COUNTY DURHAM

LANDSCAPE GUIDELINES

Grassland

Making a difference where you live

DURHAM COUNTY COUNCIL

Contents

GRASSLANDS IN DURHAM

Semi-natural Grasslands

Acid grasslands

Neutral Grasslands

Calcareous Grasslands

Marshy Grasslands

National Vegetation Classification Grassland Communities

Semi-Natural Grassland

Semi-natural grasslands are plant communities where native grasses, wild flowers, sedges and mosses predominate in the absence of trees and shrubs. Some grassland species are ubiquitous, but many have more specific ecological requirements and geographical distributions, so that types of soil, both physical and chemical, together with soil hydrology, geology and location within County Durham, play a major role in influencing sward composition.

Semi-natural grasslands are of high conservational value as they provide a very diverse habitat, supporting an exceptional variety of plants and invertebrates including the rare and nationally important Teesdale Violet *Viola rupestris*, Spring Gentian *Gentiana verna,* False Sedge *Kobresia simpliciuscula* and Northern Brown Argus *Aricia artaxerxes.* These in turn support large populations of birds (e.g. Curlew *Numenius arquata*, Lapwing *Vanellus vanellus* and Skylark *Alauda arvensis)*, reptiles and mammals.

Most of these important grasslands rely on active management such as grazing, cutting and in some circumstances burning to keep the sward open to maintain their biological interest. However, since the post-war period many have suffered through agricultural improvement, neglect and direct losses caused by development or quarrying.

Grasslands are highly sensitive to disturbance or nutrient enrichment, with their wildlife interest quickly being lost through the use of fertilisers (especially artificial/inorganic fertilisers), herbicides or through cultivation and reseeding. This gives rise to improved grassland – impoverished in species, dominated by a few aggressive or competitive grasses and very few wildflowers.

As a result very few extensive semi-natural grassland areas remain; the rest are small, often isolated remnants of a habitat that was once more widespread. A number of grassland communities, now scare not only in the UK but also in Europe, can be found in the county, for example the species rich, Upland hay meadows. One type of magnesian limestone grassland, the Purple Moor-grass *Sesleria albicans* – Small Scabious *Scabiosa columbaria* community is similarly limited in its distribution, but only occurs in Britain and more specifically, the Durham area. The importance of many of these grasslands is often recognised through their designation as Sites of Special Scientific Interest (SSSI) and Special Areas of Conservation (SAC).

Organisations and individuals all have a role to play in conserving and restoring biodiversity. After the UK Government signed the Convention on Biological Diversity in 1992, it set out its conservation objectives in the UK Biodiversity Action Plan. A series of habitat action plans set targets for semi-natural grasslands – to halt the decline of wildlife-rich grasslands, to restore the condition of those remnant examples suffering from inappropriate management, and to re-establish swards of wildlife value.

Grassland Communities

Dry semi-natural grasslands can be divided into three broad types; acid, neutral and calcareous. These are determined largely by the underlying geology and hence the species of flora and fauna that they are most likely to support. Acid grasslands normally occur on soils which have a pH below 5. Neutral grasslands are found on moist mineral soils with a pH of between 5 and 6.5 whereas calcareous grasslands occur largely on pervious calcareous bed rocks where the soils tend to be shallow and the pH is typically between 6.5 and 8.5.

Marshy (or wet) grassland communities occur in wetter areas where the ground is kept permanently or periodically wet through high rainfall, humidity or water table, or by the impervious nature of the underlying rock leading to springs and seepages. Most of these communities resemble dry grassland in structure and are managed in a similar ways, though in many cases grasses are replaced as the dominant species by Sedge *Carex* or Rush *Juncus* species.

The plant communities found in either the dry or marshy grasslands vary across the county, reflecting changes in geology, soils, climate and the influence of human activity. Some grassland types are closely associated with one landscape type or County Character Area; others are more widespread in their distribution and show little change in their composition over a broad geographical range. Different communities can occur in close proximity to one another in response to changes in conditions whatever the underlying substrate; major influences being the position on a slope, aspect and altitude. For example, the calcareous grassland communities on the East Durham Limestone Plateau can grade very locally into to more neutral grassland vegetation where the glacial boulder clay is deeper and the influence of the limestone is less pronounced. Dry semi-natural grasslands may also grade very quickly into wetter grassland and mire habitats, where rushes are often characteristic.

Existing plant communities are also heavily influenced by management - by cutting, grazing and in some circumstances burning. Most types of grassland are successional and changes in the intensity, frequency or type of management can result in shifts from one grassland type to another. For example Upland hay meadow can loose their species richness and grade into improved grassland due to more frequent and badly timed cutting and associated application of fertiliser. In the absence of any management they would undergo vegetation change resulting in the development of scrub and eventually woodland.

Grassland communities, classified using the National Vegetation Classification System (NVC) found in County Durham include:

Acid Grassland

U1 *Festuca ovina - Agrostis capillaris –Rumex acetosella*

U2 *Deschampsia flexuosa*

U4 *Festuca ovina - Agrostis capillaris – Gallium saxatile*

U5 *Nardus stricta – Galium saxatile*

U6 *Juncus squarrosus – Festuca ovina*

Neutral Grassland

MG1 *Arrhenatherum elatius*

MG3 *Anthoxanthum odoratum - Geranium sylvaticum*

MG5 *Cynosurus cristatus - Centaurea nigra*

MG6 *Lolium perenne – Cynosurus cristatus*

MG7 *Lolium perenne*

MG8 Cynosurus cristatus – Caltha palustris

Calcareous Grassland: Carboniferous Limestone

CG9 *Sesleria albicans – Galium sterneri*

CG10 *Festuca ovina - Agrostis capillaris –Thymus polytrichus*

OV37 Calaminarian grassland

Calcareous Grassland: Magnesian Limestone

CG2 *Festuca ovina – Avenula pratensis*

CG3 *Bromus erectus*

CG6 *Avenula pubescens*

CG*8 Sesleria albicans - Scabiosa columbaria*

Maritime grasslands

Marshy Grassland

M22 *Juncus subnodulosus - Cirsium palustre*

M23 *Juncus effusus/acutiflorus - Galium palustre*

M24 *Molinia caerulea – Cirsium dissectum*

M25 *Molinia caerulea – Potentilla erecta*

M26 *Molinia caerulea-Crepis paludosa*

M27 *Filipendula ulmaria - Angelica sylvestris*

MG9 *Holcus lanatus – Deschampsia cespitosa*

MG10 *Holcus lanatus - Juncus effusus*

Acid Grasslands

In County Durham, acid grassland has a western bias, being characteristic of acidic sandstones and shales and base-poor drift in the North Pennines, Pennine Dales Fringe and West Durham Coalfield. However rare and fragmented examples do also occur in other areas across the county on superficial deposits such as sands and gravels, disturbed ground with acidic substrates, particularly colliery shales and some railway ballasts.

Character

Usually grazed, acid grasslands vary from the semi-improved pastures and rough grazing in the uplands to lowland heath and disturbed soils. In the west, it is common to find with any of the acid grassland types, Soft Rush *Juncus effuses* and Sharp Flowered Rush *J. acutiflorus*, often forming large patches. Although generally species poor, and therefore often overlooked, they can support bird and animal communities of international importance and occasional very species rich examples can be found in small patches often in un-mown banks of upland hay meadows.

Largely due to improvement for agricultural purpose being uneconomical, acid grasslands is the most common type of semi-natural grassland in County Durham.

Characteristic Species

Grasses include Common Bent *Agrostis capillaris*, Sheep's Fescue *Festuca ovina*, Red Fescue *Festuca rubra*, Crested Dog's-tail *Cynosurus cristatus*, Sweet Vernal-grass *Anthoxanthum odoratum* and Field Wood-rush *Luzula campestris*. Other characteristic species include Heath Bedstraw *Gallium saxatile*, Heath wood-rush *Luzula multiflor*a, Tormentil *Potentilla erecta* and Wavy Hair-grass *Deschampsia flexuosa*.

NVC communities found in County Durham include:

- **U1 *Festuca ovina - Agrostis capillaris - Rumex acetosella* grassland.** Open sward of small tussocky grasses, generally occurs in a mosaic with lowland heath in the West Durham Coalfield, but can be found elsewhere in the lowlands on sandy acidic soils over glacial deposits with a few patches also surviving in association with the magnesian limestone grasslands.

- **U2 *Deschampsia flexuosa* grassland**. Species-poor grassland dominated by Wavy Hair-grass *Deschampsia flexuosa*. Especially typical of upland grouse moors where regular burning is practiced.

- **U4 *Festuca ovina - Agrostis capillaris – Gallium sax*atile grassland**. The typical acid grasslands of upland fells. Generally a short, closed sward, sometimes a little rough and tussocky, occurring over steeper unenclosed slopes.

- **U5 *Nardus stricta – Galium saxatile* grassland**. Coarse, tussocky grassland of poor-quality pastures on ill-drained, impoverished acid soils. Often a monoculture of Mat-grass *Nardus stricta* on poor soils under strong grazing pressure.

- **U6 *Juncus squarrosus – Festuca ovina* grassland**. Develops extensively in wetter situations, over gentle slopes and plateaus at higher altitudes. Heath Rush *Juncus squarrosus* is often dominant on wet ground on the moorland edge, especially where strong grazing pressure has eliminated heath.

Potential new sites

Soils previously carrying acidic grassland. Acidic quarry and mine wastes and overburdens. Pastures restored following mineral working on base poor soils. Damaged peat.

Further Information

Backshall, J., Manley, J. & Rebane, M. (Editors). 2001. *The Upland Management Handbook*. English Nature. Peterbrough.*

English Nature. 2000. *Lowland Acid Grassland: A Rare and Unique Habitat*. English Nature Publications.*

Cliton, S.J. and Hedley, S 1995. *Durham Wildlife Audit – The Distribution, abundance and conservation of wildlife in County Durham*. The Environment Department, Durham County Council.

Crofts A. and Jefferson R.G. (eds.) *The Lowland Grassland Management Handbook* (2nd Edition). English Nature.*

Lees, A. & Campbell, L. (Eds) (2007). *The Durham Biodiversity Action Plan*. The Durham Biodiversity Partnership. This is available electronically from http://www.durhambiodiversity.org.uk/.

Rodwell, J. S. (ed.) 1992. *British Plant Communities. Volume 3. Grassland and montane communities.* Cambridge University Press.

UK Biodiversity Steering Group. 1995. *Biodiversity: the UK Steering Group Report.* London: HMSO. Action plan for lowland acid grasslands is available electronically from www.ukbap.org.uk/habitats.htm.

* Available electronically from Natural England's website www.naturalengland.org.uk.

Neutral Grassland

Distribution

General eastern bias towards the East Durham Limestone Plateau and Tees Lowlands, but there are concentrations in the North Pennine's upper dales of Teesdale and Weardale. Elsewhere, scattered distribution.

Character

Usually managed as part of a traditional farm system as old unimproved and semi-improved pastures and meadows or found as rough unmanaged grasslands of road verges, railway embankments and waste ground on free draining, neutral soils. Species-rich pastures and meadows are relatively uncommon; most are now species-poor through agricultural improvement.

Characteristic Grasses

Cock's-foot *Dactylis glomerata*, Common Bent *Agrostis capillaris*, Crested Dog's-tail *Cynosurus cristatus*, Red Fescue *Festuca rubra*, Meadow Fescue *Festuca pratensis*, Sweet Vernal Grass *Anthoxanthum odoratum*, Yellow Oat-grass *Trisetum flavescens* and Yorkshire-fog *Holcus lanatus*.

NVC communities found in County Durham include:

MG1 *Arrhenatherum elatius*: rank grassland. Rough unmanaged grasslands, very variable in character but generally has an abundance of tall tussocky grasses. Often found on road verges and waste ground.

MG3 *Anthoxanthum odoratum - Geranium sylvaticum*: northern hay meadow. Traditionally managed species-rich hay meadows characterised by a dense growth of grasses and herbs up to 60 - 80 cm high. No single grass species is consistently dominant and the most striking feature of the vegetation is generally the variety and abundance of herbs, including Wood Crane's-bill *Geranium sylvaticum,* Pignut *Conopodium majus,* Great Burnet *Sanguisorba officinalis* and Lady's Mantles *Alchemilla* spp*.* Restricted to the Upper North Pennine dales.

MG5 *Cynosurus cristatus - Centaurea nigra*: lowland hay meadow and pasture. Typically occurs on free draining natural loam and clay sols in lowland areas. The community is highly localized and fragmented, with most sites surviving as small, isolated fields or groups of small fields. Examples can be found in Hamsterley Forest and on the Magnesian Limestone near Hawthorn Dene. Traditionally managed either as pasture, or hay meadows, and although of limited interest for birds, often support significant numbers of invertebrates.

MG6 *Lolium perenne – Cynosurus cristatus* improved grassland. Permanent pasture on moist but freely draining or moderately impeded brown soils in lowland Britain. It occurs where there has been intensive improvement for pasture. The community is also widespread as a long-established recreational sward, on road verges and on lawns. By the processes of agricultural improvement, grassland of this kind has been derived from a wide range of vegetation types and often, species characteristic of these former vegetation types can persist at low frequencies.

MG7 *Lolium perenne* leys and related improved grasslands Species poor grassland dominated by Perennial Ryegrass *Lolium perenne*. Grasslands of this kind are often sown as high productivity swards, for intensive agriculture or recreational use. Often derived from MG6 *Lolium perenne – Cynosurus cristatus* grassland by further improvement but can develop naturally where other swards are trampled, heavily grazed or subject to 'natural enrichment'.

MG8 Cynosurus cristatus – Caltha palustris grassland. Like MG5, may be managed either as pasture or as hay meadow usually occurring in lowland areas and the fringe of the uplands on clay and loam soils with neutral pH. Restricted to situations where there is prolonged, as opposed to seasonal inundation but can also occur as more fragmentary stands below springs, flushes and seepage lines in association with other wetland habitats. Important for breeding birds such as waders. Rare in Durham.

Of these MG3, MG5 and MG8 are of greatest conservation interest.

Potential New sites

Neutral soils. Road verges. Conservation headlands in arable fields.

Further Information

Rodwell, J. S. (ed.) 1992. *British Plant Communities. Volume 3. Grassland and montane communities*. Cambridge University Press.

Cliton, S.J. and Hedley, S 1995. *Durham Wildlife Audit – The Distribution, abundance and conservation of wildlife in County Durham*. The Environment Department, Durham County Council.

Crofts A. and Jefferson R.G. (eds.) *The Lowland Grassland Management Handbook* (2nd Edition). English Nature. Available electronically from Natural England's website www.naturalengland.org.uk.

Lees, A. & Campbell, L. (Eds) (2007). *The Durham Biodiversity Action Plan*. The Durham Biodiversity Partnership. This is available electronically from http://www.durhambiodiversity.org.uk/.

UK Biodiversity Steering Group. 1995. *Biodiversity: the UK Steering Group Report.* London: HMSO. Action plans for both upland and lowland hay meadows is available electronically from www.ukbap.org.uk/habitats.htm.

Calcareous Grassland: Carboniferous Limestone

Distribution

North Pennines.

Character

Species-rich upland grasslands dominated by fine-leaved grasses and calcicolous species occurring on shallow, well drained and base rich soils derived from calcium rich carboniferous limestone. Managed primarily by grazing.

Characteristic Grasses

Common Bent *Agrostis capillaris,* Meadow Oat-grass *Avenula pratensis*, Red Fescue *Festuca Rubra,* Sheep's Fescue *Festuca Ovina,* Sweet Vernal Grass *Anthoxanthum odoratum,* Quaking-grass *Briza media.*

NVC communities found in County Durham include:

CG9 *Sesleria albicans – Galium sterneri* grassland. Very variable in character; can occur as closed or open swards. Confined to sub-montane or montane climates. Often contains a number of nationally rare plants such as the Teesdale Violet *Viola rupestris*. **CG9d sub-community** occurring on the sugar limestones in Upper Teesdale is very localised and floristically unique, enriched by a variety of preferential and highly distinctive northern montane, alpine and arctic-alpine species.

CG10 *Festuca ovina - Agrostis capillaris–Thymus polytrichus* grassland. Essentially a sub-montane community of the British uplands developed over calcareous bedrock where soils are less base-rich and species more associated with acid conditions (e.g. Mat Grass *Nardus stricta*) become more prevalent. Generally old unimproved pastures of short, closed swards cropped by heavy grazing.

Calaminarian Grassland. Generally short open vegetation of fine-leaved grasses, flowers, mosses and lichens that are tolerant of toxic metals and low nutrient levels. Restricted to the spoil heaps of former lead mines and natural mineral outcrops amongst calcareous bedrocks. Corresponds closest to **NVC OV37 *Festuca ovina – Minuartia verna* community**.

Potential new sites

Calcareous soils. Limestone quarry wastes and restored grasslands on base rich upland soils.

Further Information

English Nature. 2001. *Lowland Calcareous Grassland: A Scarce and Special Habitat*. English Nature Publications. Available electronically from Natural England's website www.naturalengland.org.uk.

Cliton, S.J. and Hedley, S 1995. *Durham Wildlife Audit – The Distribution, abundance and conservation of wildlife in County Durham.* The Environment Department, Durham County Council.

Crofts A. and Jefferson R.G. (eds.) *The Lowland Grassland Management Handbook* (2nd Edition). English Nature. . Available electronically from Natural England's website www.naturalengland.org.uk.

Lees, A. & Campbell, L. (Eds) (2007). *The Durham Biodiversity Action Plan*. The Durham Biodiversity Partnership. This is available electronically from http://www.durhambiodiversity.org.uk/.

Rodwell, J. S. (ed.) 1992. *British Plant Communities. Volume 3. Grassland and montane communities*. Cambridge University Press.

UK Biodiversity Steering Group. 1995. *Biodiversity: the UK Steering Group Report.* London: HMSO. Action plan for upland calcareous grasslands is available electronically from www.ukbap.org.uk/habitats.htm.

Calcareous Grassland: Magnesian Limestone

Distribution

East Durham Limestone Plateau.

Character

Species-rich, semi-natural grassland developed over magnesian limestone. These grasslands have unique ecological characteristics due to their geographical position and as a consequence often produce a distinctive assemblage of both Northern and Southern species which are close to or at the limit of their natural growing range. Formerly more abundant but generally restricted to those areas unsuitable for cultivation such as escarpment slopes, coastal areas and quarry edges.

Characteristic Grasses

Blue Moor-grass *Sesleria albicans*, Cock's Foot *Dactylis* glomerata, Common Bent *Agrostis capillaris*, Downy Oat-grass *Avenula pubescens*, Meadow Oat-grass *Avenula pratensis*, Quaking-grass *Briza media*, Sheep's Fescue *Festuca Ovina*, Upright Brome *Bromopsis erecta* and Yellow Oat-grass *Trisetum flavescens*.

NVC communities found in County Durham include:

NVC CG2 *Festuca ovina – Avenula pratensis* grassland. Comprises of a mixture of grasses and herbs in a continuous, closed sward. Largely restricted to the Durham Coast on steeply-sloping cliffs with a southerly aspect, but may occur inland in similar situations to CG8.

NVC CG3 *Bromus erectus* grassland. Typically ungrazed grassland, often with rank and tussocky swards. Usually on warmer, south facing slopes of the escarpment.

NVC CG6 *Avenula pubescens* grassland. Rank and tussocky grassland of unimproved pastures or abandoned quarries on damper more mesotrophic calcareous soils.

NVC CG8 *Sesleria albicans - Scabiosa columbaria* grassland. Very rare grassland community with distribution restricted to the magnesian limestone in the Durham area. Characteristic of shallow rendzina soils on the steep escarpment slopes and drift free ridges with the most extensive tracks found around Cassop Vale and Thrislington National Nature Reserve.

Maritime grasslands. Very variable in character. Occur on shallow boulder clays of cliff tops and clay slopes and limestone sea cliffs. Influenced by sea spray, which extends approximately 500m in land.

Potential new sites

Calcareous soils. Limestone quarry wastes and restored grasslands. Coastal grasslands. Road verges.

Further Information

Natural England and the Grasslands Trust have successfully developed a novel and innovative project to protect and manage some of Durham's rarest and most threatened grasslands. The project is being funded as a Group Higher Level Stewardship (HLS) Agreement whereby a suite of fragmented and difficult to manage grassland sites are being managed by the Trust. For Further information on this project contact the Grassland Trust Conservation Officer for the Durham Magnesian Limestone Grasslands project T: 02380 650093.

Durham Wildlife Trust (2007). *Magical Meadows and the Durham Magnesian Limestone Grassland.* A Natural Area Publication. Durham Wildlife Trust. This is available from www.durhambiodiversity.org.uk.

Cliton, S.J. and Hedley, S 1995. *Durham Wildlife Audit – The Distribution, abundance and conservation of wildlife in County Durham*. The Environment Department, Durham County Council.

Crofts A. and Jefferson R.G. (eds.) *The Lowland Grassland Management Handbook* (2nd Edition). English Nature.*

English Nature. *Lowland Calcareous Grassland: A Scarce and Special Habitat.* English Nature Publications.*

Hedley S., Clifton S. & Mullinger S (1997). The Durham Magnesian Limestone – Natural Area Profile No. 6 English Nature, Peterborough.

Lees, A. & Campbell, L. (Eds) (2007). T*he Durham Biodiversity Action Plan*. The Durham Biodiversity Partnership. This is available electronically from http://www.durhambiodiversity.org.uk/.

Rodwell, J. S. (ed.) 1992. *British Plant Communities. Volume 3. Grassland and montane communities*. Cambridge University Press.

UK Biodiversity Steering Group. 1995. *Biodiversity: the UK Steering Group Report.* London: HMSO. Action plan for lowland calcareous grasslands is available electronically from www.ukbap.org.uk/habitats.htm.

* Available electronically from Natural England's website www.naturalengland.org.uk.

Marshy Grassland

Distribution

Widespread but localised.

Character

A range of damp grasslands dominated by wetland species usually found in association with mires or in mosaics with other grassland and heath communities. Distinguished from mire communities by only the occasional presence of surface water and the distinct lack of sphagnum. Often occurs on peat or mineral soils derived from a variety of substrates on level or gently sloping ground.

Susceptible to agricultural improvement, drainage and built development. Not necessarily species rich, but can be highly important feeding and breeding ground for many birds.

NVC communities found in County Durham include:

M22 *Juncus subnodulosus - Cirsium palustre* fen-meadow. Very variable in species composition which often reflects a unique and complex history of mowing and grazing management. Can be found either in, or around, well-developed springs, flushes and mires or marking areas where there is a high water table. Rare in County Durham.

M23 *Juncus effusus/acutiflorus - Galium palustre rush-pasture*. Upland rushy pastures, usually an intimate mix of marshy and unimproved acid grassland. Particularly characteristic of the less improved pastures or allotments and intakes in the moorland fringes. May also form in discrete areas of hay meadows.

M24 *Molinea caerulea – Cirsium dissectum* fen-meadow. Rare wet grassland, formerly more extensive in the Carrs of the Tees Lowlands. Found in association with mire communities, typically marking out better drained fringes of bogs and fens, or the margins of wet hollows and flushes.

M25 *Molinia caerulea – Potentilla erecta* mire. Dominated by Purple Moor-grass *Molinia caerulea*, occurring over gently-sloping ground often marking out seepage zones and flushed margins of streams, water–tracks and mires. Often occurring in conjunction with wetter mire and heath vegetation.

M26 *Molinia caerulea - Crepis paludosa* mire (M26b *Festuca rubra* sub-community). Rare sub-community occurring on moderately base-rich peats and peaty mineral soils usually on flushed slopes over limestones. Occurs on slopes in enclosed meadow and pasture in association with MG3.

M27 *Filipendula ulmaria - Angelica sylvestris* mire. Tall herb community typical of ungrazed situations in the lowlands fringing watercourses or wetlands.

Of these examples of M22, M24 and M26 are considered to be particular priorities for conservation.

Species poor marshy grasslands include:

MG9 *Holcus lanatus – Deschampsia cespitosa* damp pasture. Species poor damp pasture commonly developing by invasion of Tufted Hair-grass *Deschampsia cespitosa* into improved permanent grassland and reseeded grassland (MG6 and MG7) where drainage is poor.

MG10 *Holcus lanatus - Juncus effusus* rush pasture. Species poor rush pasture commonly developing by invasion of rush into improved permanent grassland where drainage is poor. Also common on abandoned agricultural land, damp verges and in ditches.

Potential new sites

Wet soils. Wet ground in restored mineral workings. Margins of wetlands.

Further Information

Cliton, S.J. and Hedley, S 1995. *Durham Wildlife Audit – The Distribution, abundance and conservation of wildlife in County Durham*. The Environment Department, Durham County Council.

Crofts A. and Jefferson R.G. (eds.) *The Lowland Grassland Management Handbook* (2nd Edition). English Nature.*

English Nature. 2004. *Purple Moor-Grass and Rush Pasture*. English Nature Publications.*

Lees, A. & Campbell, L. (Eds) (2007). *The Durham Biodiversity Action Plan*. The Durham Biodiversity Partnership. This is available electronically from http://www.durhambiodiversity.org.uk/.

Rodwell, J. S. (ed.) 1992. *British Plant Communities. Volume 2. Mires and Heaths*. Cambridge University Press.

UK Biodiversity Steering Group. 1995. *Biodiversity: the UK Steering Group Report.* London: HMSO. Action plan for purple moor-grass and rush pastures available electronically from www.ukbap.org.uk/habitats.htm.

* Available electronically from Natural England's website www.naturalengland.org.uk.

National Vegetation Classification Grassland Communities

The main semi-natural native grasslands communities found in County Durham are listed below and described in detail over the following pages.

U1 *Festuca ovina - Agrostis capillaris –Rumex acetosella*
U2 *Deschampsia flexuosa*
U4 *Festuca ovina - Agrostis capillaris – Gallium saxatile*
U5 *Nardus stricta – Galium saxatile*
U6 *Juncus squarrosus – Festuca ovina*
MG1 *Arrhenatherum elatius*
MG3 *Anthoxanthum odoratum - Geranium sylvaticum*
MG5 *Cynosurus cristatus - Centaurea nigra*
MG6 *Lolium perenne – Cynosurus cristatus* grassland
MG7 *Lolium perenne*
MG8 Cynosurus cristatus – Caltha palustris
CG9 *Sesleria albicans – Galium sterneri*
CG10 *Festuca ovina - Agrostis capillaris –Thymus polytrichus*
OV37 Calaminarian grassland
CG2 *Festuca ovina – Avenula pratensis*
CG3 *Bromus erectus*
CG6 *Avenula pubescens*
CG*8 Sesleria albicans - Scabiosa columbaria*
Maritime grasslands
M22 *Juncus subnodulosus - Cirsium palustre*
M23 Juncus effusus/acutiflorus - Galium palustre
M24 *Molinia caerulea – Cirsium dissectum*
M25 *Molinia caerulea – Potentilla erecta*
M26 *Molinia caerulea - Crepis paludosa*
M27 *Filipendula ulmaria - Angelica sylvestris*
MG9 *Holcus lanatus – Deschampsia cespitosa*
MG10 *Holcus lanatus - Juncus effusus*

U1 *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland

Distribution

West Durham Coalfield. Wear Lowlands. East Durham Limestone Plateau.

Character

Open sward of small tussocky grasses, among which can be an abundance of herbs, many of which are diminutive ephemerals. Generally occurs in a mosaic with lowland heath in the West Durham Coalfield, but can be found elsewhere in the lowlands on sandy acidic soils over glacial deposits with a few patches also surviving in association with the magnesian limestone grasslands. In this situation, vegetation on the shallow calcareous soils over the limestone grades from grassland dominated by Blue Moor-grass *Sesleria albicans* or Sheep's Fescue *Festuca Ovina* (CG8 or CG2 communities) to U1 grassland occurring over the sandy acidic soils of the glacial deposits. In Durham this is the northern limit of this more typical southern acid grassland community.

Geology

Superficial deposits such as sand and gravel and base-poor drift.

Soils

Characteristic of base poor and often summer-parched soils.

Species

Sheep's Fescue *Festuca ovina* and Common Bent *Agrostis capillaris* are the dominant grasses but Yorkshire Fog *Holcus lanatus* and Sweet Vernal-grass *Anthoxanthum odoratum* may also occur.

Perennial herbs include Sheep's Sorrel *Rumex acetosella*, Tormentil *Potentilla erecta* and Mouse-ear Hawkweed *Pilosella officinarum*. Mosses and Lichens are often an important component of the sward.

Where grassland occurs in conjunction with Heathland habitat, scattered shrubs such as Heather *Calluna vulgaris* may be frequent especially where grazing pressure has relaxed. Infestation of surrounding soils by Bracken *Pteridium aquilinum* is also common and scattered fronds may be found.

Management

Grazing by sheep, cattle and rabbits important in maintaining the short open sward. Can tolerate soil disturbance (e.g. shallow rotovation). Optimum sward height 1-5cm.

U2 *Deschampsia flexuosa* grassland

Distribution

North Pennines, Pennine Dales fringe.

Character

Typically species-poor, tussocky grassland of the upland fringes, especially on upland grouse moors where regular burning is practiced. Grazing is often important in maintaining this community.

Geology

Pervious siliceous bedrocks or coarse-textured superficial deposits such as sand and gravel and base-poor drift.

Soils

Characteristic of base poor, free draining but moist mineral soils with a pH of 5 or below. Peat. May develop where leaching has created acid conditions.

Species

Dominated by Wavy Hair-grass *Deschampsia flexuosa*.

Few associated herbs found frequently, often just scattered plants of Heath Bedstraw *Galium saxatile* and Tormentil *Potentilla erecta*.

Dwarf shrubs including, Heather *Calluna vulgaris*, Bilberry *Vaccinium myrtillus* and Crowberry *Empetrum nigrum* may also occur, but are characteristically sparse and often grazed to short sprigs.

Management

Managed by practices such as burning, grazing by sheep, cattle and rabbits important. Optimum sward height: 5-10cm.

U4 *Festuca ovina-Agrostis capillaris–Gallium saxatile* grassland

Distribution

Typical of the North Pennines, however may to be found further east in the West Durham Coalfield.

Character

Generally a short, closed sward, sometimes a little rough and tussocky, but often close-cropped into a tight fine-textured turf. Typically rough grazing land of major agricultural importance over steeper unenclosed slopes. Generally relatively species-poor but occasionally species-rich examples are found which are closely related to the NVC community U4c in small patches on un-mown banks within the upland hay meadows.

Geology

Acidic sandstones and shales and base-poor drift.

Soils

Mainly on better drained, base poor mineral soils with a pH of 5 or below but may develop where leaching has created acid conditions.

Species

Sheep's Fescue *Festuca ovina* and Common Bent *Agrostis capillaris* are dominant. Some or all of the following grass species may also occur; Mat Grass *Nardus stricta*, Wavy Hair-grass *Deschampsia flexuosa*, Sweet Vernal-grass *Anthoxanthum odoratum*.

Other species frequently present include Heath Rush *Juncus squarrosus*, Common Woodrush *Luzula campestris*, Heath Bedstraw *Galium saxatile* and Tormentil *Potentilla erecta* together with other herbs such as Dog's Violet *Viola riviniana*.

Sub-shrubs, although usually grazed back can occur and include scatterings of Heather *Calluna vulgaris* and Bilberry *Vaccinium myrtillus*.

Agricultural improvement sees a rise in species characteristic of neutral grassland including Yorkshire Fog *Holcus lanatus*, Smooth Meadow-grass *Poa pratensis*, Crested Dog's-tail *Cynosurus cristatus*, Red Fescue *Festuca rubra*, White Clover *Trifolium repens*, Yarrow *Achillea millefolium*, Mouse-eared Chickweed *Cerastium fontanum*, Meadow Buttercup *Ranunculus acris*, Common Sorrel *Rumex acetosa* and Daisy *Bellis perennis*.

Management

Dependant on grazing by sheep, cattle and rabbits. Optimum sward height 5-10cm.

U5 *Nardus stricta – Galium saxatile* grassland.

Distribution

North Pennines.

Character

Coarse, tussocky grassland of poor-quality pastures on ill-drained, impoverished acid soils in the upland fringes, usually where there is high grazing pressure; often referred to as 'white moor'. Can also be found on re-colonized mineral workings at the head of dales.

Geology

Acidic sandstones and shales and base-poor drift.

Soils

Moist, peaty, mineral soils, usually base poor and infertile with a pH of 5 or below.

Species

Mat-grass *Nardus stricta* is dominant, but any number of the following species may occur in small numbers; Sheep's Fescue *Festuca ovina*, Common Bent *Agrostis capillaris*, Wavy Hair-grass *Deschampsia flexuosa*, Sweet Vernal-grass *Anthoxanthum odoratum*, Common Woodrush *Luzula campestris*, Heath Bedstraw *Galium saxatile* and Tormentil *Potentilla erecta* along with Bilberry *Vaccinium myrtillus* which is grazing resistant. Heath Rush *Juncus squarrosus* may also be frequent.

Management

Short to medium swards maintained by grazing particularly by sheep.

U6 *Juncus squarrosus – Festuca ovina* grassland

Distribution

North Pennines, Pennines Dales Fringe, West Durham Coalfield.

Character

Characteristic of moist peats and peaty mineral soils, over gentle slopes and plateaus at higher altitudes, common on moorland edge especially where strong grazing pressure has eliminated heath. Often grades into blanket bog where species more associated with bog, persist in small amounts.

Geology

Peats, acidic bedrocks.

Soils

Moist peat and peaty mineral soils, almost always base poor and infertile.

Species

Heath Rush *Juncus squarrosus* dominant with Sheep's Fescue *Festuca ovina* usually co-dominant, Wavy Hair-grass *Deschampsia flexuosa* and Common Sedge *Carex nigra* may also be present.

The only common herbs are Heath Bedstraw *Galium saxatile* and Tormentil *Potentilla erecta*. On wetter ground Narrow-leaved Cotton-grass *Eriophorum angustifolium* and Sphagnum *Sphagnum spp*. may occur in small amounts. Mosses can be numerous, the most common being *Polytrichum commune*.

Management

Short to medium sward height maintained by grazing by livestock (sheep, cattle)

MG 1 *Arrhenatherum elatius*: rank grassland (MG1a – Arrhenatherum - Festuca rubra and MG1b – Arrhenatherum - Urtica dioica Sub-communities)

Distribution

Widespread.

Character

Rough, unmanaged grasslands, very variable, but generally characterised by an abundance of tall tussocky grasses. Despite the long list of species associated with this grassland, it is usually species poor. Most often found on road verges, railway embankments, churchyards and in neglected agricultural and industrial sites such as building sites, disused quarries and rubbish dumps.

Geology

Permeable sandstones, limestones and superficial deposits of alluvium, glacio-fluvial material or most commonly till.

Soils

Characteristic of free draining, mesotrophic to eutrophic soils. In artificial habitats the soils may be shallow and somewhat stoney or compacted and clayey.

Species

False Oat-grass *Arrhenatherum elatius* is typically dominant together with Yorkshire Fog *Holcus lanatus*, Cocksfoot *Dactylis glomerata* and Timothy *Phleum pratense*. Tufted Hair-grass *Deschampsia cespitosa* co-dominant in damper stands.

Tall and sprawling herbs are often a feature including Hogweed *Heracleum sphondylium*, Cow Parsley *Anthriscus sylvestris*, Sweet Cicely *Myrrhis odorata*, Rosebay Willowherb *Chamerion angustifolium*, Angelica *Angelica sylvestris*, Knapweed *Centaurea nigra*, Nettle *Urtica dioica*. Tufted Vetch *Vicia cracca*, Meadow Vetchling *Lathyrus pratensis* and Meadow Cranesbill *Geranium pratense may also occur*. Occasional species rich examples may include species such as Lady's Mantles *Alchemilla spp.*

Management

Largely unmanaged but infrequent cutting needed to stop invasion of shrubs. Grazing absent or irregular.

MG3 *Anthoxanthum odoratum-Geranium sylvaticum*: Upland hay meadow

Distribution

Confined to the upland dales of the North Pennines.

Character

Species rich hay meadows, characterised by a dense growth of grasses and herbs up to 60 - 80 cm high. Rare due to agricultural improvement, but still occurs where non-intensive hay-meadow treatment has been applied in a sub-montane climate. Fragments also still exist along riverbanks, road verges and in churchyards.

No single grass species is consistently dominant but herbs occur in great abundance. Locally steep banks or wet flushes within the meadows often means a subtly changes in the flora and grassland community types. Semi-improved meadows and pastures higher up the dale side often contain similar species in reduced numbers depending on the extent of improvement and grazing pressure.

Geology

Permeable sandstones and limestones. Superficial deposits of alluvium, head, glacio-fluvial material or most commonly till.

Soils

Free draining, brown earth soils on level to moderately sloping sites

Species

Characteristic grasses include Sweet Vernal-grass *Anthoxanthum odoratum*, Crested Dog's Tail *Cynosurus cristatus*, Red Fescue *Festuca rubra*, Quaking Grass *Briza media*, Yellow Oat-grass *Trisetum flavescens* and Meadow Oat-grass *Avenula pratensis.*

Herbs occur in great abundance and can include; Great Burnet *Sanguisorba officinalis*, Pignut *Conopodium majus*, Wood Anemone *Anemone nemorosa*, Bugle *Ajuga reptans*, Ragged Robin *Lychnis flos-cuculi*, Rough Hawkbit *Leontodon hispidus*, Primrose *Primula vulgaris*, Moonwort *Botrychium lunaria*, Globeflower *Trollius europaeus*, Common Sorrel *Rumex acetosa*, Lady's Mantles *Alchemilla spp*., Marsh Marigold *Caltha palustris*, Glaucous Sedge *Carex flacca*, Water Avens *Geum rivale*, Adderstongue *Ophioglossum vulgatum*, Tway-blade *Listera ovata*, Common Spotted Orchid *Dactylorhiza fuchsii*, Meadow Vetchling *Lathyrus pratensis*, Yellow-rattle *Rhinanthus minor*, Bistort *Polygonum bistorta*, Meadow Saxifrage Saxifraga granulata.

Rare species include: Eyebrights *Euphrasia spp*, Melancholy Thistle *Cirsium heterophyllum,* Wood

Cranesbill *Geranium sylvaticum,* Marsh Hawk's-beard *Crepis paludosa,* Northern Hawksbeard *Crepis mollis* and Small White Orchid *Pseudorchis albida.* On steeper banks with less frequent cutting Mat Grass *Nardus Stricta*, Devil's-bit Scabious *Succisa pratensis*, Betony *Stachys officinalis* and Fragrant Orchid *Gymnadenia conopsea* maybe more abundant. Mosses are frequent.

Management

Linked to traditional farming management. Cut for hay in late July or early august with aftermath grazing (by sheep or cattle) until the onset of winter, spring grazing.

Further Information

For detailed guidance on hay meadow management, sources of donor seed sites and possible of available funding support contact the Haytime Project Officer at the North Pennines AONB Tel: 01388 528801 or visit their website www.northpennines.org.uk.

MG5 *Cynosurus cristatus-Centaurea nigra*: lowland hay meadow and pasture

Distribution

North Pennines, Pennine Dales Fringe, West Durham Coalfield, Wear Lowlands, Tees Lowlands and East Durham Limestone Plateau.

Character

Herb rich grassland of rather variable appearance. Traditionally-managed as hay meadows or pastures occurring in lowland areas and fringes of uplands. Rare due to agricultural improvement but areas do survive within farm fields, churchyards, road verges, railway embankments and disused quarries.

Geology

Various. Clays, shales, sandstones and superficial deposits of low calcium content.

Soils

Brown soils of generally loamy to clayey texture.

Species

Fine leaved grasses include Crested Dog's Tail *Cynosurus cristatus*, Sweet Vernal Grass *Anthoxanthum odoratum*, Common Bent *Agrostis capillaris*, Red Fescue Festuca rubra, Yellow Oat-grass *Trisetum flavescens*. Courser grasses for example Cocksfoot *Dactylis glomerata* and Yorkshire Fog *Holcus lanatus* are less frequent.

Herbs comprise a substantial proportion of the vegetation and can include species such as, Bulbous Buttercup *Ranunculus bulbous*, Common Sorrel *Rumex acetosa*, Yarrow *Achillea millefolium*, Self Heal *Prunella vulgaris*, Knapweed *Centaurea nigra*, Ox-eye Daisy *Leucanthemum vulgare*, Birds-foot Trefoil *Lotus corniculatus*, Yellow-rattle *Rhinanthus minor* and Salad Burnet *Sanguisorba minor*. In meadows found in the upland margins, species more characteristic of calcifugous grassland may occur these include Tormentil *Potentilla erecta* and Devil's-bit Scabious *Succisa pratensis.*

Management

Management is variable. Meadows usually cut annually for hay followed by grazing by sheep/cattle and a light application of natural organic manures. Pastures, low intensity grazing by sheep, cattle or horses to obtain an optimum sward height of 5-10cm.

MG6 *Lolium perenne – Cynosurus cristatus* grassland

Distribution

Widespread.

Character

Common permanent grassland on moist but free draining soil. It is virtually ubiquitous community of British Lowlands occurring wherever there has been intensive improvement for pasturing. The community is also widespread as a long-established recreational sward, on road verges and on lawns. By the processes of agricultural improvement, grassland of this kind has been derived from a wide range of vegetation types. Species characteristic of these former vegetation types can persist at low frequencies.

Geology

Various.

Soils

Moist but free draining circumneutral brown earths.

Species

The most abundant grass is usually Perennial Ryegrass *Lolium perenne*, with varying degrees of Crested Dog's-tail *Cynosurus cristatus*. Other frequent grasses include Red Fescue *Festuca rubra*, Common Bent *Agrostis capillaris*, Yorkshire Fog *Holcus lanatus* Cocksfoot *Dactylis glomerata*, Smooth Meadow-grass *Poa pratensis* and Rough Meadow-grass *P. trivialis*.

Herbs are limited with White Clover *Trifolium repens* being the most frequent and it may attain co-dominance with Perennial Ryegrass *Lolium perenne.* Common Mouse-ear *Cerastium fontanum,* Ribwort Plantain *Plantago lanceolata,* Meadow Buttercup *Ranunculus acris,* Daisy *Bellis perennis,* Creeping Thistle *Cirsium arvense* and Ragwort *Senecio jacobaea* may also be present.

Management

Pasture grazed in rotation through the year and occasionally cropped for hay or silage.

MG7 *Lolium perenne* leys and related grasslands

Distribution
Widespread.

Character
Species poor grassland dominated by Perennial Ryegrass *Lolium perenne* and other specially selected grasses. Grasslands of this kind are often sown as high productivity swards, for grazing or silage; others are permanent amenity and recreational swards developed due to their resistance to heavy use. Most examples tend to have been created by sowing into pre-existing meadows or pastures but some have developed naturally where existing swards have been trampled, heavily grazed or been subject to 'natural enrichment'.

Geology
Various

Soils
Various

Species
Perennial Ryegrass *Lolium perenne* is usually dominant along with other specially selected species such as Timothy *Phleum pratense* spp. *pratensis*, Meadow Foxtail *Alopecurus pratensis*, Rough Meadow-grass *Poa trivialis* and Meadow Fescue *Festuca pratensis*.

White Clover *Trifolium repens* is the only frequent herb.

Management
Grazing or mowing.

MG8 *Cynosurus cristatus-Caltha palustris* grassland

Distribution

North Pennines, Pennine Dales Fringe.

Character

Species rich and varied grassland with no single species consistently dominant. Restricted to areas where there is prolonged rather that seasonal inundation and areas of poorly drained ground below springs, flushes and seepage lines which produce a trickle of moderately calcareous water. Maybe managed as a pasture or hay meadow.

In Durham most often found in association with MG3 – Upland Hay Meadows in the wetter areas. Characterised by moisture loving or moisture tolerant plants.

Geology

Various.

Soils

Gleyed brown earths, gleyed brown calcareous earths and surface water gleys.

Species

Constant grasses include Crested Dog's Tail *Cynosurus cristatus*, Sweet Vernal-grass *Anthoxanthum odoratum*, Red Fescue *Festuca rubra*, Rough Meadow-grass *Poa trivialis*, Yorkshire Fog *Holcus lanatus*. Meadow Fescue *Festuca pratensis*, Perennial Rye-grass *Lolium perenne*, Creeping Bent *Agrostis stolonifera*, Common Bent *Agrostis capillaris* and Cocksfoot *Dactylis glomerata.* Quaking-grass *Briza media* may also be present but less frequent.

Sedges include Carnation Sedge *Carex panicea* and Brown Sedge C. disticha.

Frequent herbs include Marsh Marigold *Caltha palustris*, Meadow Buttercup *Ranunculus acris*, Creeping Buttercup *R. repens*, White Clover *Trifolium repens* and Red Clover *T. pratense*. Autumn Hawkbit *Leontodon autumnalis*, Common Mouse-ear *Cerastium fontanum*, Daisy *Bellis perennis*, Great Burnet *Sanguisorba officinalis*, Meadow Vetchling *Lathyrus pratensis* and Smooth Lady's Mantle *Alchemilla glabra* may also occur.

Management

Traditional management as pasture involves grazing by cattle or horses (but not usually sheep because land is too wet). May also be managed as part of a hay meadow system.

CG9 *Sesleria albicans – Galium sterneri* grassland

Distribution

North Pennines.

Character

Very variable in character but confined to sub-montane or montane climates. Can occur as closed or open swards or in rocky situations. The sward can be short with an even close-cropped appearance when grazed or be taller and decidedly tussocky when ungrazed. Often contains a number of nationally rare species which are often related to altitude.

Geology

Carboniferous Limestone.

Soils

Free draining but moist, shallow base-rich soils derived from calcium rich limestone.

Species

Blue Moor-grass *Sesleria albicans* is abundant along with Sheep's Fescue *Festuca ovina* and Quaking Grass *Briza media*.

Sedges such as Glaucous Sedge *Carex flacca* and Spring Sedge *C. caryophyllea* are also common along with herbs such as Wild Thyme *Thymus polytrichus*, Common Rockrose *Helianthemum nummularium*, Limestone Bedstraw *Galium sterneri*, Eyebrights *Euphrasia spp*., Fairy Flax *Linum catharticum*, Tormentil *Potentilla erecta* and Autumn Gentian *Gentianella amarella*. Nationally rare species such as Teesdale Violet *Viola rupestris* may also occur. Mosses are frequent and an important component of the sward.

In the **sub-community NVC CG9d** which occurring on the sugar limestones in Upper Teesdale, the grass and sedge swards are enriched by a variety of preferential and highly distinctive northern montane, alpine and arctic-alpine species, including Spring Gentian *Gentiana verna*, Hoary Whitlow-grass *Draba incana*, Mountain Avens *Dryas octopetala* and Alpine Bistort *Polygonum viviparum*. Other characteristic species include Hoary Rockrose *Helianthemum oelandicum*, Horseshoe Vetch *Hippocrepis comosa*, False Sedge *Kobresia simpliciuscula*, Bird's-eye Primrose *Primula farinosa*, Alpine Bistort *Polygonum viviparum*, Hair Sedge *Carex capillaris*, Dark-red Helleborine *Epipactis atrorubens*, Limestone Bedstraw *Galium sterneri*, Spring Sandwort *Minuartia verna* and Bitter Milkwort *Polygala amara*.

Management

Low intensive grazing by sheep. Optimum sward height is 2-15cm. On the sugar limestone it is important to keep summer grazing to a minimum as severe trampling by grazing animals can loosen the highly friable sugar limestone substrate, which then becomes susceptible to wind erosion.

CG10 *Festuca ovina-Agrostis capillaris–Thymus polytrichus* grassland

Distribution
North Pennines.

Character
Essentially a sub-montane community of the British uplands developed over calcareous bedrock. Generally old unimproved pastures of closed swards, close-cropped by heavy grazing.

Geology
Carboniferous Limestone.

Soils
Fairly base-rich and often moist brown earths.

Species
Usually dominated by Sheep's fescue *Festuca ovina* and Common Bent *Agrostis capillaris*. Red Fescue *Festuca rubra* is also frequent.

Wild thyme *Thymus polytrichus* is abundant. Often characterised by a mixture of species more associated with acid conditions such Heather *Calluna vulgaris*, Mat Grass *Nardus stricta*, Heath Rush *Juncus squarrosus*, Tormentil *Potentilla erecta* and Heath Bedstraw *Galium saxatile* along with more calcicolous plants such as Glaucous Sedge *Carex flacca* and Rough Hawkbit *Leontodon hispidus*.

Also present occasionally are various Lady's Mantle *Alchemilla* spp. including the nationally rare Smooth Lady's Mantle *Alchemilla glabra*. Mosses are frequent.

Management
Low intensive grazing by sheep or cattle. Optimum sward height 2-10cm.

Calaminarian grassland (Corresponds closest to NVC OV37 *Festuca ovina – Minuartia verna* community)

Distribution

North Pennines.

Character

Short open vegetation dominated by species that are tolerant of toxic metals, low nutrient levels, droughts and grazing. Restricted to spoil heaps of lead mines, natural mineral outcrops amongst calcareous bedrocks and river shingles downstream of mine working.

Geology

Carboniferous Limestone

Soils

Skeletal soils over fine, stoney gravels containing high levels of heavy metals including lead, zinc and cadium.

Species

Dominated by metallophytes, most notably Spring Sandwort *Minuartia verna*, Alpine Scurvy-grass *Cochlearia micacea* and Alpine Pennycress *Thlaspi caerulescens*, together with genetically-adapted range of other species, such as Sheep's Fescue *Festuca ovina*, Bent's *Agrostis spp*., Bladder Campion *Silene vulgaris*, Thyme *Thymus polytrichus*, Mountain Pansy *Viola lutea*, Thrift *Armeria spp*. and Moonwort *Botrychium lunaria*. Pyrenean Scurvy-grass *Cochlearia pyrenaica* occurs in the damper areas. Mosses and Lichens abundant.

Management

Maintenance is dependent on continuous grazing by sheep or rabbits to inhibit the onset of gorse scrub.

CG2 *Festuca ovina – Avenula pratensis* grassland

Distribution

Sparsely distributed throughout East Durham Limestone Plateau `

Character

Comprises of a mixture of grasses and herbs in a continuous, closed sward. Typically has a southern distribution in Britain and as a consequence many of the Southern species are absent. Largely restricted to the Durham Coast on steeply-sloping cliffs with a southerly aspect where it often incorporates maritime species such as Sea Plantain *Plantago maritima*, but may occur inland in similar situations to CG8.

Geology

Magnesian Limestone

Soils

Free-draining calcareous brown earths or rendzinas

Species

Sheep's Fescue *Festuca Ovina* is the most abundant but with Red Fescue *Festuca rubra*, Meadow Oat Grass *Avenula pratensis* and Quaking Grass *Briza media* frequent. Crested Hair-grass may also be present.

Herbs such as Wild Thyme *Thymus polytrichus*, Common Rockrose *Helianthemum nummularium*, Small Scabious *Scabiosa columbaria*, Salad Burnet *Sanguisorba minor*, Bird's-foot Trefoil *Lotus corniculatus,* Harebell *Campanula rotundifolia*, Rough Hawkbit *Leontodon hispidus*, Lady's Bedstraw *Galium verum*, Ribwort Plantain *Plantago lanceolata*, Fairy Flax *Linum catharticum*, Autumn Gentian *Gentianella amarella* and Eyebright *Euphrasia spp*. may be present.

The communities occurring on the Durham Coast may include more maritime species such as Sea Plantain *Plantago maritima*.

Management

Maintained by grazing, traditionally sheep and rabbits. Optimum sward height is 2-10cm with up to 10% bare ground.

CG3 *Bromus erectus* grassland

Distribution

Sparsely distributed throughout East Durham Limestone Plateau. `

Character

Typically ungrazed, often with rank and tussocky swards and as a consequence there is reduced frequency of many of the diminutive light-demanding associates characteristic of other close cropped calcicolous grasslands. Usually on warmer, south facing slopes of the escarpment, but rarely in patches larger than a fraction of a hectare. This community typically has a southern distribution and therefore within Durham lacks many of the typical southern species.

Geology

Magnesian Limestone.

Soils

Shallow calcareous soils.

Species

Upright Brome *Bromopsis erecta* is dominant with Sheep's Fescue *Festuca ovina*, Quaking Grass *Briza media* and Glaucous Sedge *Carex flacca* also occurring.

Herbs include, Salad Burnet *Sanguisorba minor*, Ribwort Plantain *Plantago lanceolata,* Bird's-foot Trefoil *Lotus corniculatus*, Dwarf Thistle *Cirsium acaule*. Due to its taller, ranker swards some of the lower growing species such as Wild Thyme *Thymus polytrichus* and rosette-forming species such as Hoary Plantain *Plantago media* are largely absent.

Orchids may also be present and include Pyramidal Orchid *Anacamptis pyramidalis* and Fragrant Orchid *Gymnadenia conopsea.*

Management

Maintained by livestock grazing (sheep, cattle, horses) and rabbits. Optimum sward height to maintain species richness is 2-15cm.

CG6 *Avenula pubescens* grassland

Distribution

Sparsely distributed in the East Durham Limestone Plateau.

Character

Rank and tussocky in character. Typically found as a narrow, patchy fringe towards the bottom of valley-side slopes or as small isolated stands in unimproved pastures or abandoned quarries on damper soil.

Geology

Magnesian Limestone.

Soils

Moist, but free draining mesotrophic calcareous soils on flat or gently sloping sites.

Species

Usually dominated by a mixture of Red Fescue *Festuca Rubra* and generally smaller amounts of Downy Oat-grass *Avenula pubescens* and Meadow Oat-grass *Avenula pratensis.* Crested Hair-grass *Koeleria macrantha* frequent but in small amounts. Glaucous Sedge *Carex flacca* often present.

Relatively few associated herbs and restricted to those species that can produce large rosettes or sprawls of shoots including Dandelion *Taraxacum officinale* agg. Bird's-foot Trefoil *Lotus corniculatus,* Rough Hawkbit *Leontodon hispidus,* Ribwort Plantain *Plantago lanceolata,* Salad Burnet *Sanguisorba minor* and Dwarf Thistle *Cirsium acaule.* Mosses infrequent.

Management

A short to medium sward height community maintained by livestock grazing (sheep, cattle and horses) and rabbits. Optimum sward height range for maintenance of favourable condition: 2-15cm.

CG8 *Sesleria albicans - Scabiosa columbaria* grassland.

Distribution

East Durham Limestone Plateau.

Character

Very rare grassland community restricted to calcareous soils over Magnesian Limestone in the Durham area. Comprises of generally closed swards in which Blue Moor-grass *Sesleria albicans* is often dominant in vigorous tussocks especially in an ungrazed sward. Usually unimproved pastures on steep escarpment slopes and drift free ridges but also occurs in abandoned quarries and road verges.

Geology

Magnesian Limestone.

Soils

Characteristic of shallow, free draining immature rendzina soils that are rich in calcium and magnesian carbonates with a pH generally above 7.

Species

Blue Moor-grass *Sesleria albicans* is dominant. Other grasses include, Sheep's Fescue *Festuca ovina*, Quaking Grass *Briza media*, Meadow Oat-grass *Avenula pratensis,* Crested Hair-grass *Koeleria macrantha.* Glaucous Sedge *Carex flacca* often present.

Herbs include Wild Thyme *Thymus polytrichus*, Common Rockrose *Helianthemum nummularium*, Small Scabious *Scabiosa columbaria*, Knapweed *Centaurea nigra*, Burnet Saxifrage *Pimpinella saxifraga* and Bird's-foot Trefoil *Lotus corniculatus*, Slender St-John's Wort *Hypericum pulchrum* and Kidney Vetch *Anthyllis vulneraria*. Rarer species include Mountain Everlasting *Antennaria dioica*, Globeflower *Trollius Europaeus*, Bird’s-eye Primrose *Primula farinosa*, and Dark-red Helleborine *Epipactis atrorubens*.

Orchids such as Bee Orchid *Ophrys apifera* and Pyramidal Orchid *Anacamptis pyramidalis* occur.

Management

Maintained by grazing by livestock and rabbits. Optimum sward height is 1-5cms with 5% or more, bare ground/rock.

Maritime grasslands

Distribution

East Durham Limestone Plateau.

Character

Occur on cliffs and slopes in less severely exposed locations influenced by geology and the maritime influence of sea spray, which in some exposed situations may continue for up to 500 m inland. Varied community containing calcicolous and mesotrophic species alongside salt tolerant species.

On the Durham coast the vegetation is also unusual in that species with a northerly distribution such as Birds-eye Primrose *Primula farinosa* and Melancholy Thistle *Cirsium heterophyllum*, overlap with those of a southerly distribution such as Yellow-wort *Blackstonia perfoliata* and Pyramidal Orchid *Anacamptis pyramidalis*.

Geology

Magnesian Limestone.

Soils

Shallow boulder clays of cliff tops and limestone cliffs.

Species

A maritime form of Red Fescue *Festuca rubra* is a constant component, together with maritime species such as Thrift *Armeria maritima*, Sea plantain *Plantago maritima*, Buck's-horn Plantain *P. coronopus* and Sea Carrot *Daucus carota* ssp *gummifer*. Inland grassland species include Ribwort Plantain *Plantago lanceolata*, Bird's-foot Trefoil *Lotus corniculatus*, Common Restharrow *Ononis repens* and several species of grass including Creeping Bent *Agrostis stolonifera*, Wood False-brome *Brachypodium sylvaticum*, Cocksfoot *Dactylis glomerata*, Quaking Grass *Briza media*, False Oat Grass Arrhenatherum elatius and Downy Oat-grass *Avenula pubescens*.

Management

Short sward maintained by grazing or exposure to wind.

M22 *Juncus subnodulosus - Cirsium palustre* fen-meadow

Distribution

Very sparsely distributed in East Durham Limestone Plateau.

Character

Very variable composition reflecting the unique and complex management regimes. Typically consists of Rushes *Juncus spp*. and Sedges *Sedges spp*.. Rank in character if not grazed. Can be found either in, or around well-developed springs, flushes and mires or marking areas where there is a high water table. Usually has a southern distribution, rare in County Durham.

Geology

Very variable. Lime rich bedrock or heavy-textures superficials.

Soils

Moist, base-rich and moderately mesotrophic peats and mineral soils.

Species

Blunt Flowered Rush *Juncus subnodulosus* is usually dominant but Hard Rush *Juncus inflexus* and Jointed Rush *Juncus articulatus* may also be present. Sedges may include Lesser-Pond Sedge *Carex acutiformis*, Brown Sedge *Carex disticha*, Greater Tussock Sedge *Carex paniculata* and Hairy Sedge *Carex hirta*.

Grasses include, Tufted Hair-grass *Deschampsia cespitosa*, Yorkshire Fog *Holcus lanatus* and Red Fescue *Festuca Rubra*.

Herbs include, Marsh Thistle *Cirsium palustre*, Meadowsweet *Filipendula ulmaria*, Wild Angelica *Angelica sylvestris*, Hemp Agrimony *Eupatorium cannabinum*, Marsh Marigold *Caltha palustris*, Water Horsetail *Equisetum fluviatile*, Sneezewort *Achillea ptarmica*, Common Valerian *Valeriana officinalis* and Marsh Pennywort *Hydrocotyle vulgaris*.

Management

Requires grazing usually by cattle to maintain conservation value during the period April to November. A few sites are managed as hay meadows with a July hay cut followed by aftermath grazing. Optimum sward height 5-40cm. Soils have a high water table during the year but surface flooding is rare.

M23 *Juncus effuses/acutiflorus-Galium palustre* rush-pasture

Distribution

Concentrated in North Pennines.

Character

Upland rushy pasture. Particularly characteristic of the less improved pastures of allotments and intakes in the moorland fringes. May also form discrete areas in hay meadows, acidic flushes and wet wood pasture. Similar grasslands occur in the lowlands in poorly drained areas on base poor drift.

Geology

Impervious acid bedrock and base poor drift.

Soils

Moist, moderately acid to neutral, peaty and mineral soils, with a pH range of 4-6.

Species

Characterised by abundance of Soft Rush *Juncus effusus* or Sharp-flowered Rush *Juncus acutiflorus*. Yorkshire Fog *Holcus lanatus* is the most frequent grass species but Creeping Bent *Agrostis stolonifera*, Sweet Vernal Grass *Anthoxanthum odoratum* and Rough Meadow Grass *Poa trivialis* are common on drier stands along with

Herbs include, Lesser Spearwort *Ranunculus flammula*, Marsh Bedstraw *Galium palustre* and Cuckoo Flower *Cardamine pratensis*.

Management

Maintained by mainly grazing by cattle or sheep during the period April to November. More occasionally maintained as hay meadow with a late July cut followed by aftermath grazing. Optimum sward height 5-40cm. Soils have a high water table during the year but surface flooding is rare.

M24 *Molinia caerulea – Cirsium dissectum* fen-meadow

Distribution

Tees Lowlands, East Durham Limestone Plateau.

Character

Rare marshy grassland, formerly more extensive in the Carrs of the Tees Lowlands. Found in association with mire communities, typically marking out better drained fringes of bogs and fens, or the margins of wet hollows and flushes.

Geology

Various

Soils

Moist, neutral to mildly acidic peaty and peaty mineral soils

Species

Purple Moor-grass *Molinia caerulea* is the most abundant species. Associated flora is usually reduced to scattered individuals of only a few species. The most common species are Rushes including Hard Rush *Juncus inflexus* and Sharp-flowered Rush *Juncus acutiflorus*. Sedges include, Brown sedge *Carex disticha*, Tawny Sedge *Carex hostiana*, Carnation sedge *Carex panicea* and Flea Sedge *Carex pulicaris*.

Tormentil *Potentilla erecta* is the most common herb species with the following occurring occasionally; Great Burnet *Sanguisorba officinalis*, Marsh Bedstraw *Galium palustre*, Pepper Saxifrage *Silaum silaus*, Fen Bedstraw *Galium uliginosum*, Sneezewort *Achillea ptarmica*, Marsh Marigold *Caltha palustris*, Marsh Valerian *Valeriana dioica*, Devils-bit Scabious *Succisa pratensis* and Water Forget-me-not *Myosotis scorpioides*.

Management

Maintained by mainly grazing by cattle during the period April to November. More occasionally maintained as hay meadow with a late July cut followed by aftermath grazing. Optimum sward height 5-40cm. Soils have a high water table during the year but surface flooding is rare.

M25 *Molinia caerulea – Potentilla erecta* mire

M25a Erica tetralix sub-community

Distribution

North Pennines, West Durham Coalfield.

Character

Occurs over gently-sloping ground often marking out seepage zones and flushed margins of streams, water–tracks and mires in the uplands. Often occurring in conjunction with wetter mire and heath vegetation.

Geology

Acid bedrock and base poor drift.

Soils

Moist but well aerated acid to neutral peats and peaty mineral soils.

Species

Purple Moor-grass *Molinia caerulea* abundant. Other grass species have limited importance but Sweet Vernal-grass *Anthoxanthum odoratum*, Velvet Bent *Agrostis canina* and Red Fescue *Festuca rubra* may occur occasionally. Other species include Cross-leaved Heath *Erica tetralix* and Heather *Calluna vulgaris*, Common Cotton-grass *Eriophorum angustifolium*, Sharp-flowered Rush *Juncus acutiflorus*, Bog Asphodel *Narthecium ossifragum* and Bog Violet *Viola palustris*. Sphagnum *Sphagnum spp.* mosses may also be noticeable forming patched alongside which Sundew *Drosera spp*. and Cranberry *Vaccinium oxycoccos* occur.

Management

Usually grazed by cattle during the period April to November, however in a few cases winter burning may also be practiced. Optimum sward height 5-40cm. Soils have a high water table during the year but surface flooding is rare.

M26 *Molinia caerulea-Crepis paludosa* mire

M26b *Festuca rubra* sub-community

Distribution

North Pennines.

Character

Rare sub-community occurring on flushed slopes over limestones between 250m and 450m altitude. Often occurs on flushed slopes where the water table is close to the surface for much of the year within enclosed grasslands managed as meadow and pasture. Often in association with MG3 meadows.

Geology

Base rich and calcareous peats.

Soils

Moist, moderately base-rich peats, calcareous peats and peaty mineral soils.

Species

Purple Moor Grass *Molinia caerulea* is usually dominant, other grasses include Red Fescue *Festuca rubra*, Sheep's Fescue *Festuca ovina*, Yorkshire Fog *Holcus lanatus*, Tufted Hair-grass *Deschampsia cespitosa*, Quaking Grass *Briza media* and Sweet Vernal Grass *Anthoxanthum odoratum*.

Sedges and rushes common: Common Sedge *Carex nigra*, Carnation sedge *Carex panacea*, Sharp Flowered Rush *Juncus acutiflorus*, Compact Rush *Juncus conglomeratus* and Jointed Rush *Juncus articulatus* being most frequent.

Common herbs include Marsh Marigold *Caltha palustris*, Marsh Valerian *Valeriana dioica*, Devil's-bit Scabious *Succisa pratensis*, along with Water Avens *Geum rivale*, Rough Hawkbit *Leontodon hispidus* and Common Knapweed *Centaurea nigra*.

Management

Meadow management requires an annual cut in July combined with spring and aftermath grazing (as with the MG3 grassland, in which it is often associated). Pastures require grazing by cattle or sheep to maintain an optimum sward height of 5-15cm.

M27 *Filipendula ulmaria-Angelica sylvestris* mire

Distributions

Tees Lowlands, East Durham Limestone Plateau.

Character

Tall herb community typical of ungrazed situations in the lowlands, fringing watercourses or wetlands but also occurs in artificial habitats alongside roadside projects; generally species poor.

Geology

Various.

Soils

Moist, reasonably rich, alluvial soils along side rivers, streams and ponds and on more eutrophic gleys and peats.

Species

Meadow Sweet *Filipendula ulmaria* is dominant. Apart from Rough Meadow Grass *Poa trivialis*, grasses and rushes infrequent.

Herbs include Wild Angelica *Angelica sylvestris*, Valeriana *Valeriana spp.*, Common Sorrel *Rumex acetosa,* Ragged Robin *Lychnis flos-cuculi*, Marsh Bedstraw *Galium palustre* and Bog stitchwort *Stellaria alsine*.

Management

Unmanaged. Avoid draining and grazing. This Community cannot tolerate anything other that very light or sporadic grazing.

MG10 *Holcus lanatus-Juncus effusus* rush pasture

Distribution

Widespread.

Character

Species poor rush pasture, characteristic of strongly impeded drainage. Sward with prominent tussocks of rushes surrounded by a generally species poor and short grassy ground due to heavy grazing between the clumps of rushes. Widely distributed in pastures, but also common on abandoned agricultural land, damp verges and in ditches.

Geology

Any impervious bedrock including clay, shales or pervious substratum where there is superficial deposits such as till and alluvium.

Soils

Brown earths, brown calcareous earths and alluvial soils which are kept moist and sometimes waterlogged by ground or surface water.

Species

Soft Rush *Juncus effusus* usually dominant. Yorkshire Fog *Holcus lanatus* and Creeping Bent *Agrostis stolonifera* most abundant grasses. Herbs are relatively few in number although Creeping Buttercup *Ranunculus repens* and Meadow Buttercup *R. acris* can be frequent. Mosses tend to be sparse.

Management

Managed by grazing by cattle or sheep. Can tolerate moderate trampling.

MG9 *Holcus lanatus – Deschampsia cespitosa* damp pasture.

Region

Widespread.

Character

Species poor, damp pasture commonly developing by invasion of Tufted Hair-grass *Deschampsia cespitosa* into improved permanent grassland and reseeded grassland where drainage is poor. Occurs in patches or as extensive stands on level to moderately steep ground. Course tufted and tussocky sward.

Geology

Any impervious bedrock including clay, shales or pervious substratum where there are superficial deposits such as till and alluvium.

Soils

Permanently moist, gleyed and periodically inundated circumneutral soils.

Species

Dominated by Tufted Hair-grass *Deschampsia cespitosa*. Yorkshire Fog *Holcus lanatus*, Cocksfoot *Dactylis glomerata* and False Oat-grass *Arrhenatherum elatius*. Frequent herbs species include Creeping Buttercup *Ranunculus repens*, Meadow Buttercup *Ranunculus acris*, Common Sorrel *Rumex acetosa*, Common Mouse-ear *Cerastium fontanum* and Ribwort Plantain *Plantago lanceolata*. Mosses infrequent.

Management

Variable but often grazed by cattle and sheep. Can tolerate moderate trampling.

GRASSLAND MANAGEMENT

The need for management

Management tools

Special cases

Restoring diversity

The need for management

Most grasslands are dependant on continual management by cutting, grazing or in some circumstances burning to maintain their structure, balance and diversity. Changing the intensity or frequency of these management practices can result in the grassland becoming course and rank and losing diversity, and shifting from one grassland community to another or in the absence of management, resulting in the development woodland or scrub.

The species composition and vegetation structure of a grassland is highly dependent on whether it is a pasture or a meadow and therefore the management techniques used. Meadows are usually managed by mowing and possibility grazing whereas pastures are typically managed by grazing alone.

If the conservation interest of a semi-natural grassland is to be maintained the basic management practice which has given rise to the plant communities must be continued or, where that management practise has lapsed, reinstated.

Most grassland management regimes are likely to be aimed principally at the vegetation. However, many sites may also be important for both invertebrates and birds (e.g. Lapwing *Vanellus vanellus*, Curlew *Numenius arquata* and Yellow Wagtail *Motacilla flava*), therefore management prescriptions will need to vary depending on the species that you are trying to conserve.

In general, the following should be avoided or minimised on important semi-natural grassland sites:

- Over or under grazing by livestock
- Heavy poaching or build up of latrines/dung heaps in sensitive areas
- Addition of lime to acid soils
- Vehicle and machinery damage
- Use of inorganic fertilizers. (Organic manure should only be used where there is a proven history of use)
- Use of herbicides

Prior to starting any actual grassland management, it is essential to develop an action plan based upon clear conservation objectives. These should be developed after an analysis and evaluation of the site, assessment of the constraints and the availability of resources such as machinery, livestock and finances. Not all management options will be practicable or acceptable in every situation.

Published Guidance

Natural England has published guidance on managing lowland semi-natural grasslands in '*The lowland Grassland Management Handbook'*. This can be downloaded from Natural England's website at www.naturalengland.org.uk.

Key Points

- Get to know the grassland. Observe and map the physical characteristics including variations in slope; aspect; drainage features such as occurrence of natural springs and flushes and artificial features such as ditches; soil type, structure, acidity and depth; sward structure.
- Collect information on the ecology of the site - flora, fauna and plant communities. The County Ecologist and Local Wildlife Trust may have useful information on these.
- Determine what the ecological requirements of the communities and species are. For example the soil type, microclimate, or nutrient requirements.
- Find out about any protected species that may be affected by operations. Contact specialist groups if necessary.
- Establish if there are any landscape designations (Sites of Special Scientific Interest (SSSI), Local Wildlife Sites, Scheduled Ancient Monuments etc) that might affect how the site is managed. (The location of these sites can be checked on the Multi-Agency Geographic Information for the Countryside website at www.magic.gov.uk). Advice should be sought from Natural England if the scheme is to take place close to or within a SSSI or European protected area.
- Gather information on the historical management. Maintenance of the botanical richness is often best achieved by mimicking the regimes that are responsible for creating and maintaining them in the first place.
- Determine if the current regime has created/maintained the key individuals/communities or if it's had a detrimental effect. The management regime should only be altered if there is clear evidence that the wildlife interest is in decline. Any change in management needs to fulfil the ecological requirements of the characteristic communities and species you wish to conserve.
- Continually review the conservation objectives.
- Take advice. There are various bodies (including The Wildlife Trust, Natural England, Defra and the Grasslands Trust) that can provide advice on managing grassland and may also be able to recommend specialists for carrying out detailed assessments.
- For more detailed management practises tailored towards birds and invertebrates please refer to 'Further Information'

Further Information

Funding

Funding may be available via agri-environmental schemes administered by Natural England for grassland management, restoration and creation. Visit www.naturalengland.org.uk.

Grants may also be available through English Heritage to manage a site that contains a scheduled monument or archaeological site. For further information visit website www.english-heritage.org.uk.

Managing grassland for birds and invertebrates

Details on managing habitats for birds and invertebrates are available from the Royal Society for the Protection of Birds (RSPB) website www.rspb.org.uk. They have also produced the following handbooks and leaflets:

- Kirby, P. 1992. *Habitat Management for Invertebrates: a practical handbook*. RSPB.
- Andrews, J. and Rebane, M. 1994. *Farming and Wildlife. A practical management handbook*. RSPB.
- Benstead, P, Drake, M, José, P, Mountford, O, Newbold, C and Treweek, J (1997). *The wet grassland guide: managing floodplain and coastal wet grasslands for wildlife*. RSPB, Sandy.
- Benstead, P J, José, P V, Joyce, C B and Wade P M (1999) *European wet grassland: guidelines for management and restoration*. RSPB, Sandy.

Buglife have produced a series of handbooks '*Managing Priority Habitats for Invertebrates*' for each of the BAP priority grassland habitats which. These are available from their website www.buglife.org.uk.

Management Tools

Grazing

Grazing can be fundamental to the maintenance of grassland biodiversity and is a key management tool for semi-natural grasslands, in particular pastures. It maintains species richness by reducing soil fertility, limiting the ability of more aggressive species to achieve dominance and helps to prevent scrub encroachment.

The behaviour of grazing animals such as selective grazing, browsing, trampling, poaching, manuring, creates heterogeneity and structural diversity which can support an array of plant, invertebrate and bird species. The effects on grassland structure and composition are complex and vary according to species used, breed, age, intensity, timing (duration and season) and system (sequence and pattern) of grazing. The three main domestic species used are sheep, cattle and horses, although goats which by preference are browsers are potentially very useful in restoration of grasslands.

Rabbits can be a significant non-domestic grazer. The main problem faced by conservationists is that rabbits are hard to control and rabbit grazing is difficult to direct. However in the correct densities rabbits can play an important role in maintaining species richness especially where cessation of livestock grazing has occurred.

Published Guidance

Natural England has published guidance on grazing semi-natural grasslands in section 5 of '*The lowland Grassland Management Handbook*'. This can be downloaded from Natural England's website at www.naturalengland.org.uk.

Key Points

- Grazing should aim to remove the year's growth over a given period of time, without damaging the sward.
- The correct stocking level (no. of animals per unit area) is dependent on the type of animal used, grazing duration, type of grassland and plant community and conservation objectives. Lighter, later and/or less frequent grazing will benefit invertebrates more, whilst heavier grazing in autumn/winter can benefit plant diversity. For further information on correct stocking densities refer to the published guidance or contact The Grazing Advice Partnership.
- Prevent over/under grazing. Too low a grazing pressure could lead to successive scrub encroachment and loss of biodiversity whilst continuous over-grazing can lead to soil erosion, elimination of certain species and invasion of problem species such as Creeping Thistle *Cirsium arvense*, Common Ragwort *Senecio jacobaea* and Docks *Rumex* spp..

- Timing of grazing will be determined by the conservation objectives. Spring/Summer grazing suppresses scrub encroachment and prevents build up of leaf litter. Early spring/autumn grazing is particularly beneficial as it opens up germination sites for annuals and biennials. To maintain species diversity grazing should be reduced in late spring/summer to allow plants to flower and set seed.
- Regular assessment of the sward should be undertaken and the stocking rate adjusted as appropriate. Where there is an existing grazing regime, continue this if it appears to be maintaining the conservation value of the site.
- Lack of livestock may be a major constraint in delivering conservation objectives as it requires substantial resources to initialise and maintain and thus can be extremely costly. It may be more economical to rent the land to a local farmer to graze their stock.
- Always seek advice

Choice of grazing species

The species or combination of species used will largely depend on your conservation objectives, resources available and the grassland structure that is to be achieved. All animals graze selectively and this will have an impact on not only the species composition but sward height. The three main species used are sheep, cattle and horses, although goats can also be used.

Sheep

- Create uniform short, tight swards and can prevent species becoming dominant.
- Very selective and depending on grazing intensity will avoid certain species and as a result may lead to an increase of weed species (e.g. Thistles). They also target flowering plants which can have a negative impact on species diversity.
- Often graze preferentially in small patches; select the most palatable patches first.
- Not suitable for tall vegetation, therefore generally not the best animals for restoration grazing.
- Lighter and more agile than cattle and may be more appropriate for grazing on steep slopes.
- Relatively inexpensive to maintain.
- Can be suitable for controlling Ragwort *Senecio jacobaea*.

Cattle

- Generally better than sheep at creating and maintaining a structurally diverse sward of benefit to invertebrates. They also trample the ground more, which opens up the sward allowing the establishment of short lived species and aids seed germination.
- Relatively unselective grazers; will graze tall, course vegetation and maintain sward heights of around 5cm.
- Particularly good at knocking down and opening up tall coarse vegetation such as Bracken *Pteridium aquilinum* and scrub, therefore have a useful role in restoring grasslands.

- It is more difficult to acquire commercially-farmed cattle for conservation grazing compared to sheep, as farmers are less likely to be willing to graze cattle on conservation grassland because of their value and requirements for them to put on weight.
- Overstocking during the autumn and winter period can lead to infestations of Docks, Ragwort and Thistles.
- Hardy or primitive breeds can eat course vegetation compared to modern lowland breeds and are more useful in conservation management.

Horses and Ponies

- Horses are very selective and prefer to graze on grass, creating structurally varied swards.
- Create very short swards down to 2cm
- Horses are generally not used for nature conservation purposes as overstocking can lead to the increase of nitrogen loving plants and weeds, poaching, bare patches and overgrown, course vegetation. They also require considerable care during the winter months including supplementary feeding. However if monitored properly, light grazing by horses may be beneficially especially on sites valuable for invertebrates due to the diverse sward structure created.
- If it is a choice between no management or grazing solely by horses, as can often be the case at urban sites, opt for the latter at light stocking densities, or shorter duration.
- Hardy breeds of ponies (e.g. Shetland and New Forest) however maybe a useful management tool in reclaiming neglected grassland as they trample and eat coarse grasses and are tolerant of quite poor grazing.

Goats

- Goats either graze or browse, but most types prefer to browse or eat course vegetation.
- Potentially very useful in restoring grassland invaded by shrubs and trees. At higher stocking densities rates will also eat thistles, rushes etc.
- Inexpensive and hardy. Very agile and good climbers.

Further Information

Organisations

The Grazing Advice Partnership (www.grazinganimalsproject.org.uk) is an excellent resource with advice to help land managers achieve appropriate grazing on conservation sites and a useful provision of advice on stocking densities and species to use.

Publications

English Nature (2005). *The importance of livestock grazing for wildlife conservation*. English Nature, Peterbourgh. Available from Natural England's website www.naturalengland.org.uk.

Flora Locale (2009) *Grazing for wild plants and Biodiversity*. Flora Locale, Marlborough. Available from www.floralocale.org.

Grazing Animal Project (2001) *The Breed Profiles Handbook: Guide to the selection of livestock breeds for grazing wildlife sites*. Grazing Animals Project, Newark. Available form The Grazing Advice Partnership website www.grazinganimalsproject.org.uk.

Mowing and Cutting

Like grazing, annual mowing and removal of plant material reduces soil fertility, prevents the dominance of competitive grasses and is effective in controlling scrub. However it has a very different impact on grassland structure and composition. It is unselective, producing a sward which is relatively uniform in height and structure and as a result can produce a very different species composition compared with that produced through grazing.

Those grasslands of highest conservation value tend to be traditionally managed as hay meadows for example MG3 *Anthoxanthum odoratum-Geranium sylvaticum*: northern hay meadows.

Published Guidance

Natural England has published guidance on mowing and cutting semi-natural grasslands in chapter 6 in '*The lowland Grassland Management Handbook'*. This can be downloaded from Natural England's website www.naturalengland.org.uk.

Key Points

- If the meadow is species rich, maintain historical management regimes that has created the particular botanical interest. Each farm system will be different.
- Aim to maintain a sward which has space for new plants to germinate and become established.
- The cutting/mowing regime will depend on the flowering period of the species present. A spring cut may also be beneficial to knock back thistles and vigorous grasses that can sometimes take hold during winter. For MG3 grassland, cutting should be carried out from late June to late July however dates will differ depending on locality and weather conditions. Ensure that a late cutting of hay (late August/Sept) is done one in every five years.
- Maintain a flexible approach to cutting dates. If the grassland holds important populations of breeding birds (e.g. Yellow Wagtail *Motacilla flava* or Redshank *Tringa totanus*) ensure cutting does not take place before their eggs have hatched. Cutting should also be timed to allow characteristic annual, biennial or short lived perennials to set seed (e.g. Yellow Rattle *Rhinanthus minor*).
- Consider using centre-out mowing method especially where the grassland supports important breeding bird species. This allows birds and their chicks to escape to the edges.
- Consider leaving uncut flower margins, large patches or corners each year as a valuable food source for invertebrates (although uncut margins should be rotated annually to prevent invasion by rank grass).
- Removal of the crop is key to retaining the wildlife interest of a meadow; this helps to prevent a build up of litter which can cause nutrient enrichment and impede seed germination (however, grass cut as hay should be left to dry for a few days to allow the seeds to drop).

- Do not replace a hay cutting with haylage or silage as it often involves earlier and more frequent cutting regimes, eliminating seed return which may have devastating effect on species diversity and abundance.
- Restrict rolling or chain harrowing to late summer or autumn. If essential in spring, work should minimise disturbance to ground-nesting birds.
- Do not use inorganic fertilisers, however occasional applications of farmyard mature may be applied where there is a proven history of use.
- Avoid very low cutting heights as this can produce 'scalping' resulting in the creation of bare patches in the sward providing favourable areas for the invasion of undesirable species.
- Discourage machinery access to grassland when the ground conditions are wet, to avoid rutting which may damage the sward and again create areas where undesirable species may invade.
- Maintain aftermath and/or spring grazing. Both cattle and sheep are suitable. Where aftermath grazing cannot be introduced, a second cut may need to take place in early to mimic that of grazing to achieve a short sward by the end of the growing season.
- Avoid feeding livestock with hay/concentrates as this can cause adverse changes to the botanical composition of the grassland through nutrient enrichment, trampling and smothering.
- Be flexible, you may need to change the regime over the years if the species diversity reduces.

Further Information

For detailed guidance on managing upland hay meadows, restoration, seed sources and sources of available funding support contact the Haytime Project Officer at the North Pennines AONB (Tel: 01388 528801). The North Pennines AONB have also produced a number of guidance leaflets which are available from their website www.northpennines.org.uk which includes '*Managing species-rich hay meadows for wildlife'*.

Other organisations which will be able to give advice include Farming and Wildlife Advisory Group and Natural England.

For detailed habitat management advice aimed at invertebrates buglife have produced a series of handbooks on priority habitats. These can be downloaded from www.buglife.co.uk.

Weed Management

Problems of weed invasion and infestation into pastures and meadows are usually the result of poor grassland management such as over grazing or the cessation of a traditional practice. The main problem species include; Creeping Thistle *Cirsium arvense*, Common Ragwort *Senecio jacobaea*, Docks *Rumex spp*., Stinging Nettle *Urtica dioica* and Rushes *Juncus* spp.. In the uplands Bracken *Pteridium aquilinum* can also be a problem.

Controlling problem species should first be addressed by improved habitat management to remove the cause of infestation. For example this may require changes to pasture management by changes to the grazing regime to minimise establishment opportunities. Thereafter various techniques including pulling, levering, bruising, cutting or mowing may remove or weaken plants and prevent them seeding.

One important rule for managing nature conservation sites is to remain vigilant for 'problem' plant species. A problem that is identified early, be it the first seedlings of an invasive exotic species or a rapid increase in a highly competitive native species, can usually be solved quickly, safely and at low cost. Problems that are not spotted, or are ignored, may quite rapidly develop into major management issues that carry high environmental and economic costs.

The approach to the control of these species and methods adopted will be influenced by a number of factors including the nature of the wildlife interest of a particular site, management objectives, resources available and species of weed.

The use of non-chemical methods of weed control should always be considered before embarking on the use of chemical control options. However, herbicides may offer an alternative and it is accepted that herbicides may frequently form a key component of the selected management programme – either alone, or as part of an integrated approach, involving both chemical and non-chemical methods.

Published Guidance

Detailed guidance on the mechanical and chemical control of weeds, including weed profiles and recommend control measures, can be found in a number of handbooks including 'The *herbicide handbook: guidance on the use of herbicides on nature conservation sites*' and '*The lowland Grassland Management Handbook'*. These can be downloaded from Natural England's website www.naturalengland.org.uk.

Key Points

- The use of non-chemical methods of weed control should always be considered before embarking on the use of chemical control options. If chemical control is used, most treatments will have to be repeated over consecutive years to effectively bring the infestation under control.
- Avoid blanket spraying of herbicide, but target herbicidal control e.g spot treatment or weed wiping.
- Prevention is better that cure. Adapt management regimes accordingly to reduce risks of weed invasion. Minimise activities or management that create large areas of bare ground or disturbance to reduce weed invasion.
- Be aware, some weed species may also have positive qualities from a conservation perspective. They may support a diverse range of invertebrates and contribute to a desirable habitat structure or provide an important food source.

Further Information

Blackshall, J., Manley, J., & Rebane, M., eds. 2001. *The upland management handbook*. English Nature, Peterborough*.

Burn, A. (Ed.) (2003) *The herbicide handbook: guidance on the use of herbicides on nature conservation sites*. English Nature in association with FACT*.

Cooke, A.S. 1986. *The use of herbicides on nature reserves. Focus on Nature Conservation No. 14*. Peterborough: Nature Conservancy Council*.

English Nature. 1995a. *Bracken control. Lowland Heathland Management Series*. Peterborough: English Nature*.

* The above publications can be downloaded as PDF files from the Natural Englands website: www.naturalengland.org.uk

Scrub Management

Scrub usually develops where management such as grazing, burning or mowing has been reduced or has ceased altogether and is often viewed as an undesirable development, particularly where it is invading an area of existing high nature conservation.

Although scrub encroachment can be viewed as one of the major threats to grassland biodiversity, its intrinsic nature conservation value on grasslands both at a site and landscape level should not be overlooked when developing and deciding on appropriate scrub management.

There are three main options for managing scrub encroachment; hand- or machine-cutting, grazing by goats or by chemicals such as herbicides. Which option(s) and techniques will depend on the conservation objective, species composition of the scrub, its successional stage and the resources available.

Published Guidance

Detailed guidance on all aspects of scrub management from scrub species profiles to technical advice are provided in '*The scrub management handbook: guidance on the management of scrub on nature conservation sites*'. Chapter 12 in '*The Lowland Grassland Management Handbook*' is also a useful source of information on scrub management. Both publications can also be downloaded from Natural England's website www.naturalengland.org.uk.

Key Points

- Retain scrub where possible to encourage breeding bird and invertebrate populations, provided its development does not threaten the conservation value of the grassland.
- Prevention is better that cure. Soil conditions alter under scrub; the increased shade and build up of nutrients in the soil favours woodland ground flora and can lead to a loss of characteristic grassland communities.
- Ensure any follow-up management is put into place straight away (grazing, re-cutting, mowing, weed control)

.

Burning

Burning is generally employed in the management of upland moorland communities dominated by Heather *Calluna vulgaris* to provide a succession of new, highly digestible shoots for Grouse, Sheep and other livestock to graze. On wetter upland soils, where Purple Moor Grass *Molinia caerulea* and Rushes *Juncus* spp. are dominant, burning may also be used to prevent tussock formation and promote succulent new herbage for livestock.

Burning is not however, a management technique which is widely used in lowland grasslands and in general it is not recommended as a management technique for meadows and pasture. Although it can be very good in intially controlling scrub.

Burning in England is only permitted between 1 November and 31 March in the lowlands and in the upland areas from the 1 October to 15 April. A licence is required at all other times and can only be obtained in very specific circumstances. Applications for burning during restricted periods should be made at your local Natural England office.

Published Guidance

Natural England has published guidance on burning as a management practice in Chapter 9 of '*The Lowland Grassland Management Handbook*'. This can be downloaded from Natural England's website at www.naturalengland.org.uk.

Key Points

- Burning must be conducted safely, with care for people, property, the environment and natural resources.
- In general, unless burning is a known traditional practice it should not be introduced as a management tool (although may be a useful in initially restoring or reclaiming grassland).
- Ensure some sort of management regime such as grazing or mowing is introduced after burning.
- Avoid burning more than half the site in any one year. Aim for a mosaic of burnt patched to provide the greatest variety of conditions for wildlife.
- Uncontrolled fires and poorly timed burning can cause great damage to wildlife and its habitat. Seek specialist advice wherever possible.
- Avoid repeated burning as this may change the species composition of the sward and in some cases encourage weeds.
- Aim to burn in January, February and March to limit the adverse effects of fire on flora and fauna.

Further Information

The '*Heather & Grass Burning Code*' describes a good standard of practice and raises awareness of the laws, and helps burners to burn safely and in ways that can benefit wildlife. This is available form Natural England's website www.naturalengland.org.uk. Best practice guides, offering specific advice in more detail than the code have also been produced.

Other Management Practices

For advice on a range of miscellaneous management practises which are likely to affect semi-natural grasslands for example artificial fertilisers, farmyard manure, rolling, chain harrowing, draining and soil disturbance please refer to chapter 8 of '*The lowland Grassland Management Handbook*' which is available on Natural England's website www.naturalengland.org.uk.

Special Cases

Churchyards

Churchyards are often managed traditionally and as a consequence can provide a valuable wildlife refuge especially in urban and intensively farmed areas.

Although the techniques used for managing churchyards will be similar to those outlined in the previous sections, there are however a range of practical issues that are specifically relevant to churchyards.

Published Guidance

Barker, G.M.A. 1997. *Wildlife Conservation in the care of churches and churchyards*. London: Council for Places of Worship of the General Synod of the Church of England.

Burman, P. and Stapleton, H. 1986 *The Churchyard Handbook* (3rd Ed). Church House Publishing and Council for the care of Churches.

Caring for God's Acre (undated). *Grassland: Management of Churchyard Grassland for Conservation*. Caring for God's Acre. Hereford.

Key Points

- Carry out a survey of the flora and fauna as a prerequisite to setting any management objectives.
- Research any regulations and restrictions that may apply to the churchyard (e.g. SSSI status, Conservation Area)
- Ascertain history of past management
- Aim to manage the site as sensitively as possible so that it meets the needs of both the parishioners and that of wildlife.
- Always try and create a diverse range of habitats. Consider how different areas are being used; certain areas may need to be kept short e.g. the paths, in front of the church and around tended graves.
- Cutting/mowing regimes will depend on the flowering period of the species present; the type of habitat that is being created/maintained and how the space is being used. For example the paths and other well used areas will probably need to be mown as often as a lawn, while the precise timing in other area will depend upon local conditions but where possible should mimic a hay cutting regime, with a cut in late July to early August and another (in place of aftermath grazing) in late September to October. Further advice on the mowing regimes specific to churchyards can be obtained from the leaflets in 'Published Guidance'.

- Always remove cuttings (however grass cut as hay should be left to dry for a few days to allow the seeds to drop).
- It may be necessary to control invasive species from time to time. The use of non-chemical methods of weed control should always be considered before embarking on the use of chemical control options. See 'Weed Management' for further information.
- Monitor the grassland and be prepared to be flexible; change the management regime if the species diversity reduces.

Further information:

As part of a national 'living churchyards' campaign promoting sympathetic churchyard management for wildlife - a DIY information pack has been produced which gives good advice on surveying, preparing management plans, management techniques and where to find additional help & advice. This is available for a small charge from The Church & Conservation Projects, The Arthur Rank Centre, Stoneleigh, Warwickshire, CV8 2LZ. Tel: 01203 696969.

The Council for the Care of Churches has produced a number of leaflets on mowing regimes and the management of wildflowers meadows areas including '*Wildlife in Church and Churchyards – Plants, Animals & their Management*' which is available from The Council for the Care of Churches, Church House, Great Smith Street, London, SW1P 3NZ. Tel: 020 7898 1000.

Road Verges

Verges are becoming increasingly important wildlife habitats. Their linear nature means that for some species of plants and animals, they can provide migration and dispersal routes to larger habitat areas and increasingly they are the only remnant of unimproved semi-natural grassland in intensively farmed and urban areas and can support rare plants and invertebrates.

Traditionally verges were often managed by cutting to provide a forage crop or by grazing. Today however, verge maintenance is usually carried out by tractor-mounted flail cutters and the cuttings are left in-situ. The vegetation nearest the road is also exposed to pollutants, dirt, herbicides and de-icing salt. As a result of modern practises, this has lead to changes in the nutrient status of the soils and an increase in coarser and more aggressive species which can tolerate these conditions. Nevertheless species-rich examples can still be found and are of high conservation value.

Most verges are the responsibility of the County Council Highways Department and primarily management is undertaken for road safety and amenity. Maintenance of sightlines and signs take priority but it is often possible to combine the safety aspect and conservation value. Although Local Authorities may be reluctant to remove cuttings due to funding constraints, parish councils, voluntary groups and the Local Wildlife Trust might be willing to act as agents for cutting and removing grass.

The management techniques for species-rich verges are similar to those already outlined in mowing and cutting, however there are a number of important management considerations specifically relevant to road verges.

Key Points

- Identify the key nature conservation features of a verge (plant community/rare species) then develop appropriate management objectives and prescriptions.
- Targeted those verges of special wildlife importance as funding may be a huge constraint.
- Verge maintenance must be properly organised and agreed with the relevant highways authority.
- To maintain biodiversity, species-rich verges must be mown, preferably twice a year (with the exception of MG1 grassland communities which should be mown only sporadically). The precise timing should depend upon local conditions and species present but in general should mimic a hay cutting regime, with a cut in late July to early August and another (in place of aftermath grazing) in late September to October.
- Cuttings must be removed to avoid nutrient build in the soil.
- It may be necessary to control invasive species from time to time. The use of non-chemical methods of weed control should always be considered before embarking on the use of chemical control options. See 'Weed Management' for further information.
- Where salt use is considered essential, bins should replace heaps on all vulnerable verges.
- Consult an ecologist or other countryside adviser for expert guidance.

Further Information

Organisations

For further information on verges in Durham contact the Durham Biodiversity Partnership. In recent years they have undertaken a survey of road verges in different locations across the county and have been working with the local authority highways departments to find ways of changing current management. Information on the survey including management prescriptions can be viewed using the Durham County Council online mapping service.

Flora Locale have produced an advisory note on '*Road verges in the countryside*' which aims to promote good practice when planting on road verges. This can be downloaded from their website www.floralocale.org.

Guidance

Lees, A. & Campbell, L. (Eds) (2007). *The Durham Biodiversity Action Plan: Transport Corridors*. The Durham Biodiversity Partnership.

Spellerberg. I.F. & Gaywood M.J. (1993). *Linear habitats & Wildlife Corridors*. English Nature Research Report No. 60. Natural England. Peterborough.

Farming & Wildlife Advisory Group (FWAG). (1985). *Road Verges – A guide for users and Managers*. Information leaflet no. 20. Stoneleigh: FWAG.

Wood-Pasture & Parkland

Wood-pasture is very variable in character and include ancient deer parks, designed parklands, winter-grazed woodlands in the uplands, juniper woods and more recent encroachments of woodland onto heath and pasture. However the defining factor for wood-pasture is that they are primarily managed by grazing, resulting in a mosaic of habitats; woodland, grassland or heathland often with veteran open grown or high forest trees.

Historically, many NVC types of grassland and heaths can be found in wood-pastures, but most surviving semi-natural grasslands in wood-pastures tend to occur most commonly on neutral or acidic soils.

Management remains largely the same as those outlined in managing grasslands by grazing however there are number of points specifically relevant to wood-pasture.

Key Points

- The management objectives and prescriptions will depend on the wood pasture structure type and species present, however long-term planning is essential as trees can live for more than 500 years.
- Level of grazing should reduce, but not permanently suppress natural regeneration.
- Periodic exclusion of grazing may be beneficial to allow regeneration of the tree resource; however this is usually a short term management prescription before seasonal grazing is reinstated.
- Re-introduction of grazing to former grazed sites should not prejudice the long-term survival of the woodland component.
- Do not use artificial fertilisers or farmyard manure.
- Prevent damage to trees from livestock, including browsing, bark stripping, rubbing against trees and soil compaction under the canopy. Consider providing additional shelters to help to reduce the time animals spend under trees and maintain the correct stocking density.
- Avoid supplementary feeding and locating water stations near trees to prevent build up of nutrients from manure.
- Take specialist advice.

Further Information

The Forestry Commission can provide advice and have published useful publications on restoring and managing wood-pasture. They can also recommend specialists for carrying out more detailed

assessments. A Woodland Assessment Grant may be available to help you undertake assessments of ecological, landscape, historical and cultural factors and for community involvement. Funding may also be available through the Higher Level Stewardship Scheme, for further information contact Natural England.

Restoring Diversity

An important feature of unimproved semi-natural grassland is their low fertility compared to improved swards. An increase in fertility tends to favour nutrient responsive species and in the absence of effective management, short and often species-rich swards can become dominated by a combination of coarse grasses, tall herbs and scrub because they are able to out compete the less vigorous herbs and fine-leaved grasses for water, light and nutrients. A leaf litter may also develop, further suppressing plant growth and increasing the soil nutrient status.

Successful restoration depends on reversing this trend. Removal of vegetation coupled with reinstatement of positive management is usually essential. Restoration is best targeted at semi-improved grasslands that retain some characteristic species of the target community and sites that are adjacent to existing semi-natural grasslands.

Restoration techniques remain largely the same as those outlined in managing grasslands however before restoring a site, the following key points should be considered.

Published Guidance

Natural England has published guidance on restoring lowland semi-natural grasslands in chapter 10 of '*The Lowland Grassland Management Handbook*'. This can be downloaded from Natural England's website www.naturalengland.org.uk.

Key Points

- Prior to setting management objectives, research the ecological and management history of the site, including reasons for its present condition. Assess the current nature conservation of the site, identifying any key features of wildlife interest.
- Consider what type of grassland the site might supported and whether it is possible to return to this by introduction of appropriate management.
- Consider how the management objectives can best be achieved (e.g. creation of specific conditions for certain species or controlling scrub).
- Consider both the cost and benefits of implementing these objectives. What resources are available to restore the site and maintain it?
- Find out if there are any environmental designations – SSSI, Local Wildlife Sites or Scheduled Ancient Monuments etc that might affect how the grassland needs to be managed. (The location of these sites can be checked on the Multi-Agency Geographic Information for the Countryside website at www.magic.gov.uk). Advice should be sought from Natural England if the scheme is to take place close to or within a SSSI or European protected area.
- In some instances it may not be worth trying to restore the grassland. For example, long term management will be required to maintain any restored sward and if this is not viable then restoration may not be worth while.

- Take advice. Defra and Natural England provide advice, grants and useful publications on restoring and managing semi-natural grasslands. They can also recommend specialists for carrying out more detailed assessments.

Restoration Methods

Grazing, Mowing, Burning and the use of herbicides are all useful techniques used to restore unmanaged grasslands.

Grazing

- The species or combination of species used will largely depend on your conservation objectives and grassland structure that is to be achieved. Cattle and hardy breeds of ponies (e.g. Shetland and New Forest) can be very efficient at restoring rank swards by opening it up and allowing short-lived species to recolonise. Trampling also helps break up the littler layer.
- Timing of grazing is not critical except where the dominant grass is particularly unpalatable. In this case, greater suppression is achieved if grazed in spring when the young leaves are more palatable. Grazing during spring is also beneficial for scrub control. Reducing grazing in summer will allow plants to flowers and set seed, but maintaining or increasing it in autumn will create gaps for seed establishment.
- The right stocking density will depend on site characteristics and conservation objectives.

Mowing

- Mowing is particularly useful as a pre-treatment to reduce the sward height prior to grazing with sheep. It does not however break up the leaf litter to the same extent as grazing, but this can be tackled by using a chain harrow. Flailing can also help to open up the turf to allow seedlings to establish.
- Be aware, cutting rank grassland can have a great impact on invertebrate populations. Where possible leave parts of the site uncut as refuges.
- Always remove cuttings to help prevent nutrients from returning to the system and to avoid smothering of low growing herbs and fine grasses.

Burning

- Burning can be a useful management tool to initially restore or reclaim grassland which has been heavily encroached by shrubs; where vegetation has become rank and/or where there is deep leaf litter preventing seedling recruitment. If used, it must be followed by either grazing or mowing as burning has been found to encourage the spread of certain unwanted species.

Herbicide

- The use of non-chemical methods of weed control should always be considered before embarking on the use of chemical control options. If chemical control is used it should be combined with other techniques such as a continuation of grazing.

Sward Enhancement

Improved management alone may be insufficient to restore a grassland especially where agricultural intensification and in particular the use of inorganic fertilisers and/or improved drainage has converted formerly species rich semi-natural grassland into species poor semi-improved grassland. In this instance prior to increasing botanical diversity by natural colonisation or artificial introduction of seeds/plants, recovery is dependant on reducing the residual effects of previous fertilisation and drainage.

This section deals with situations where grasslands still retain some botanical interest rather that the creation of grassland on areas with no existing botanical interest (e.g. ex-arable land). The ideal site will be adjacent to an unimproved habitat from which species can recolonise. However, since ideal sites are rare, the main criterion for enhancement should be low soil fertility and low/no weed burden.

The best method and technique used will be dependant on a number of factors including seed sources and resources available.

Published Guidance

Natural England has published guidance on restoring lowland semi-natural grasslands in '*The Lowland Grassland Management Handbook*'. They have also published a series of Rural Development Service Technical Advice Notes on sward enhancement. These can be downloaded from Natural England's website at www.naturalengland.org.uk.

Key Points

- Be clear on the objectives, especially the grassland community and species that you want to restore, the most appropriate methods and time scales to achieve this. Target communities should be guided by the original composition (where known).
- Find out if there are any environmental designations – SSSI, Local Wildlife Sites or Scheduled Ancient Monuments etc that might affect how the grassland needs to be managed. (The location of these sites can be checked on the Multi-Agency Geographic Information for the Countryside website at www.magic.gov.uk). Advice should be sought from Natural England if the scheme is to take place close to or within a SSSI or European protected area.
- Past management may have resulted in increased residual soil fertility (especially phosphorous) and altered pH, therefore appropriate management regimes may need to be reinstated to assist in the depletion of nutrients and provide the right conditions for establishment. Adding the hemiparastic Yellow Rattle *Rhinanthus minor* will help reduce soil fertility and also reduces the vigour and dominance of competitive grasses. Beneficial fungi in the soil may also have become depleted in the soil due to application of fertiliser and as a consequence may act as a barrier to

the enhancement of species diversity. Soil inocula taken from existing semi-natural grasslands may need to be introduced.

- Allowing natural recolonisation may be the most appropriate method, however its success will largely be determined by the existing seed bank and proximity to a 'source pool' of colonisers. An existing seed bank is unlikely to be present after a period of agricultural improvement; however boundary features such as hedges, ditches, field margins and road verges may be species rich and could provide a valuable seed source.
- Introduction of seeds/plants by surface broadcasting, seed slotting, spreading of green hay or the introduction of pot grown wildflowers and seedling plugs may be required. The technique used will depend on individual site conditions and circumstances. See section on seed sources for further information.
- The use of non-chemical methods of weed control should always be considered before embarking on the use of chemical control options. If chemical control is used it should be combined with other techniques such as a continuation of grazing.
- Take Advice.

Further Information

Funding

Funding may be available via agri-environmental schemes for the management, restoration and creation of semi-rich, semi-natural grasslands. For further information contact Natural England www.naturalengland.org.uk.

Publications

Flora Locale is a registered charity who promotes good practice in the use and sourcing of wild flora. Advisory notes and other useful information can be downloaded from their online library on their website www.floralocale.org.

The Rural Development Service has produced a number of technical advice notes on sward enhancement. The advisory notes outline how to select the most suitable sites for sward enhancement plus different methods of diversifying the sward. These can be downloaded from Natural England's website www.naturalengland.org.uk.

Organisations

The Farming and Wildlife Advisory Group (FWAG) can provide advice on the management and improvement of existing wildlife and landscape features and sources of grant aid and practical assistance.

GRASSLAND CREATION

Creating new species-rich grasslands

Choosing a seed mixture

Origins of seed and plant material

Identifying the most appropriate seed source

Establishment of vegetation

Creating Species Rich Grassland

Semi-natural grasslands are recognised as important and vulnerable habitats under the UK Biodiversity Action Plan (BAP) and as a result Durham Biodiversity Partnership has produced action plans for:

- Lowland and Upland Calcareous
- Lowland and Upland Hay Meadows
- Purple Moor Grass and Rush Pastures
- Lowland Acid grasslands.

Key targets include the restoration and creation of these grasslands as they can play an important role in biodiversity. Creating new grasslands also have the potential to expand existing grasslands, link areas of semi-natural vegetation and buffer important habitats from disturbance, pollution or amenity.

There are many opportunities for the creation of species rich grasslands, for example in the restoration of landfill sites, quarries and other industrial and urban waste sites; sites associated with development such as roadside verges, landscaping around housing, golf courses and parks; and set aside and reversion from arable.

The main factors likely to limit success is high residual soil fertility (nitrogen, potassium and particularly phosphorous), altered pH and the seed bank of competitive and invasive species. In semi-natural grasslands, high species diversity only occurs within a narrow range of both phosphorous and potassium.

Where soil fertility is found to be too high, it may be necessary to take measures to reduce fertility which may include; top soil stripping, continual cropping, deep cultivation or sowing of Yellow Rattle *Rhinanthus minor* (For more details on measures to reduce fertility please refer to English Nature's published guidance). Note, it may take several seasons for soil fertility to drop sufficiently to enable the next stage of the project to proceed.

Good seed-bed preparation, control of undesirable species (especially in the first year) and careful management both in the early stages of establishment thought to the long term are also crucial to the successful creation of species rich grasslands.

Published Guidance

Natural England has published guidance on restoring lowland semi-natural grasslands in '*The Lowland Grassland Management Handbook*'. This can be downloaded from Natural England's website at www.naturalengland.org.uk.

Key Points

- Conduct a thorough survey of the site and adjacent land to determine the suitability for grassland creation e.g. soil pH, soil structure, soil-water relations and soil fertility, presence of steep slopes, changes of level, drainage lines and seepage zones.
- Plan ahead. All the options and the objectives for creating the grassland should be considered at an early stage as these will dictate species and methods used.
- Allow sufficient time to obtain plants/set up growing contracts and prepare the site.
- Determine the ecological position of the site. Is there an opportunity to enlarge, buffer or link existing nature conservation or semi-natural grassland sites? This information will also help determine the proximity to a 'source pool' of colonisers which may influence the establishment method.
- Surveying adjacent or nearby semi-natural grasslands. This will provide information on the types of species which occur naturally and grow well in the locality.
- Measure soil fertility by chemical analysis or bioassay technique (if practical). The soil sample must be representative of the area and comprise a minimum of 25 cores per sample. Seek professional advice from ADAS.
- Determine the ecological position of the site. Is there an opportunity to enlarge, buffer or link existing nature conservation or semi-natural grassland sites? This information will also help determine the proximity to a 'source pool' of colonisers which may influence the establishment method.
- Advice should be sought from Natural England if the scheme is to take place close to or within a SSSI or European Protected Area. (The location of these sites can be checked on the Multi-Agency Geographic Information for the Countryside website at www.magic.gov.uk). Soil disturbance should be avoided on archaeological sensitivity areas. Consult English Heritage or The County Archaeologist for advice on best practise for such sites.
- Gather knowledge of past management and plant and animal communities. This may provide valuable information on the type of grassland that might successfully be created or conversely whether the site might be unsuitable and better restored to heathland or woodland.
- Seek professional advice from a qualified ecologist or other expert with a good knowledge of British plant communities.

Further Information

Flora Locale has produced a number of guidance notes on the use of wild flowers seed in habitat creation. These include a code of practice on the collecting, supplying, growing and purchase of wild flower stock and what and where to plant. These can be downloaded from their website www.floralocale.org.

Natural England has published a series of Rural Development Service Technical Advice Notes on arable reversion to species rich grassland which can be downloaded from their website www.naturalengland.org.uk. These include *'Site selection and choice of methods', 'Establishment of a sown sward'* and *'Early management of the new sward'*.

ADAS will be able to provide professional advice on measuring and evaluating soil fertility.

Benstead, P, Drake, M, José, P, Mountford, O, Newbold, C and Treweek, J (1997) *The wet grassland guide: managing floodplain and coastal wet grasslands for wildlife*. RSPB, Sandy.

Benstead, P J, José, P V, Joyce, C B and Wade P M (1999) *European wet grassland: guidelines for management and restoration*. RSPB, Sandy.

Choosing a Seed Mixture

The species selected and the source (please refer to identifying the most appropriate seed source) will partly depend on the objectives and ecology of the site. It is also important to know what habitats and species were on the site originally. One of the keys to success is to sow seeds of species that are adapted to the local soils and climate and reflect the semi-natural vegetation of the area in which it will be sown. The ideal way to achieve this is by sowing a seed mixture which has been harvested from a local semi-natural grassland. However, this option is not always feasible and until such mixtures are widely available, the next best option is to use an appropriate wildflower seed mixture based on an appropriate community from the National Vegetation Classification (NVC).

General Principles

- Always choose species that are native to the UK (see section on seed origin), establish well and appropriate to the location and habitat objective.
- Seed mixtures usually consist of 80% grass seed to 20% herbs.
- Some species will inevitably do poorly or disappear, so its important to start with a greater number of species than is expected to survive.
- To establish cover, choose some species which germinate easily over a wide range of conditions such as Oxeye Daisy *Leucanthemum vulgare*, Buttercup *Ranunculus acris*, Yarrow *Achillea millefolium* and Self-heal *Prunella vulgaris*.
- Avoid seed mixes containing coarse grasses e.g. Perennial Rye-grass *Lolium perenne* and Cocksfoot *Dactylis glomerata.* Grasses should be principally fine-leaved species e.g. Crested Dog's-tail *Cynosurus cristatus* and Common Bent *Agrostis capillaris.*
- Avoid rare species which may have special habitat and management requirements or species which may have special germination requirements.
- If wanting to introduce locally rare or uncommon species use only material collected from nearby wild populations.
- If commercial seed is being used, order from recognised suppliers who should be asked to supply a list of the proportions and sources of species included in the mixtures. Do not accept substitute species unless these are clearly suitable for the purpose required.
- Rather than buying off-the-shelf mixes, it can often be better to list the species you want (refer to the tables below to find suitable species) and ask the seed supplier to make up a mix to suit your requirements.
- Consider contract seed collection. Many specialist growers and nurseries are able to collect seed and, if needed, grow this on according to your requirements. Ordering material in this way is an excellent way to ensure that correctly sourced material is supplied.

The following tables suggest plant species suitable for the different grassland types. This is a general guidance and in many cases it is best to select seed mixes to suit the project objectives and individual site characteristics. The suggested species contain the most frequent species of the community on which they are based and do not contain species not found in County Durham. They also exclude species

which are too competitive and likely to dominate at the expense of greater diversity (such as Yorkshire-fog *Holcus lanatus*) or those which are unlikely to be commercially available such as Woodrushes *Luzula spp*. And Sedges *Carex spp*..

If the aim is to re-create a target semi-natural grassland type then the species mix should be drawn up with reference to the species composition of the NVC grassland table in Rodwell (1992). Always seek professional help.

Neutral Grasslands

MG5 (*Centaurea nigra-Cynosurus cristatus* grassland) is found on neutral soils where there has been a long history of low intensity management of the grassland as meadow or pasture. It is the most appropriate community to mimic on moderately- or well-drained neutral soils in the lowlands where the vegetation can be grazed or cut regularly. This will be the best mixture for use on most ex-agricultural soils.

Wildflowers suitable for sowing on neutral soils (neutral = ph 6-7)	
Grasses Common Bent *Agrostis capillaris* Meadow Foxtail *Alopecurus pratensis* Sweet Vernal Grass *Anthoxanthum odoratum* Quaking Grass *Briza media* Crested Dog's-tail *Cynosurus cristatus* Meadow Fescue *Festuca pratensis* Red Fescue *Festuca rubra* Rough Meadow Grass *Poa trivialis* Yellow Oat-Grass *Trisetum flavescens*	**Herbs** Autumn Hawkbit *Leontodon autumnalis* Bulbous Buttercup *R. bulbosus* Burnet Saxifrage *Pimpinella saxifraga* Bush Vetch *Vicia sepium* Cat's-ear *Hypochaeris radicata* Common Birds Trefoil *Lotus corniculatus* Common Knapweed *Centaurea nigra* Common Sorrel *Rumex acetosa* Cowslip *Primula veris* Great Burnet *Sanquisorba officinalis* Meadow Buttercup *Ranunculus acris* Meadow Crains-bill *Geranium pratense* Meadow Vetchling *Lathyrus pratensis* *Ox-eye Daisy Leucanthemum vulgare* Pignut *Conopodium majus* Ribwort Plantain *Plantago lanceolata* Self Heal *Prunella vulgaris* Yarrow *Achillea millefolium* Yellow Rattle *Rhinanthus minor*

Calcareous Grassland: Carboniferous Limestone

Wildflowers suitable for sowing on calcareous soils over Carboniferous Limestone (calcareous = pH >7.5)	
Grasses Common Bent *Agrostis capillaris* Quaking Grass *Briza media* Crested Dog's tail *Cynosurus cristatus* Sheep's Fescue *Festuca ovina*	**Herbs** Birds Foot Trefoil *Lotus corniculatus* Common Knapweed *Centaurea nigra* Common Rock Rose *Helianthemum nummularium* Devil's-bit Scabious Succisa pratensis

Red Fescue *Festuca rubra* Crested Hair Grass *Koeleria macrantha* Meadow Oat Grass *Avenula pratensis* Sweet Vernal Grass *Anthoxanthum odoratum*	Fairy Flax *Linum catharticum* Harebell *Campanula rotundifolia* Limestone Bedstraw *Galium sterneri* Meadow Buttercup *Ranunculus acris* Ribwort Plantain *Plantago lanceolata* Rough Hawkbit *Leontodon hispidus* Self Heal *Prunella vulgaris* Smooth Lady's Mantle *Alchemilla glabra* Thyme *Thymus polytrichus* Dog Violet *Viola riviniana* Yellow Rattle *Rhinanthus minor*

Calcareous Grassland: Magnesian limestone

For species lists that are specific to each of the four magnesian limestone grassland communities found in Durham please refer to the leaflet 'Seed for Magnesian Limestone Grasslands' by the Durham Wildlife Trust's Magical Meadows Project. Due to the ecological sensitivity of the magnesian grasslands communities within Durham, seeds used for creation or enhancement of magnesian limestone grasslands should be of native origin and from a local source only.

Below is a more general species list for sites that have a combination of thin magnesian limestone soils and deeper mesotrophic brown earths and gley soils, which has a combination of species from CG2 & MG5 grasslands (*Festuca ovina – Avenula pratensis & Cynosurus cristatus - Centaurea nigra grasslands)*.

Wildflowers suitable for sowing on calcareous / neutral soils over Magnesian Limestone (calcareous = ph 6-8)	
Grasses Common Bent *Agrostis capillaris* Creeping Bent *Agrostis stolonifera* Sweet Vernal-grass *Anthoxanthum odoratum* Quaking-grass *Briza media* Crested Dog's-tail *Cynosurus cristatus* Red Fescue *Festuca rubra* Meadow Oat-grass *Avenula pratensis* Crested Hair-grass *Koeleria macrantha* Yellow Oat-grass *Trisetum flavescens*	**Herbs** Agrimony *Agrimonia eupatoria* Betony *Stachys officinalis* Burnet Saxifrage *Pimpinella saxifrage* Common Bird's-foot-trefoil *Lotus corniculatus* Common Knapweed *Centaurea nigra* Common Rock-rose *Helianthemum nummularium* Cowslip *Primula veris* Devil's-bit Scabious *Succisa pratensis* Fairy Flax *Linum catharticum* Hoary Plantain *Plantago media* Kidney Vetch *Anthyllis vulneraria* Lady's Bedstraw *Galium verum* Meadow Buttercup *Ranunculus acris* Meadow Vetchling *Lathyrus pratensis* Mouse-ear Hawkweed *Pilosella officinarum* Rough Hawkbit *Leontodon hispidus* Salad Burnet *Sanguisorba minor*

	Small Scabious *Scabiosa columbaria* Wild Thyme *Thymus polytrichus* Yellow-rattle *Rhinanthus minor*

Acid Grasslands

The species list below is based on U4 (*Festuca ovina-Agrostis capillaris-Galium saxatile* grassland) which is the typical grazed vegetation of moderately- or well-drained base-poor mineral soils. It is often heathy and in fact heathland creation should always be considered as an alternative to grassland creation on acid soils. Many of the more typical species of this community (such as mosses and sedges) and the more attractive species (such as Common Dog-violet *Viola riviniana*, and Bitter-vetch *Lathyrus montanus*) are unavailable commercially so this is inevitably a short species list. However, this reflects the nature of the community, which is not normally species-rich.

Grasses and wild flowers suitable for sowing on acid soils (acid = pH 4.5-5.5)	
Grasses Common Bent *Agrostis apillaries* Sweet Vernal Grass *Anthoxanthum odoratum* Wavy Hair Grass *Deschampsia flexuosa* Sheep's Fescue *Festuca ovina* Red Fescue *Festuca Rubra*	**Herbs** Autumn Hawkbit *Leontodon autumnalis* Cat's-ear Hawkbit *Hypochaeris radicata* Common Birds Foot Trefoil *Lotus corniculatus* Common Knapweed *Centaurea nigra* Common Sorrel *Rumex acetosella* Devil's-bit Scabious *Succisa pratensis* Germander Speedwell *Veronica chamaedrys* Harebell *Campanula rotundifolia* Heather *Calluna Vulgaris* Heath Bedstraw Galium Saxatile Heath Speedwell *Veronica officinalis* Meadow Buttercup *Ranunculus acris* Ribwort Plantain *Plantago lanceolata* Self heal Prunella vulgaris Sheep's Sorrel *R. acetosella* Tormentil *Potentilla erecta* Yarrow *Achillea millefolium*

Grasses and wildflowers suitable for sowing on damp acid/neutral soils

Some wetland species can be expected to colonise naturally where natural drainage regimes are restored or artificial drainage is impeded, though on improved grasslands this may result in relatively species poor grasslands such as MG9 *Holcus lanatus – Deschampsia cespitosa* and MG10 *Holcus lanatus - Juncus effusus* developing. Creating species rich marshy grasslands is likely to be a specialist exercise and in some the composition of the sward will be heavily influenced by management. The common herbaceous species characteristic of the different plant communities could be introduced if seed of regional origins can be found, preferably through the use of locally collected seed though hay crops from marshy grassland are not generally easy to come by.

Grasses and wildflowers suitable for sowing on damp acid/neutral soils

Grasses Marsh Foxtail *Alopecurus geniculatus* Sweet Vernal Grass *Anthoxanthum odoratum* Tufted Hair Grass *Deschampsia cespitosa* Meadow Fescue *Festuca pratensis* Red Fescue *F.rubra* Rough Meadow Grass *Poa trivialis* **Sedges** Glaucous Sedge *Carex flacca* **Rushes** *Juncus* spp	**Herbs** Bugle *Ajuga reptans* † Common Fleabane *Pulicaria dysenterica* Creeping Buttercup *R. repens* Cuckoo Flower *Cardamine pratensis* † Devil's-bit Scabious *Succisa pratensis* Great Burnet *Sanguisorba officinalis* Greater Birds Foot Trefoil L*otus uliginosus* Gypsywort *Lycopus europaeus* Lesser Spearwort *Ranunculus flammula* Marsh Marigold *Caltha palustris* † Meadowsweet *Filipendula ulmaria* Ragged-Robin *Lychnis flos-cuculi* Sneezewort *Achillea ptarmica* Water Avens Wild Angelica *Angelica sylvestris* † = plant as transplant

Further Information

Publications

Rodwell, J. S. (ed.) 1992. *British Plant Communities. Volume 2. Mires and Heaths*. Cambridge University Press.

Crofts A. and Jefferson R.G. (eds.) *The Lowland Grassland Management Handbook* (2nd Edition). English Nature.*

As part of the MAGical Meadows project a number of advice notes and publications were produced including advice on appropriate seed mixture. These can be downloaded the Durham Biodiversity Partnership website www.durhambiodiversitypartnership.org.uk.

Magical Meadows (2005). *Seeds for Magnesian Limestone Grasslands.* Durham Wildlife Trust.

Identifying the most appropriate seed/plant source

The most appropriate seed source will be determined by the objectives, seed availability, target NVC community, ecology and ecological sensitivity of the site. It is important to plant species that are characteristic of the community to be restored/created and appropriate to the locality.

Native seed better represents the genetic diversity of British wild plants compared with imported stock or commercially bred agricultural and amenity varieties. In addition, certain cultivated varieties can grow very vigorously and out-compete native plants. There is also evidence that in some cases, certain varieties or 'ecotypes' of the same species can be better adapted to local conditions (particularly climate), or have characteristics (flowering time or growth form) to which others species like birds and invertebrates are also locally adapted. Therefore, when enhancing or re-creating grassland habitats, the planting stock should be of British native origin and if available, seeds should be sourced from within the same region (e.g. natural areas) or locality as the planting site. When planting adjacent to habitats of high conservation value only seed or plants of local origin should be used.

British native-origin grass seed is not always available and therefore it might be acceptable in limited situations to use non native species and/or cultivars, however the use of such species should be confined to sites away from areas of high conservation value. Certain agricultural varieties of grass are widely sown in the countryside and their continued use should not present an additional risk to populations of wild grasses. In these cases choose non-aggressive agricultural cultivars and those that have already been widely introduced into the farmed landscape

Key Points

- Generally, where the site is adjacent to a SSSI, or any known semi-natural grassland, habitat or within an ecologically sensitive area (e.g. North Pennines), use either natural regeneration and colonisation or seeds/plants of local origin only.
- On less sensitive sites in the wider countryside, natural regeneration or local origin is recommended but regional stock is acceptable.
- For other projects where the objective is to create attractive "amenity" wildflower grassland in urban areas or gardens (rather than restore native plant communities); less stringent guidelines over seed origin can be applied. Nevertheless, the seed origin of wild flowers should be from British origin.

Published guidance

The Forestry Commission defines four broad regions of origin in the UK which are subdivided further into local seed zones. You can view an interactive map at
http://www.durhamlandscape.info/landscape/usp.nsf/pws/Landscape+Guidelines+-+Woodlands+and+Forestry+-+Woodland+Planting+-+Origins+of+seed+and+planting+stock
showing the recommended local seed zones for planting in County Durham.

Natural England have produced a technical information note, *'Seed sources for grassland restoration and re-creation in Environmental Stewardship'*, which can be downloaded from their website www.naturalengland.org.uk. Where appropriate a capital grant is also available for purchasing British native origin seed under the Environmental Stewardship Higher Level Scheme.

Flora Locale have also produced a Guidance Note, '*Sourcing Native Flora'*, which can be downloaded from their website www.floralocale.org.uk.

Seed Sources

New grasslands are most easily established from seed. For wildlife conservation purposes, only seeds of British origin should be used - this is particularly important where establishing grassland adjacent existing semi-natural habitats. There are two main sources of seed for grassland creation schemes, seed harvested from semi-natural grassland or commercially supplied seed.

Seed harvested from semi-natural grasslands

This method is generally preferable, especially if a donor site can be identified close to the creation scheme. This will ensure that the seed is of local provenance and is likely to have a species composition suited to the local climate and soils. It will also contain many species which are not obtainable from commercial sources; however the composition will largely depend on which species are setting seed at the time of collection.

Seed can be harvested by hay cutting, tractor mounted vacuum harvester, or by hand collection. Mechanical methods will generally be required to obtain enough seed to establish all but the smallest areas of new grassland.

Key Points

- Donor sites must be carefully selected. It should be in the same location as the receptor site and support the target vegetation community that is to be created. Site characteristic e.g. soil type, soil pH, hydrology and management should also be similar.
- Plan ahead. This approach requires sufficient time to locate donor sites.
- Each donor site will need to be assessed on an individual basis as to the appropriate time and method for seed collection. Hand collection may be required to target specific desired species.
- Consider taking collections more than once during the season and/or over a few years to maximise collection of seed of the full suite of species to establish stock in cultivation or established directly on site. Harvest only a proportion of the site in any one year.
- In some circumstances, it may be appropriate to sow a nurse crop of native grasses to suppress populations of unsown weed species, but could also be useful where there is a need to protect seedlings from, extremes of winter weather on exposed sites, intensive grazing by rabbits or wildfowl, or where there is a risk of soil erosion.
- Always seek professional advice.

Seed from Commercial Suppliers:

An increasing number of seed merchants now supply wild flower and grass seed. Care should be taken to ensure that wherever possible the seed is of British origin. In some cases it may be possible to obtain seed native to particular geographical regions.

General seed mixes for particular soil types are available, though it is preferable where possible to obtain a mix which is matched specifically to both the soil type and geographical location of the site. The grass species selected should be non-vigorous and capable of thriving in nutrient-poor soils.

The main advantages of using a commercial mix is that the precise composition of the mixture is known and a mixture tailored for particular conditions can be obtained. However there are generally only a restricted range of species that can be bought commercially and some species (especially native grasses) are currently expensive as they are difficult to grow and harvest.

Seed should be ordered from recognised suppliers who should be asked to supply a list of the proportions and sources of species included in the mixtures.

Establishment of vegetation

Given that a suitable seed mixture has been selected for the particular ecological conditions of a site (please refer to the sections on seed origin and selecting the most appropriate seed source), successful establishment depends upon the ability of the desired plant species to germinate, establish and persist.

Weed burden must be reduced to a manageable level prior to sowing as they will out compete wildflower species (problem species include Common Couch *Elytrigia repens*, Broadleaved Dock *Rumex obtusifolius*, Stinging Nettle *Urtica dioica* and Creeping Thistle *Cirsium arvense)*. This may mean delaying sowing for a year. The use of non-chemical methods of weed control should always be considered before embarking on the use of chemical control options, however it maybe that the most appropriate method of controlling weeds initially, is blanket herbicide. Once the wildflower seeds have been sown, topping, spot treatments, weed wipping or an 'eco-puller' will be more appropriate to control weeds. Note some weed seeds can remain viable in the soil for many years.

Natural regeneration:

Allowing the sward to regenerate naturally is a low cost method and particularly appropriate where the import of seed is to be minimised (for example on sites close to an SSSI) and/or there is no appropriately sourced seed available for sowing. The establishment of desired species will be best if the methods of ground preparation and management are carefully chosen in to favour the required species and to suppress weed. However, natural regeneration has drawbacks; it is usually a slow process with unpredictable results and the degree of success is variable due to a greater risk of soil erosion, nutrient leaching and possible weed problems.

This said it can be successful and should always be considered. It is often a valid approach for restoring some semi-natural grasslands or quarry workings (especially if the weed-rich topsoil has been removed).

This method can be supplemented by strewing locally collected seeds or introducing a number of species-rich turfs which can act as a source of seed to enrich the rest of the site.

Important considerations include:

- whether the existing seed-bank contains species typical of the target vegetation type
- proximity to a 'source pool' of colonisers; this will determine the speed to which plants colonise
- fertility of the soil; natural regeneration is most effective where the soil is infertile

Where soil erosion may be an issue, a nurse crop or companion species such as annuals or slow growing grasses may need to be sown to provide appropriate conditions for colonising species. 'Westerwolds' ryegrass is usually unsuitable as it can be very difficult to eliminate.

Spreading of hay

Spreading of hay can be an effective method of scattering seeds used to diversify swards and is a good means of introducing a range of local wildflower and grass species, many of which are not obtainable commercially. However its effectiveness, much depends on the thickness of hay spread (too thick a layer of hay can suppress germination); the amount of bare ground and subsequent weather conditions. Seed production of individual species will also be affected by the time of hay cut and the variation in weather conditions from year to year.

This method is also a valid approach for restoring grasslands that still retains some of the botanical interest or where there is archaeological interest and disturbance is to be minimised.

Key Points

- Donor sites must be carefully selected. It should be in a similar location as the receptor site and support the target vegetation community that is to be created. Site characteristic e.g. soil type, soil pH, hydrology and management should also be similar.
- A short sward with large gaps is required prior to hay spreading.
- Hay must be 'bedded' in after spreading (e.g. by trampling of stock or rolling)
- Always seek professional advice.

Direct sowing of seed

This can be the easiest way of establishing vegetation, with seed being broadcast using a spinner or drilled on to the soil surface. The wildflower seed mixture should contain 20% herbs and 80% grasses by weight. On sites with lower nutrients levels it is possible to sow a lower seed quantity with more herbs and less grasses.

As a general rule, a sowing rate of 20 kg/ha will be appropriate in most circumstances, however where establishment conditions are ideal (low fertility and few weeds) 15 kg/ha will be sufficient. In difficult situations it may be necessary to increase this to 30 kg/ha.

Key points

- The weed burden must be reduced to a manageable level prior to sowing. This may mean delaying sowing for a year.
- A firm, fine (weed-free) seed bed is required for the successful germination and establishment of grasses and wildflower seeds and care should be taken to ensure the ground is prepared sufficiently well before seeding.
- The seed must be thoroughly mixed before and during sowing to avoid separation; mixing the seed with an inert substance such as fine sand, barley meal or sawdust helps to ensure even distribution.
- Planting should be carried out at the optimal time for plant establishment and survival, using methods to ensure maximum rates of plant germination, growth and survival. The best time for sowing is usually late summer/early autumn.

- Ensure that an appropriate seed mix is sown, from the right source.
- After sowing of seeds, seeds should be bedded in to ensure germination e.g. trampling by cattle or light rolling.
- Nurse crops sown to aid establishment may need to be considered especially on exposed sites, or where there is a risk of soil erosion.
- Monitor the new grassland for evidence of pest damage, and take early action to deal with any pests.

Pot grown wildflowers or seedling plugs:

If required, establishment of vegetation can further be encouraged by the direct transfer of pot-grown plants into the habitat creation site. However, pot grown transplants or seedling plugs are expensive and it is recommended only as a supplement to the other methods. Mortality can be high as they are susceptible to drought, vulnerable to competition from the existing sward and damage from slugs and rabbits. For best results it is advisable to create bare areas around the spot where the plug is to introduced to reduce competition.

However this method can be used to introduce additional species in the following situations:

- Where species are difficult to germinate from seed;
- Where the species reproduce vegetatively, are scarce or the seeds are expensive;
- where there are small variations in soil type or soil moisture and species can be specifically selected for these areas;
- or to introduce specific food plants for invertebrates.

If large numbers or a particular species is required, it maybe necessary to set up a contract with a nursery to grow plug plants from seeds.

Species better introduced as plugs include: Bugle *Ajuga reptans*, Harebell *Campanula rotundifolia*, Cuckoo Flower *Cardamine pratensis*, Meadows Crane's bill *Geranium pratense*, Field Scabious *Knautia arvensis*, Meadow Saxifrage *Saxifraga granulate*, Common Rock Rose *Helianthemum nummularium.*

Further Information:

The Rural Development Service has produced a number of technical advice notes on methods of sward enhancement, including; diversifying grassland by spreading species rich green hay, oversowing and slot seeding and use of pot grown plugs. These can be downloaded from Natural England's website www.naturalengland.org.uk.

Flora locale has compiled a list of organisations that can help locate grassland seed donor sites suitable for wild-seed harvesting by brush harvester or combine, or using green hay or forage-harvesting techniques. They have also produced a number of technical and advisory notes; Collecting and using brush-harvested seed, Spreading forage-harvested grass from a hay meadow, Spreading green hay,

Obtaining native seed and Methods of collecting seed from native grasslands. These are all available on their website www.floralocale.org.

Initial aftercare

The initial stages of vegetation establishment are critical to the success of grassland creation projects. During the first growing season, regular cutting and/or grazing is usually required to reduce competition from the more vigorous species, including weeds. The commencement of grazing or cutting will depend on the growth rate of the vegetation, and the need to control weeds.

Key Points

- Regular cutting and/or grazing will be required in the first year to promote grass growth and control weeds. Sward height should be used to determine the frequency of cutting, but as a guide, once the sward reaches 10-15cm in height it should be cut to a height of 5-7cm.
- Cuttings should be removed from the site as leaving them will retain nutrients and may smother young plants.
- Any perennial weed problems should be addressed early on.

Long-term management

Appropriate aftercare and long term management is essential. In the absence of management the vegetation will gradually progress to coarse grassland and scrub with a resultant loss of species diversity. The long term conservation objectives for the grassland will dictate the management methods used.

Key Points

- Correct management of the developing grassland is essential in these early years – the site must be regularly checked and action taken to manage any weed problems.
- Cutting and grazing must also be carefully managed to enable the developing sward to become properly established. Any regime should allow the flowers to set seed before it is cut or grazed.
- Be prepared to be flexible and change management regimes in response to the requirements of the individual site.

Contact Name & Addresses

ADAS, Woodthorne, Wergs Road, Wolverhampton , WV6 8TQ. Tel: 01954 268301. **www.adas.co.uk** *Environment Specialist that provides conservation advice to farmer*	**Royal Society for the Protection of Birds**, The Lodge, Sandy, Bedfordshire, SG19 2DL. Tel: 01767 680551. **www.rspb.org.uk** *Charitable body concerned with the conservation of wild birds and their habitats.*
Butterfly Conservation, Manor Yard, East Lulworth, Wareham, Dorset, BH20 5QP. Tel: 01929 400209. **www.butterfly-conservation.org.uk** *Charitable body concerned with the conservation of butterflies, moths and their habitats.*	**Farming and Wildlife Advisory Group**, The Tyne Tees Group, Enterprise House, Hamire Business Park, Barnard Castle, County Durham, DL12 8XT. Tel: 01833 696634. **www.fwag.org.uk** *Charitable organisation providing farm conservation advice throughout the UK.*
Department for Environment, Food and Rural Affairs, Nobel House, 17 Smith Square, London, SW1P 3JR. Tel: 0207 238 6000. **www.defra.gov.uk** *Contact for information on environmental land management schemes and agricultural regulations in England.*	**Flora Locale,** Denford Manor, Hungerford, Berkshire RG17 0UN. Tel: 01488 680 457 **www.floralocale.org** *Charitable body concerned with the conservation of wild plants and their habitats.*
Durham Biodiversity Partnership, Rainton Meadows, Chilton Moor, Houghton-le-Spring, Tyne & Wear, DH4 6PU. Tel: 0191 5843112 **www.durhambiodiversity.org.uk** *The Durham Biodiversity Action Plan – including grassland habitat action plans - can be accessed or downloaded from this site.*	**The Grassland Trust**, Wessex House, Upper Market Street, Eastleigh, SO50 9FD. Tel: 02386 650093 **www.grasslands-trust.org.uk** *Charatiable organisation working specifically to protect wildlife rich grasslands.*
Durham Wildlife Trust, Rainton Meadows, Chilton Moor, Houghton-le-Spring, Tyne & Wear, DH4 6PU, Tel: 0191 584 3112 **www.durhamwt.co.uk** *Voluntary conservation organisation concerned with the conservation of wildlife in the UK. Advice on nature conservation issues. Links to specialist groups giving advice on individual species (Red Squirrel, Otter, Water Vole, Bats, Badger, Butterflies).*	**Grazing Animals Project**, The Kiln, Mather Road, Newark, Nottinghamshire, NG24 1WT. Tel: 01636 670095. **www.grazinganimalsproject.info/** *Contact for advice on grazing networks and grazing management for conservation.*
English Nature Northminster House, Peterborough, PE1 1UA. Tel: 01733 455000 **www.naturalengland.org.uk** *Contact for all matters concerning nature conservation, Sites of Special Scientific Interest and the Wildlife Enhancement Scheme. Lead agency for the conservation of lowland calcareous grassland under the UK Biodiversity Action Plan*.	**North Pennines AONB Partnership,** Weardale Business Centre, The Old Co-op building, 1 Martin Street, Stanhope, Co. Durham, DL13 2UY. Tel: 01388 528801 **www.northpennines.org.uk** *Statutory body set up to conserve the North Pennines Area of Outstanding Natural Beauty*
Environment & Heritage Service, Commonwealth House, 35 Castle Street, Belfast, Northern Ireland, BT1 1GU. Tel: 028 9025 1477. **www.ehsni.gov.uk** *Contact for all matters relating to the conservation of the natural and built heritage in Northern Ireland including responsibility for the Areas of Special Scientific Interest.*	**MAGIC** **www.magic.gov.uk** *Online Geographical Information System showing boundaries of national environmental designations and land management initiatives.*
Emorsgate Wild Seeds, Emorsgate Seeds, Limes Farm, Tilney All Ainys, Kings Lynn, Norfolk, PE34 4RT. Tel: 01553 829028 **www.wildseed.co.uk**	**Plantlife**, 14 Rollestone Street, Salisbury, Wiltshire, SP1 1DX. Tel: 01722 342730. **www.plantlife.org.uk** *Charitable body concerned with the conservation of wild plants and their habitats.*
	Really Wild Flowers, HV. Horticulture Ltd, Spring Mead, Bedchester, Shaftesbury, Dorset, SP7 0JU. Tel: 01747 811778**.** **www.reallywildflowers.co.uk**

Published by DURHAM COUNTY COUNCIL 2009

Landscape Section, Regeneration & Economic Development, County Hall, Durham, DH1 5UQ

Tel: 0191 383 4365

www.durhamlandscape.info