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1. Introduction

Do you own or manage grassland? We would love to hear from you! Species-rich wildflower grassland can provide a wide range of benefits to you, your livestock, wildlife and the wider environment.

We can carry out botanical surveys to assess the condition of existing sites, including priority habitat assessments and baseline surveys to support your application/endorsement for the Sustainable Farming Incentive GRH6 (Management of species-rich grassland). We can advise on management of existing species-rich grassland sites to maximise their botanical and conservation interest. For other sites we can advise on restoration methods. It may even be possible to create new wildflower grassland on sites not currently managed as grassland such as arable farmland. We have a range of specialist machinery to brush-harvest seed from wildflower meadows in the Cotswolds and prepare sites for seeding.

There are currently a variety of funding options available for grassland restoration and we can advise on the most appropriate funding available for your project. Following any

management work we can provide ongoing support through management advice and follow-up botanical surveys.

This pack provides a summary of current best practices but, as every site is different, the most appropriate course of action can often only be determined following a site visit and assessment. **Please contact us to arrange a free site visit to discuss your grassland's future.**

2. Benefits

Species-rich wildflower grassland can provide a wide range of benefits to you, your livestock, wildlife and the wider environment.

- Livestock can benefit from increased mineral intake and lower parasitic burdens and can command a higher price
- No chemical input costs
- Increase in botanical diversity and richness and protection of rare plants
- Increase in biodiversity throughout food chain – plants, invertebrates, mammals, farmland birds and raptors such as barn owls and kestrels
- Provision of nectar sources for pollinators – this can improve nearby arable yields
- Can enlarge or join-up this important habitat in the Cotswolds – a priority of the Cotswold Nature Recovery Plan
- Protection of archaeological sites from cultivation
- Buffering of other areas from fertiliser run-off
- Reduction of soil erosion and flooding
- Carbon will accumulate in undisturbed grassland
- Improves landscape character/view – great from a public relations perspective

It should be noted that species-rich grassland will likely have lower productivity/yield than 'improved' grassland, and so may require changes in livestock practices (e.g. hardier/traditional breeds, lower grazing intensity or timing of lambing) to accommodate this.

3. Assessment of existing grassland sites

We recommend an initial site visit and botanical survey for a variety of reasons:

- to assess the soil type/fertility and suitability of the site for restoration to species-rich grassland
- to survey the existing wildflower species diversity of the site, including the presence of indicator species
- to measure a baseline to enable to success of any management changes or restoration work to be monitored
- botanical surveys are often required by funders or to support an application to GRH6 under the Sustainable Farming Incentive

If a site looks to be particularly fertile and we have concerns about its suitability for restoration, or if required to support an application to GRH6 under the Sustainable Farming Incentive, we can also carry out soil testing on your behalf.

In much of the Cotswolds, the underlying limestone geology results in base-rich soils and calcareous grassland – and we typically see the lowland calcareous grassland indicator species set out in Table 1. Along our river valleys we also see lowland meadows (including floodplain meadows) on the heavier clay soils. These have a different range of indicator species including great burnet, meadowsweet, ragged robin, bugle, greater bird's-foot trefoil, marsh bedstraw, fen bedstraw, meadow vetchling, pepper saxigrage, pignut, sneezewort and cuckoo flower. The British Geology Society website includes an interactive map showing the underlying geology of the UK and can be a useful guide as to the type of grassland you have.

Table 1 Lowland calcareous grassland indicator species

English name	**Latin name**
Agrimony	*Agrimonia eupatoria*
Betony	*Betonica officinalis*
Carline thistle	*Carlina vulgaris*
Clustered bellflower	*Campanula glomerata*
Common bird's-foot trefoil	*Lotus corniculatus*
Common rock-rose	*Helianthemum nummularium*
Common knapweed	*Centaurea nigra*
Cowslip	*Primula veris*
Dropwort	*Filupendula vulgaris*
Devil's-bit scabious	*Succisa pratensis*
Eyebright	*Euphrasia officinalis*
Fairy flax	*Linum catharticum*
Field scabious	*Knautia arvensis*
Greater knapweed	*Centaurea scabiosa*
Hairy violet	*Viola hirta*
Harebell	*Campanula rotundifolia*
Hoary plantain	*Plantago media*
Horseshoe vetch	*Hippocrepis comosa*
Kidney vetch	*Anthyllis vulneraria*
Lady's bedstraw	*Galium verum*
Milkwort species	*Polygala species*
Mouse-ear hawkweed	*Pilosella officinarum*
Wild marjoram	*Origanum vulgare*
Orchids	*Various*
Ox-eye daisy	*Leucanthemum vulgare*
Rough hawkbit	*Leontondon hispidus*
Salad burnet	*Poterium sanguisorba*
Small scabious	*Scabiosa columbaria*
Dwarf thistle	*Cirsium acaule*
Wild basil	*Clinopodium vulgare*
Wild thyme	*Thymus drucei*
Yellow-wort	*Blackstonia perfoliata*

Please contact the team on grasslands@cotswolds-nl.org.uk for advice on any aspects of grassland management

4. Management of existing species-rich grassland sites

Existing species-rich grassland tends to be found on sites with naturally low soil fertility and has generally had little or no historical inputs of fertiliser/herbicide or seed i.e. is unimproved. Low fertility soils support a high diversity of wildflowers because there is less competition from the usually vigorous grasses. True unimproved grassland is rare, and the remnants are often found on steep slopes which have escaped mechanical farming operations. Most unimproved grassland in the Cotswolds is known about and mapped but from time to time we do discover new, unmapped gems! There is, however, a broad continuum from unimproved to improved grassland and many grasslands which have only received low or historical chemical inputs will still have reasonable species diversity and can be revived through improved management as discussed below or restoration work as discussed in Section 5 (Restoration Methods) below.

In summary, ideal management of wildflower grasslands is a late summer hay cut (removing cuttings) followed by autumn/winter aftermath grazing to remove as much material and fertility from the site as possible – however many sites are managed quite successful by hay cuts or grazing alone.

(a) Cutting for hay

Where a hay crop is required, where grass growth is too vigorous to be managed by grazing alone or where grazing is not possible on a site, grasslands should be cut for hay once a year no earlier than July to allow the majority of plants to flower and set seed prior to cutting. Cuttings should be wilted and turned in situ to allow seeds to drop before removal as hay. All cuttings must be removed to reduce soil fertility and to stop new seedlings from being smothered. Although from a biodiversity perspective, leaving grassland to be cut in August/September can be beneficial as it allows late flowering species to flower and set seed, this should be weighed up against the difficulty of finding a contractor prepared to remove cuttings in early autumn as the hay has less nutritional value when cut late. Use of a forage harvester to 'cut to waste' may be an option at this time of year. To minimise the impact on dormant invertebrates it is a good idea to retain part of the field (20-33%) as long grass each winter (rotating the section kept long annually). Strips of rough grassland are also very attractive to hunting kestrel and owls in winter.

Cutting using heavy machinery can be difficult on steeper slopes so an alternative on some smaller areas is to use brushcutters or traditional scythes and manually raking off the arisings.

If livestock are available, autumn/winter aftermath grazing following the hay cut (see further below) will benefit the site.

It should be noted that repeated hay cuts alone can be less successful than grazing – risks include the creation of a homogenous sward, soil compaction and damage to structures such as anthills. Cutting also creates less bare ground for germination of seedlings than grazing.

(b) Grazing

Grazing is usually preferential to hay cutting alone wherever possible for a variety of reasons. An exception would be where a site has been managed as a hay meadow for many years, and then continuity of this traditional management should be a priority.

Cattle-grazing is generally best as cows can graze longer swards than sheep and break up tussocky 'thatched' grassland. The action of the cows' mouths tends to pull vegetation out creating a mosaic of sward height (sheep tend to nibble vegetation evenly to a short sward height). A heterogonous sward height is good for many species of plants and insects because different species have different habitat requirements. Cows also disturb the ground, creating bare patches and bedding in the seeds, which helps many wildflower seeds to germinate. Cow dung areas are used by a range of invertebrates that in turn support many mammals in the food chain.

Where only sheep are available this is still preferential to cutting alone, provided they are not stocked at a very high density. If the sward is particularly long, it may be necessary to reduce its height by cutting for hay (removing cuttings) before introducing sheep to aftermath graze.

Native ponies are also a good option and can be particularly good at breaking up thatch and tor-grass on sites that have been unmanaged for some time. Domestic horses can also be used but can be very selective and so can damage the flora unless they are at low densities. At high densities horses tend to create very short turf around patches of nettles, thistles and ragwort. Their dung can also increase nutrient levels unless removed regularly. We have also seen sites managed successfully with donkeys and goats!

For optimum sward maintenance, rotating grazing animal species can create a mosaic of varied sward heights and plant species composition. Mixed species grazing, once common throughout British grassland, is now an exception to current pasture management found throughout the landscape.

Intensity of grazing is important. Too little and grasses and other competitive species will take over. Too much and poaching can become an issue, with the remaining turf short and homogeneous – which will only suit a limited range of species. Ideal livestock density will depend on species and breed as well as the size and topography of the site, but generally low intensity 'extensive' grazing over a long period is preferred. Intensive 'mob' grazing can be particularly good for many plants, and minimises selective grazing, but is generally not so good for invertebrates.

Timing of grazing is also important. Grazing should be removed from April onwards for several months as livestock (particularly sheep) tend to graze flower heads, weakening those species, removing seeds and encouraging more vigorous 'undesirable' species such as creeping thistle and ragwort. Managed grazing can then increase from late summer after the main flowering period and continue throughout the autumn/winter (until it becomes too damp). This will enable removal of any dead vegetation, weaken any dominant grasses and prevent scrub encroachment. However, to minimise the impact

on dormant invertebrates it is a good idea to retain part of the field (20-33%) as long grass each winter (rotating the section kept long annually), as discussed above.

(c) Scrub management

Some scrub is beneficial as it provides habitat for invertebrates and reptiles, as well as nesting birds. The early spring flowers of shrubs such as hawthorn and blackthorn can be an important early nectar source for insects. Some plants such as primrose and violets also thrive in partly shaded areas. The benefits of creating grassland-scrub mosaics is recognised in the Cotswold Nature Recovery Plan and Countryside Stewardship options.

Rotational management of scrub may be required to prevent it taking over large areas of grassland and the Glorious Cotswold Grasslands team is able to arrange autumn/winter habitat management sessions with our team of volunteers to help with this.

(d) 'Undesirable' species

Undesirable species such as creeping/spear thistle, common ragwort, stinging nettle or broad-leaved/curled dock can be controlled by repeated hand pulling, cutting or herbicidal spot treatment before they set seed. Bracken can be controlled by repeated crushing. Care should always be taken not to damage non-target species.

A site visit will help us advise on any specific issues you have with undesirable species.

5. Restoration methods

For grasslands which for whatever reason have lost some of the botanical diversity…

(a) Natural regeneration from soil seed banks and nearby species-rich grasslands

This should always be considered as it is inexpensive and allows plants that would naturally be there to establish. However, it is unlikely to be suitable in most cases as soil seed banks usually contain far more 'undesirable' species such as creeping thistle and ragwort than specialist grassland species, and the seed from the more specialist species does not disperse far. It can also take a long time. This method is only suitable for land which was previously species-rich and has only been cultivated or encroached by scrub for a short period, or infertile land with few 'undesirable' species present with adjacent species-rich grassland from which seed is likely to spread naturally, for example by livestock movement. Natural regeneration can be speeded up by harvesting seed or green hay from the adjacent areas and distributing on the new recipient areas.

(b) Brush harvested seed

This is, in many cases, the best method. It allows seed to be harvested from a wide variety of plants originating from a local donor site with similar characteristics, species composition and genetics to the recipient site. The composition will depend on which species are setting seed at the time of harvest and so it may be desirable to collect seed more than once to increase the range of species harvested. Brush-harvesting does not remove grasses or plants, and a hay cut can be taken within a few days.

The process requires specialist machinery and operators, and Glorious Cotswold Grasslands has several purpose-built brush seed harvesters, access to dozens of suitable donor sites across the Cotswolds National Landscape and a team of volunteers. This ensures we are able to collect a large amount of seed from a variety of sites each year.

Most of our donor sites contain **yellow rattle** (see photo right). This amazing little plant is known as the meadow maker as it supresses grass growth and promotes wildflower diversity

(c) Green hay

This is a similar method to brush harvested seed. Hay is collected from a donor site directly after cutting without the usual wilting or turning processes; this ensures more flower heads are retained. Conventional dried hay is less successful for meadow restoration as most seeds are lost during the drying process (but can still provide some results). Green hay must be spread on the receptor site within a few hours of being cut otherwise it can heat up reducing the viability of some seeds and so this methodology is logistically difficult on large sites. The green hay can be collected and spread using standard farm machinery rather than specialist equipment, but it can be difficult to handle due to its weight, and the composition is limited to whatever species have set seed by the time of cutting. For this reason, a late cut is generally best. On smaller sites green hay can be collected by strimming or scything and manual gathering and this is something the Glorious Cotswold Grasslands team can do with its volunteers. It is worth noting that the farmer will lose the value of a year's hay crop.

(d) Commercial wildflower seed mix

This is the usually the least favoured option due to the difficulty of sourcing local, native seeds from a similar soil type but can be used where no local donor site is available or if plants which tolerate higher fertility soil are required. Commercially available seed mixes may contain alien or hybrid agricultural species, seeds sourced outside the UK or seed collected from different areas of the UK. Most UK collected seed will have then been multiplied by growing as a field crop. The primary advantage of seed mixes is that the composition is known and can contain a wide range of species for a particular habitat. They will not contain some difficult-to-grow species.

(e) Plug plants

Small plug plants of many native species can be grown from seed or purchased commercially and transplanted into grassland in the spring or autumn. Plug planting over a large area is time consuming and costly therefore it is generally best used in conjunction with one of the above approaches, perhaps to introduce particularly rare species or species which are known to be tricky to grow from seed. If purchasing plug plants, care must be taken to purchase from a reputable supplier to ensure native

provenance. Glorious Cotswold Grasslands can recommend local suppliers and may be able to grow specific species from seed the team has hand-harvested from local sites.

6. Preparation of sites

(a) Donor Sites

Donor sites are selected for their high floristic content, sympathetic management and practical considerations such as topography and access. As different plants set seed at different times, ideally each donor site is seed harvested on two separate dates a few weeks apart to collect early and late flowering species seeds.

Any undesirable weed species can be avoided by careful seed harvester operation and/or harvesting prior to such species setting seed.

(b) Recipient Sites

Semi-improved grassland sites with low fertility and some existing floristic content are usually best-suited as receptor sites and the Glorious Cotswold Grasslands team can help identify suitable sites through site visits, botanical surveys and soil testing. Grassland recipient sites must be prepared to create a short sward (removing any cuttings) and scarified with chain or tine harrows to create around 30% bare soil to encourage seed germination. Alternatively, the desired amount of bare soil can sometimes be achieved through intensive "mob-grazing" by livestock.

Bare soil areas with low fertility are also suitable for restoration. These can be created as a result of activities such as building groundworks, scrub removal, or cultivation of arable land or margins.

Any ground preparation must consider factors such as the presence of archaeological interest, erosion risk and the possibility of disturbance of ground nesting birds.

Undesirable species such as creeping thistle, ragwort, stinging nettle or broad-leaved dock should be controlled by hand pulling/cutting or herbicide spot treatment. Care must always be taken not to damage non-target species.

The above advice is applicable to ground being prepared for harvested seed, green hay or wildflower seed mixes.

7. Seed distribution

Seed can be sown immediately after harvesting onto a pre-prepared site as this removes the need to dry and store the seed. If that is not possible, we can dry and clean seed to be spread in late summer/early autumn. Seed is usually spread by hand with a team of volunteers, particularly if uncleaned. After spreading, seed should be bedded in with a roller or by livestock treading the ground.

8. Ongoing support

Correct management in the first year or two of a newly restored grassland site is critical to its success. The advice below is applicable to sites restored using harvested seed, green hay or wildflower seed mixes. Once a site is established as species-rich grassland, it should be managed as described above for existing species-rich sites.

First autumn/winter

A short sward should be maintained throughout the late summer and autumn/winter period following seed distribution so light can aid germination and to reduce the vigour of competitive grasses and 'undesirable' species. This can be achieved by low intensity 'extensive' grazing over a long period or intensive 'mob' grazing – the latter can be particularly useful in the first year to prevent the seedlings being selectively grazed. If grazing is not available, the sward can be cut in March (removing any cuttings). If green hay is used rather than seed, the site should be grazed two or three weeks after spreading (once the seed has dropped) to stop the hay smothering the site.

Livestock should be removed when the ground gets too wet to prevent poaching.

Undesirable species should be controlled by hand pulling/cutting or herbicide spot treatment.

Slugs should be monitored and treated if necessary as they can decimate wildflower seedlings.

First spring/summer

From April to July, the site should be 'shut up', excluding any livestock to allow the wildflowers to bloom and set seed. Look out for yellow rattle seedlings coming up! Note that yellow rattle is an annual species and so if it is accidentally cut or grazed before it sets seed in its first year it will disappear and the restoration project is unlikely to be successful.

Undesirable species should be controlled by hand pulling/cutting or herbicide spot treatment.

A member of the Glorious Cotswold Grasslands team would be very happy to visit during this period to check that the seed has germinated and provide site-specific advice.

Future years

The site should continue to be managed as set out in section 4 (Management of Existing Species-Rich Grassland Sites) of this advice pack.

The Glorious Cotswold Grasslands team is always available to provide advice on any specific issues that arise, and would plan to return in year 3 and year 8 to carry out repeat botanical surveys to monitor the success of your project.