Forest Research

LOWLAND ACID GRASSLAND Creation and management in land regeneration

Brian Hicks and Kieron J. Doick

BPG

NOTE 16

Best Practice Guidance for Land Regeneration

Introduction

Lowland acid grassland is a priority habitat characterised by vegetation dominated by grasses and herbs on a range of lime-deficient soils. The Joint Nature Conservation Committee define it as both enclosed and unenclosed acid grassland occurring throughout the UK lowlands,[1] including that managed in functional enclosures (JNCC, 2011). The habitat is very variable in terms of floral species richness, which can range from relatively poor (less than 5 species per 4 m²) to species rich (in excess of 25 species per 4 m²) and often occurs as an integral part of lowland heath landscapes, in parklands and locally on coastal cliffs and shingle. Providing an important reservoir of rare species, this grassland habitat is of principal importance in England (Natural England, 2010), Scotland (Anon, 2013), Wales (Wales Biodiversity Partnership, 2008) and Northern Ireland (Department of the Environment Northern Ireland and the Northern Ireland Environment Agency, 2011).

Figure 1 Essex Skippers are a species characteristic of lowland acid grassland *(Photo: © Natural England/Allan Drewitt)*

The JNCC (2011) reports that the area of lowland acid grassland has undergone substantial decline in the UK, mostly due to agricultural intensification. Although there are no figures available on rates of loss, 30 000 ha is estimated to remain in the UK (JNCC, 2011). The Grasslands Trust (2012) estimates that 20 000 ha is in England, interspersed within the 35 000 ha of lowland heath. Important concentrations occur in the Breckland, the New Forest, the Suffolk Sandlings, the Weald, Dungeness, the coasts of south-west England, and the border hills of Powys and Shropshire, as well as within the Borders, Fife and Central Belt regions of Scotland.

Acid grasslands can develop in areas disturbed by human activities, including disused sand and gravel workings, and their establishment on reclaimed land can contribute to national priority habitat targets. This guidance note reviews the essential considerations and practices for establishing acid grasslands on reclaimed land.

Lowland acid grassland is normally managed as pasture; a lack of grazing leads to scrub encroachment. As with other lowland semi-natural grassland types (see BPG Note 17 on neutral grassland and BPG Note 18 on calcareous grassland) creation of this habitat should only be considered where there is a strong commitment to a long-term management regime.

Defining features of acid grassland

Acid grassland favours soil with a pH between 4 and 5.5 (JNCC, 2011; soil pH refers to measurement made in water). These soils develop over acidic rocks (e.g. sandstone and acid igneous rocks) and superficial deposits such as sands and gravels (Grasslands Trust, 2012). Specifically, lowland acid grasslands can be found:

[1] Lowland is defined as land below the level of agricultural enclosure. The altitude at which this occurs varies across the UK, typically becoming higher as one travels south.

- On sandy and gravelly soils in the warm, dry Breckland lowlands. These grasslands are species poor and dominated by Wavy Hair-grass (*Deschampsia flexuosa*)[2] but have a high proportion of ephemerals,[3] and are closely linked with heathland.
- On moister soils in south-central and south-west England (e.g. the New Forest). Here the grasslands are dominated by Bristle Bent (*Agrostis curtisii*) and often associated with wet heath (Ausden and Treweek, 1995).
- On free-draining to moderately moist soils of the Malvern Hills. These grasslands are dominated by Wavy Hair-grass.

Characteristic species of vegetation and invertebrates associated with lowland acid grasslands are presented in Tables 1 and 2, respectively. These habitats are also important for lower plants such as lichens (especially *Cladonia* spp.), bryophytes (mosses and liverworts) and very small flowering plants such as Heath Bedstraw (*Galium saxatile*) and Shepherd's Cress (*Teesdalia nudicaulis*). Animals associated with lowland acid grassland include reptiles, such as Adder (*Vipera berus*, see Figure 2), and birds including Northern Lapwing (*Vanellus vanellus*) and Eurasian Skylark (*Alauda arvensis*). Where violets are present then there may also be butterflies such as the Dark Green Fritillary (*Argynnis aglaja*), Pearl-bordered Fritillary (*Boloria euphrosyne*) and Small Pearl-bordered Fritillary (*Boloria selene*) (Symes and Day, 2003). Many of the invertebrates that occur in acid grassland are specialist species which do not occur in other types of grassland (JNCC, 2011).

Figure 2 Adders are a characteristic species of lowland acid grassland
(Photo: © Natural England/Peter Roworth)

Table 1 Vegetation species characteristic of lowland acid grassland.

Common name	Scientific name
Common Bent	*Agrostis capillaris*
Wavy Hair-grass	*Deschampsia flexuosa*
Sheep's-fescue	*Festuca ovina*
Heath Bedstraw	*Galium saxatile*
Tormentil	*Potentilla erecta*
Sheep's Sorrel	*Rumex acetosella*

Table 2 Invertebrates of lowland acid grassland.

Common name	Scientific name
Oak Mining Bee	*Andrena ferox*
Banded Mining Bee	*Andrena gravida*
4-banded Weevil Wasp	*Cerceris quadricincta*
5-banded Weevil Wasp	*Cerceris quinquefasciata*
Small Heath	*Coenonympha pamphilus*
[a ground beetle][a]	*Harpalus dimidiatus*
Wall Brown	*Lasiommata megera*
Large Skipper	*Ochlodes sylvanus*
Essex Skipper (Figure 1)	*Thymelicus lineola*

[a] Does not have a common name.

[2] Nomenclature follows Stace (2010) throughout.

[3] An ephemeral plant has a short life cycle timed to exploit a brief period when resources are freely available.

The surface soils found within existing unimproved lowland acid grasslands are characterised by shallow topsoil depths, moderate drainage rates, medium organic matter contents and total nitrogen levels, and low levels of available phosphorus. Levels of available potassium and available magnesium are not found to have a strong influence on floral diversity of the sward. Acceptable limits are summarised in Table 3.

Table 3 Characteristics of soil suitable for acid grassland establishment.

Parameter	Level
Topsoil depth	150–250 mm
Drainage	Moderate to Rapid
pH	Strongly acid to acid (pH 4.0–5.5)
Available phosphorus[a]	25 mg l^{-1} (7–14 mg l^{-1})
Organic matter[b]	3% (3–9%)
Total nitrogen[b]	0.15% (0.12–0.4%)

[a] Acceptable upper limit. A level of available phosphorus of less than 10 mg kg^{-1} is ideal to maximise floristic diversity within unimproved, semi-natural grassland communities (Marrs and Gough, 1989). While values of 11 to 25 mg kg^{-1} have potential, expect reduced floral diversity and increased risk of competition from rank and pioneer species.

[b] Acceptable lower limit. While values for upper limits are not available the values in parentheses serve as a useful guide.

Values in parentheses are primary data collected from example sites – Devils Punch Bowl, Surrey (SSSI), and Black Heath, London Borough of Greenwich (Site of Metropolitan Importance). Table 3 and photo kindly provided by Tim O'Hare Associates, Oxfordshire.

Site suitability

Before creating acid grassland it is important to assess site suitability. Thorough site surveys are required to identify potential risks to human health and the environment, and the existing ecological value of the site and the surrounding area. The suitability of the substrate for acid grassland establishment should also be assessed (see below, and BPG Note 1 on soil sampling for supplementary information). Sites should also have a topography that allows for management by grazing or cutting.

Sites suitable for creating acid grassland include landfill and mineral extraction sites where the planting substrate has a pH between 4 and 5.5. Such conditions arise when acidic soil-forming materials such as colliery spoil have been used in the restoration (see Bending *et al.,* 1999). If the substrate is too acidic, it should be increased to a suitable level, for example through the incorporation of alkaline construction wastes. Ensure that the source of such material is known and documented and that it has been tested to avoid the introduction of contamination (see BPG Note 2 on laboratory analysis of soils and spoils). Alternatively, the pH may be raised through the addition of lime (Crofts and Jefferson, 1999).

Raw mineral substrates may require treatment to support vegetation establishment, including cultivation and the addition of organic matter. Substrate compaction will hinder vegetation establishment and cultivation should be conducted to 0.5 m where the site survey identifies compaction; BPG Note 19 gives guidance on the need to cultivate before grassland habitat creation. Both deep and shallow cultivation encourage the residual seed bank to develop and where this includes invasive plant species these will need to be controlled if they become dominant. Organic matter addition is required where the water-holding capacity of the substrate is low. Ensure

that nutrient levels are not raised too high as this will favour nutrient-demanding rank species; for example, use paper-mill sludge or spent-mushroom compost. As a general rule, total nitrogen should be 0.15 to about 0.5% soil dry weight (Table 3), and available phosphorus and potassium less than 15 mg l^{-1} and 120 mg l^{-1}, respectively (Crofts and Jefferson, 1999). If the soil survey has identified high nutrient levels, several methods are available to reduce this, including blending with low fertility substrate (see above) or depletion cropping – nutrient-demanding crops are grown then harvested and removed off site, over a number of years, until the nutrient levels decrease.

While it is possible to adjust soil pH and fertility, you should aim to create a habitat that is most suited to the quality and conditions of the planting medium on your site. Creation of a habitat that is in keeping with the local character and landscape is a more sustainable practice.

Habitat creation and establishment practice

The National Vegetation Classification (NVC) recognises 6 main and 26 sub-communities of acid grassland (Rodwell, 1992). When creating acid grassland as part of a land regeneration scheme, professional judgement should be sought to identify the most appropriate combination of sub-communities (see also Gilbert and Anderson (1998) for further details).

Substrate, desired time frame and site proximity to areas of grassland similar to the target type will dictate which establishment techniques are most appropriate. Four options are considered below.

Natural colonisation is the simplest and often most successful method to introduce acid grassland species to a land regeneration site. It is most likely to produce a habitat appropriate to local conditions and will be more natural than created grassland. Natural colonisation tends to be a very slow process, and success depends on having adjacent areas of acid grassland. Areas of bare ground remain during this process. While these areas can be good invertebrate habitat, they are also prone to colonisation by invasive plant species that will need to be controlled if they become dominant and limit the natural colonisation process.

Turf inoculants are turf fragments or plugs containing desirable species taken from local donor sites. Permission must always be sought from landowners before taking any materials. Where either natural colonisation or turf inoculant methods are being adopted, consider first sowing a thin pioneer or nurse grass mix to help stabilise the substrate and speed the creation of an attractive sward, while leaving sufficient bare soil to allow natural colonisation to occur. Sow at a low rate of 12.5 kg ha^{-1} (1.25 g m^{-2}) to achieve a thin cover. Table 2 of BPG Note 18 (on calcareous grassland) gives the composition of a typical pioneer mix.

Green-hay strewing involves taking freshly cut hay from local lowland acid grassland which will contain seeds, and spreading this over the site to be colonised. Identify suitable local donor sites and ensure the hay is cut after flowering but while the seeds are still attached. At the donor site, keep turning of the hay to a minimum, and collect and spread (strew) at the receptor site as soon as possible after cutting to minimise seed losses. The hay can be removed from the receptor site after a few weeks once the seed has dropped off. Using a local source means that a closer match can be made between the new and existing grasslands and the grasses will be of native genotype; it will also help to keep transport costs to a minimum.

Seeding can be undertaken with seed collected from local acid grassland using a seed collection machine or brush harvester. Care must be taken not to deplete the donor site of seed (by over-harvesting) or of invertebrates (which may get drawn into the collecting machines). Alternatively, seed may be bought. A reputable seed house will supply seed mixtures suited to the climate and principal soil conditions of your site. Seed should be of local provenance, where available. Wildflowers and grasses are normally sown together as grasses help to stabilise the soil and provide important cover in winter. Seed is normally sown in September/October, either by hand or using agricultural machinery such as slot seeders and seed drills, which maximise the area sown for the amount of seed used (Crofts and Jefferson, 1999). If sowing by hand, mix with damp sand to help ensure the seed is evenly distributed and lightly roll or tread the soil surface. Raking should be avoided as it can concentrate seed distribution or bury the seed too deep. If there is a prolonged dry period, the seeded area may be lightly watered. Birds and other seed predators should be kept off the land as much as possible.

Biosecurity (the objective of reducing the transmission of pests and diseases) is important and good working practice should be observed when using the turf inoculant, green-hay strewing or seeding techniques to minimise the risk of transporting harmful organisms between sites. For example, clean and disinfect tools and boots before leaving donor and regeneration sites.

Habitat management and monitoring

One of the main reasons for the failure of new grasslands and the deterioration of existing grasslands is lack of management (Gilbert and Anderson, 1998). In these cases, sites degenerate to become rough grassland: unattractive, species poor and with little conservation interest (Crofts and Jefferson, 1999). Management is essential to maintain these sites in suitable condition. Two options are considered below.

Grazing is a gradual method of vegetation removal that is less damaging to the habitat than cutting or burning. Different types of grazing animals are selective in the plants that they eat and can be used to create a mosaic of grassland types and heights. Sheep, for example, bite vegetation close to the ground and prefer short, fine swards to coarser herbage. Cattle feed by wrapping their tongue around the herbage and cutting it between their lower teeth and dental pad. They are able to consume coarser herbage than sheep. Cattle trample more heavily than sheep, and an advantage of these trampled patches is that they can create gaps for the establishment of wild flowers. During the first 3 years, grazing should be controlled or prevented to allow the grassland to become established and seedlings to develop sufficient root systems to prevent uprooting when grazed. Once the grassland is established, light grazing can begin. Exact requirements will be site specific; a rule of thumb is to use 0.5 cattle or 2.5 sheep ha^{-1} yr^{-1} (Department of Transport, 1993).

Cutting is an unselective form of vegetation removal that can have detrimental effects on invertebrate populations, especially those feeding on the aerial parts of plants. Cutting also produces a sward of uniform height, structure and species composition (Crofts and Jefferson, 1999). However, it can be a useful technique to remove unpalatable species (which may become dominant) and is often used in combination with grazing. Any cutting should be timed to allow for seeds to ripen and fall, usually in mid June to July, depending on the species of vegetation present and with due regard to breeding birds. Care is required to ensure that the cut is not too low and scalps the turf. A recommended height is 100 to 150mm. Cuttings need to be removed as they will smother new growth and release nutrients as they decompose,

encouraging coarse competitive species (Ausden and Treweek, 1995). More detailed information on management can be found in Crofts and Jefferson (1999).

Even where the creation works take place in a very suitable location, evaluation of the management practices is required to get the right mix for establishment and long-term success. A site-specific long-term management plan is required. This should include a monitoring and evaluation programme that will enable the management regime to be adapted as necessary. The JNCC (2004) reports that monitoring of lowland grassland habitats should include:

- Extent of the grassland establishment: % ground cover, bald patches and presence of leaf litter.
- Sward composition: grass to herb ratio, positive indicator species, negative indicator species, species with local distinctiveness.

Further information and useful links

Ecoscope Applied Ecologists (2000). *Wildlife management and habitat creation on landfill sites – a best practice manual.* Ecoscope Applied Ecologists, Cambridge.

More information on biosecurity and plant health can be found at www.forestry.gov.uk/biosecurity.

Additional information may be found from the following organisations:

Bumblebee Conservation Trust
www.bumblebeeconservation.org

Butterfly Conservation
www.butterfly-conservation.org

Flora Locale
www.floralocale.org

Joint Nature Conservation Committee
www.jncc.defra.co.uk

Landlife National Wildflower Centre
www.wildflower.co.uk

Natural England
www.naturalengland.org.uk

Nature after Minerals
www.afterminerals.com

Plantlife
www.plantlife.org.uk

Royal Horticultural Society
www.rhs.org.uk

Royal Society of Wildlife Trusts
www.wildlifetrusts.org

RSPB
www.rspb.org.uk

The Grasslands Trust
www.grasslands-trust.org

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Stace, C. (2010). *New flora of the British Isles,* 3rd edition. Cambridge University Press, Cambridge.

Symes, N.C. and Day, J. (2003). *A practical guide to the restoration and management of lowland heathland.* RSPB Management Guides, RSPB, Sandy, Bedfordshire.

Wales Biodiversity Partnership (2008). *Section 42 Priority Habitats list for Wales.* Available from: www.biodiversitywales.org.uk/en-GB/Section-42-Lists.

The Land Regeneration and Urban Greenspace Research Group
Forest Research, Alice Holt Lodge, Farnham, Surrey GU10 4LH
Phone: +44 (0) 1420 22255 Fax: +44 (0) 1420 520180
www.forestry.gov.uk/forestresearch