monitoring (take digital photos to help with ID in later years). The monitoring done by the surveyor provides the FC with info on how the site is changing, while the monitoring done by the farmer ensures that the animals are having the desired effect, allowing you to change the management if necessary.

- If the grazing regime is annual, farmers should complete Farmer's Form 1 (and Farmer's Forms 2 & 3 if appropriate) every year in March, May, August and November. If the grazing regime is seasonal, farmers should do the recording before the livestock are given access to the woodland, and then three times during the grazing period, to help make the decision about when animals should be removed. Some plants have a seasonal growth pattern and will not be visible at certain times of year.

- In addition to the site monitoring, fill in the Management Diary (page 6) whenever jobs are done with the stock that graze the woodland.

- The farmer should keep originals of the completed management diaries, fixed point photographs, surveyor's monitoring forms, and farmer's monitoring forms; send copies of each to the Forestry Commission.

- Farmer's Forms 1, 3 and 4 involve monitoring 5.6 m radius circles (i.e. 0.1 ha) with the centre marked by a stob (see the forms for more details). You'll need a 5.6 m piece of rope/string with a loop at one end. To do the vegetation monitoring, put the loop round the marker stob. Walk a 5.6 m radius circle around the stob, looking at the vegetation, and then fill in the information required on the form.

Definition of terms used to describe vegetation

Vegetation	Where grass	Where heather & other dwarf shrubs
Ungrazed and rank (UR)	No sign of grazed leaves, lots of dead material (> 50 %) in sward	Browsed shoots very difficult to find, heather difficult to walk through
Ungrazed and green (UG)	No sign of grazed leaves, not much dead material in sward (< 50 %)	Browsed shoots difficult to find, heather reasonably easy to walk through.
Lightly grazed (LG)	Some signs of grazed leaves (less than 25 %)	Few shoots browsed
Moderately grazed (MG)	25-75 % of leaves grazed	1/3 to 2/3 shoots browsed
Heavily grazed (HG)	All leaves grazed	More than 2/3 shoots browsed, some shoots broken by trampling
Poached (P)	Ground surface disturbed by trampling over considerable area	Ground surface disturbed by trampling over considerable area, many shoots browsed
Bracken (B)	Bracken covers most of the plot (more than 75 %)	
Bare Ground (BG)	Ground bare or covered in leaf litter (more than 75 %); due to dense canopy not animal disturbance	
Moss (M)	Ground dominated by mosses (more than 75 %)	

Definition of DAFOR scale

Class	Typical abundance and frequency
Dominant (D)	The dominant vegetation / species highly visible, usually more than 70% cover
Abundant (A)	Many individuals or patches visible, usually 30-50% cover
Frequent (F)	Several individuals or few patches, cover usually 10-20%
Occasional (O)	A small patch or a few individuals, cover usually around 5-8%
Rare (R)	Single very small patch or individual, cover usually around 1-3%

See the Appendix 5 for guidance on distinguishing between the signs of different herbivores.

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Management Diary for S9 Pilot Farmers & Land Managers

Site:
Farmer:
Make a note whenever management occurs relating to the stock used to graze the woodland: date, number & type of animals, activity (e.g. movements, feeding, dosing, visits by vet), time taken and costs. Costs include time taken to do jobs, feeding costs and vet's fees. Also record time spent doing monitoring & management planning.

Date	No. & Type of Animals	Activity	Comments	Time	Cost
03/09/05	30 cattle	Cattle into wood Example	Livestock in good condition	1 hour	

APPENDIX 8: Example protocol for species-specific monitoring

Camusnagaul & Achaphubuil Woodland
WGS 030/002236

Protocol for Monitoring Impact of Seasonal Grazing on Butterfly Populations

General

This WGS includes measures to enhance the biodiversity of the site, with a particular emphasis on maintaining and enhancing habitat for butterflies.

Existing monitoring of butterfly populations

Two transects have been established and monitored under a contract with Scottish Wildlife Trust. During 2004 this monitoring role is being passed on to two local inhabitants, who are receiving training and assistance from SWT personnel to ensure that monitoring techniques remain the same. One transect is in an area of woodland with a seasonal grazing regime, and the other is in an area of woodland with no grazing.

The separation of the transects allows for some monitoring of the effect of grazing upon butterfly populations, however butterflies are mobile, and individuals might move from grazed to ungrazed areas.

Using abundance of flowering plants as an additional indicator of the impact of seasonal grazing.

The two species of most biodiversity concern present on the site are the chequered skipper and the pearl bordered fritillary. Both species rely on particular species of flowering plants for nectar and as larval foodplants. It is therefore proposed to use the abundance of these plants, both on the grazed and ungrazed transects, as an indicator of the impact of the grazing regime - on the most important habitats for these priority species in particular, and on biodiversity in general.

Chequered skipper (Carterocephalus Palaemon) nectar sources
Primary sources are bugle (Ajuga reptans), and marsh thistle (Cirsium palustre).
Also used: bluebells (Hyacynthoides non-scripta), Orchids (Dactylorhiza spp) and ragged robin (Lychnis floscuculi)
Note that *Molinia* is the larval foodplant

Pearl bordered fritillary (Boloria euphrosyne)
Larval foodplants are Violets (Viola spp) and ***nectar sources*** are Bugle (Ajuga reptans) and, to some extent, the same as for Chequered Skipper

Monitoring floral populations

Monitoring will be conducted using the existing butterfly transects. Two areas of c25m^2 along the route of each transect will be identified (and fixed via GPS and markers on the ground) as areas with populations of the above species. Annual monitoring will consist of a measure of the abundance of flowering stems during the butterflies' flying season.
Abundance will be measured in two ways:

a. digital photography

10 shots of each area will be taken… including close-ups of fixed 'quadrats'

b. assessment using DAFOR

The surveyor will assess the number of flowering stems present using the DAFOR scale, and counts of flowering stems inside a fixed 1m^2 square…

Reporting

The above information will be included in the Annual Report on Butterflies, and a copy lodged with the Forestry Commission Scotland.

Gordon Gray Stephens /Donald Kennedy 15/6/04

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