

## HAY TIME MEADOW RESTORATION

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The Hay Time project was set up in 2006 by the Yorkshire Dales Millennium Trust (YDMT) and the Yorkshire Dales National Park Authority to make a significant contribution towards the UK Biodiversity Action Plan (BAP) targets for expansion/restoration of upland hay meadows (UHM). Over the last seventy years, there has been a dramatic decline in the extent and quality of UHM. This paper reviews methods for the restoration and management of UHMs.



FIGURE 1. Upland hay meadow, Muker Meadows SSSI. (Photo D. Hill)

### INTRODUCTION

Traditional meadow management consists of an annual late-summer cut, strewing (turning the hay over the course of a few days to dry), spring and autumn grazing, light dressings of well-rotted farmyard manure, occasional additions of lime, and no inorganic inputs. Smith *et al.* (2008) have carried out long-term studies of the effects of management (cutting dates, fertiliser additions, grazing regimes), seed introduction and yellow rattle. The research showed that:

- all deviations from traditional management result in loss of conservation value of meadows;
- adding seed to existing swards increases species number;
- species-rich grasslands are associated with high fungal: bacteria ratios;
- adding functional species increases soil fungi;
- phased seed introduction is likely to be most successful;
- yellow rattle debilitates competitive grasses.

### RESTORATION RESEARCH

Other workers have investigated the various methods of seed introduction:

- Edwards *et al.* (2007) compared green hay and brush harvesting. It was found that green hay re-introduced more species than brush harvesting, and that these species persisted and expanded their populations;
- Trueman *et al.* (2003) used green hay from SSSI meadows to create species-rich meadows. Monitoring indicated that green hay was more effective than seed mixtures and dry hay, and that after three years the mean species richness was >20 per m<sup>2</sup>;
- *Aspects of Applied Biology* 115 contains a number of useful papers (e.g. Pywell *et al.*, 2012). The key abiotic constraint is residual soil fertility (phosphorus), so restoration sites need low-nutrient status; while the key biotic constraints are lack of propagules and establishment niches, so seed addition and sward disturbance are needed.

## WHY DOES SEED NEED TO BE ADDED?

Reinstating traditional management to a species-poor meadow is usually not enough in itself to begin the process of restoration. Seed of most of the desirable species is short-lived and the soil seed bank often only contains seed of 'weeds' and species already present in the sward. In addition, desirable seed is unable to naturally move as 'seed rain' from species-rich meadows to species-poor meadows due to the severe fragmentation of the meadow resource, the very short dispersal distances of most meadow species and changes in livestock movements and management.

## THE HAY TIME PROJECT

The Hay Time project is a partnership project to conserve and restore hay meadows. It uses seed sustainably harvested from species-rich donor meadows to increase the species diversity of suitable receptor meadows. It also runs events and activities to increase public awareness, enjoyment and understanding of hay meadows. It has operated in the Yorkshire Dales National Park since 2006, and YDMT has helped set up similar projects in the Nidderdale and Forest of Bowland AONBs.

## WHAT DOES THE PROJECT PROVIDE?

Coordination of restoration schemes, including:

- identifying, surveying and matching seed donor and receptor meadows;
- liaising with farmers, contractors and Natural England;
- preparing an implementation plan;
- coordinating seed harvesting and spreading operations;
- botanical monitoring.

Provision of:

- specialist seed harvesting and spreading machinery;
- trained contractors to operate the machinery;
- meadow management advice;
- training events and promoting understanding of hay meadows.

## THE BENEFITS OF USING LOCALLY-HARVESTED SEED

Locally-harvested seed provides a range of benefits: it is of known local provenance; it provides a 'natural' seed mix of what is available in the donor meadow; it maintains variety within and between regions; and, seed can be harvested at the optimal time to get ripe seed. It can also work out cheaper than buying in processed seed and it generates additional income for the donor farmer. Finally, it links donor and receptor farmers together.

## WHICH MEADOWS CAN BE RESTORED?

There are a number of factors to be taken into consideration. Firstly, the receptor meadow needs to be managed by a supportive farmer / landowner, so as to ensure long-term favourable management. Then the soil needs to be neutral pH and low in nutrients (especially phosphorus); the meadow should be mainly clear of pernicious weeds and competitive grasses; it should be (or about to be) traditionally managed; there should be a suitable nearby source to harvest seed from; and, stock (preferably cattle) should be available to open up the sward and trample the seed in.

## AVOIDING IMPACT ON THE DONOR MEADOW

Obviously, the last thing we want is for seed harvesting to have a negative impact on the remaining species-rich meadows. We therefore follow Natural England and *Flora locale* recommendations:

- to harvest no more than a third of the meadow;
- to leave harvested areas for at least three years before harvesting seed again;



- to only harvest when conditions are suitable (i.e. when the ground is dry).
- Monitoring of donor meadows before and after seed harvesting indicates no impact.

#### RECEPTOR PREPARATION

The receptor farmer needs to cut, field-dry, bale and remove the hay from the site. The site then needs to be prepared by creating ~50% bare ground to aid seed germination and establishment. This can be done by intensive grazing or mechanical disturbance, such as chain harrowing.

#### SEED HARVESTING METHODS

We have used four methods:

- green hay, where the standing crop from an area of the meadow is harvested, collected (but not baled) and spread on the same day;
- hay concentrate, which cuts and collects about the top third of the standing crop, which is then spread on the same day;
- brush harvesting, which collects seed mainly from only the higher-growing plants;
- vacuum- and hand-harvesting, for schemes that just need seed of targeted species.



FIGURE 2. A - Harvesting green hay. B - Harvesting seed using the hay concentrate machinery. (Photos D. Gamble, YDMT)



FIGURE 3. A - Brush harvesting seed. B - Harvesting seed using a leaf vacuum. (Photos D. Gamble, YDMT)



FIGURE 4. Volunteers hand-collecting meadow seed. (Photo YDMT)

### CHOOSING THE BEST METHOD

Again, there are a number of factors to be taken into consideration:

Receptor meadow:

- what species is it missing?
- receptor farmer's requirements.

Donor meadow:

- quality, area, access, terrain;
- donor farmer's requirements.

Other considerations:

- weather;
- how it fits with the rest of the programme;
- funding.

### COMPARISON OF METHODS

Over the course of the project, we have been able to compare the various methods. What is clear is that all methods have their pros and cons and no single method is suitable for all schemes. Also, doing a single scheme can be straightforward, but doing an annual programme of schemes is challenging! Our ideal scheme involves field-scale seed addition using green hay. This is because you collect seed from the widest range of plants that are in the donor meadow, and because all other methods rely on dry weather and being able to harvest seed before the donor meadow is cut (whereas the donor farmer can cut around the previously-agreed area providing the green hay).

### MANAGING EXPECTATIONS

Seed addition is only the start of a long-term restoration process. It is misleading to say a meadow has been restored just by adding seed and managing it traditionally. However, depending on the starting point of the receptor meadow, results can certainly be seen within a year or two.

So, if...

- the receptor meadow is traditionally managed;
- the soil is neutral pH and low fertility;
- the right seeds are added in the right way;

- the existing vegetation is not too competitive;
- the sward is open enough for seeds to establish;

then...

- some new species will be visible in the autumn;
- some need to over-winter before germinating;
- some can take several years before germinating;
- but some will fail to germinate.

#### WHAT HAS BEEN DONE SO FAR?

To date, we have implemented 95 schemes involving seed addition (and/or better management) to 217 meadows at 74 farms across the Yorkshire Dales National Park. The total area of 393 ha comprises of 266 ha restoration plus 127 ha enhancement.

Over 550 meadows have been surveyed, and management advice has been provided to over 150 farmers. [Note: since the seminar we have worked on a further 67 ha during the summer of 2014 and we have a busy programme lined up for 2015.]

#### WHAT EFFECT IS SEED ADDITION HAVING?

In 2011, all of the receptor meadows that we worked on in the previous four years were resurveyed and the results were statistically analysed. The key findings were that:

- all seed addition methods have led to statistically significant increases in species richness, diversity and composition;
- green hay addition is associated with increased abundance or the introduction of a large number of species;
- the vegetation at a majority of sites is, with time, moving towards the target NVC (in our case, MG3) and away from that associated with semi-improved grassland (MG6).

#### REFERENCES

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- Pywell, P.F., Woodcock, B., Tallowin, J.B., Mortimer, S.R. & Bullock, J.M. (2012). Restoring species-rich grassland: principles and techniques. *Aspects of Applied Biology*, **115**, 11-21.
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- Trueman, I. and Millett, P. (2003). Creating wild-flower meadows by strewing green hay. *British Wildlife*, **15**:37-44.

#### FURTHER INFORMATION

Hay Time Final Report 2012 is downloadable from the Resources section of [www.ydmt.org](http://www.ydmt.org) (despite its title, the project is still running).

*Hay Time in the Yorkshire Dales*. 270 pp., full colour book. Available from [www.ydmt.org/shop](http://www.ydmt.org/shop)

"A full record of the meadows that will have enduring value." George Peterken, *British Wildlife*, October 2010

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