Hay Time

Final Report

2012

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Christa Perry, Hay Time Project Officer
Tanya St Pierre, Flowers of the Dales Project Officer

- May 2012 -

Hay Time

Working with farmers to restore meadows across the Dales

YORKSHIRE DALES MILLENNIUM TRUST

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Contents

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Hay Time in the Yorkshire Dales (2010), edited by Don Gamble and Tanya St Pierre, Yorkshire Dales Millennium Trust / Scotforth Books, Lancaster, ISBN 978-1-90424459-2.

Hay Time: Analysis of survey data 2006 – 2011 by Christa Perry and Don Gamble.

Flowers of the Dales Festival Report 2011 by Tanya St Pierre.

Details on how to obtain these and other publications and resources mentioned in the text, as well as further copies of this Final Report, are in Appendix 2.

Front cover photo credits (clockwise from top):
T St Pierre, T St Pierre, P Rayner, D Gamble, P Rayner (all YDMT).

Back cover photo credit: D Gamble (YDMT).

Foreword

This report gives an overview of the Hay Time project from its launch in May 2006 to the end of the project in December 2011. It explains why the project was set up, what it aimed to do, how it did it, what still needs to be done, and celebrates its many achievements.

Although very much focussed on the physical restoration of meadows that had lost some of their botanical diversity and wildlife value, we also wanted to involve people – young and old, residents and visitors – in celebrating and protecting the remaining species-rich meadows.

The project has benefited greatly from having exceptional people to deliver the conservation and education work: Pippa Rayner, Christa Perry (Hay Time Project Officers from 2006-09 and 2009-11 respectively), and Tanya St Pierre (Flowers of the Dales Project Officer from 2009-2012). Their enthusiasm and drive enabled the project to exceed the ambitious outputs and outcomes we set ourselves. Their work has helped to secure the future of the remaining species-rich meadows, set scores of hectares of 'degraded' meadow on the road to recovery, and helped people to appreciate, understand and value the specialness of the Yorkshire Dales meadows.

The project also wouldn't have been possible without the support of numerous organisations and individuals, and especially the Dales farmers, and we are very grateful to them all.

Don Gamble
Hay Time Project Manager

Muker Meadows (D Gamble, YDMT)

Summary

Traditional, low-input management maintains the botanical diversity of species-rich hay meadows but simply re-instating traditional management to a meadow that has declined in quality due to more intensive management is usually not enough to restore it to its former species-rich condition. In most cases it is necessary to introduce seed of desirable species to a meadow lacking these species.

The Hay Time project was set up to co-ordinate restoration schemes using locally-harvested meadow seed. Although managed by the Yorkshire Dales Millennium Trust (YDMT), the project was a partnership with the Yorkshire Dales National Park Authority (YDNPA) and was supported by Natural England, Yorkshire Wildlife Trust, Flora locale, the National Trust and others. Hay Time aimed to restore at least 200 ha of upland and lowland meadows within and close to the Yorkshire Dales National Park. Project staff provided specialist advice to land managers, identified donor and receptor meadows, liaised with partner organisations, land managers, agricultural advisors and contractors, co-ordinated receptor meadow preparation and seed harvesting and spreading, monitored donor and receptor meadows, encouraged land managers to upgrade or enter into agri-environment schemes, and implemented or supported community and education initiatives. Hay Time had its own specialist seed harvesting and spreading machinery which was operated by Marsden Agricultural and Environmental Services Ltd.

The project ran from May 2006 to December 2011 and during that time it helped to implement 69 meadow restoration schemes, resulting in locally-harvested seed being added to 141 fields (279 ha). Seed was collected using several methods which ranged from field-scale seed addition to inoculation of plots within a field. Field-scale seed addition was the preferred method and this was achieved on almost 60% of the fields (170 ha).

All of the restoration meadows were surveyed before seed addition and were then re-surveyed in subsequent years. In 2011 surveys were analysed to determine the effect of seed addition on species richness, species diversity and meadow composition. The results confirm early observations that the work is having a positive effect on treated meadows, with highly significant increases seen in species richness, species diversity and meadow composition. Annual species such as eyebright and yellow rattle seem to establish very easily in receptor fields in the first summer after the seed spreading, sometimes in very large numbers. Seed addition has been less successful with mid- to late-successional species.

The relative success of meadow restoration (adding seed to introduce or greatly increase populations of key functional species such as yellow rattle) compared to meadow enhancement (adding seed of characteristic species 'missing' from an already fairly species-rich traditionally managed meadow) suggests that future work should be prioritised on restoration schemes. Re-introduction of key species such as yellow rattle appears to be much more successful and hence more cost-effective than enhancement attempts to add mid- to late-successional species to meadows that already have a fairly wide suite of species. These species could be introduced as plug plants grown on from hand-collected seed.

A complementary aim of the project was to increase public awareness, enjoyment and understanding of meadows, and to do this several community and education 'spin-off' projects were run, including the highly successful Flowers of the Dales Festival, publishing an acclaimed book, working with schools, and involvement with a theatre production. Literally hundreds of people have taken part in meadow-themed events and activities.

YDMT, together with our partners, has built up considerable experience and expertise in meadow restoration and education. Although Hay Time has now ended, there is a clear demand for the work to develop and expand.

The history of meadows: from woodland clearances in the prehistoric 'Wildwood', as part of early settlements and farms,

Introduction

Visually stunning and teeming with wildlife, species-rich hay meadows are an important part of our rural and cultural heritage, and of high nature conservation and landscape value. The Yorkshire Dales are one of the few strongholds in Britain for such meadows, and these grasslands and the striking landscape in which they occur and the few farms where traditional agriculture continues are of European significance for their wildlife and cultural value. A hay meadow may be the oldest link with the past that a settlement has, perhaps even older than the church or other historic building, so the loss of a hay meadow constitutes the loss of an historical place as much as a wildlife habitat and landscape feature.

While traditionally managed hay meadows support some rare plants, their real importance lies in their species composition. Their low fertility soils coupled with the impact of grazing and cutting means that individual species are unable to dominate, resulting in the very richest hay meadows containing over 30 species per square metre and up to 120 species per field. They are of high habitat value for a range of fauna, many of which are also UK Biodiversity Action Plan species: they provide feeding areas for invertebrates, bats and other mammals, and feeding and nesting sites for birds.

It is also becoming clear that species-rich meadows may play a part in tackling climate change as they store more carbon than species-poor meadows. Their importance for wildlife will increase as climate change impacts on other habitats. They also retain rainwater and nitrates better, so helping to reduce flood risk and water pollution.

Depending on their botanical composition, these species-rich meadows are classed as either upland or lowland meadows.[1] They are of national and international importance: both are UK Biodiversity Action Plan priority habitats, and upland hay meadows are also an Annex 1 habitat in the EU Habitats Directive. The project area includes part of the North Pennine Dales Meadows Special Area for Conservation, one of only two outstanding localities in the UK for upland meadows. Due to agricultural intensification, species-rich hay meadows are now rare and isolated. Upland meadows are largely confined to northern England, with less than 640 ha remaining including around 100 ha in the Yorkshire Dales. Lowland meadows are more widely distributed than upland meadows but there are less than 5000 ha in the whole of England and Wales, with only around 100 ha surviving in the project area.

A meadow near Richmond (P Rayner, YDMT)

The flora of upland hay meadows is very similar to the ground flora of ash woodlands in the area, suggesting that it is highly likely that these meadows derive from human clearance of the woodlands and have been maintained ever since by regular cutting and grazing. The gradual evolution of hay meadows from woodland glades and clearings is therefore intimately linked to the cultural evolution of people, from those living in early settlements to the present day.

through gradual enclosure and mechanisation, and up to the present day (NPAONB Partnership / Marcus Bryan)

For centuries, meadows were an integral part of farming in the lowlands and upland fringes of Britain, producing hay that would be fed to the farm animals through the winter. Every farm or farming community where stock rearing was important would have had some meadow land carefully managed by generations of farmers. During the winter months, light dressings of muck (well-rotted farmyard manure) are spread on the meadows. In early spring, sheep are let onto the meadows for lambing. The meadows are shut-up (stock removed) in May to allow the hay crop to grow and, depending on the weather and altitude, haymaking starts in July or early August. The meadow is cut and the vegetation turned and left to dry in the sun over a few days. When thoroughly dry, the hay is baled and stored in a barn or shed. Livestock are let back into the meadows to graze the aftermath (re-growth). In winter, hay is fed to the livestock in the meadows and the hay meadow year starts again. Only low levels of farmyard manure and occasional light dressings of lime are applied to help maintain fertility and neutral soil pH.

However, the vegetation of species-rich meadows is in a state of dynamic equilibrium and relatively minor changes in their management bring about a rapid response in the species composition. Thus the nature conservation interest of old meadows is very easily damaged or destroyed. The major cause of loss is agricultural improvement with the aim of increasing hay yield so as to increase the number of livestock that can be over-wintered. Practices such as fertiliser and herbicide application, drainage, ploughing and reseeding with high productivity rye grasses (carried out to shift from hay to silage production) reduce the species richness of old meadows. Sadly, almost everywhere traditional management has fallen into disuse and the rich, colourful floras of old meadows replaced with repetitive species-poor grasslands of little wildlife or landscape value dominated by a few common plants.

Such changes began long ago in the late 18th century but, since the Second World War, they have greatly intensified and the UK now has less than 3% of the hay meadows there once were. Although there has been significant action through England's agri-environment programme to conserve these habitats, their rarity and fragility means that they remain priorities for direct proactive restoration action and awareness-raising.

Rowing up in the 1940s (W R Mitchell Collection)

Winter fodder (D Gamble)

Rows of silage ready to be baled (T St Pierre)

Meadow Conservation 2

Concern at the loss of hay meadows and the impact on wildlife and the landscape led to the setting up of the Pennine Dales Environmentally Sensitive Area scheme in the 1980s (which has since been replaced by Environmental Stewardship). Meadow conservation was a key part of this scheme, which involved farmers and landowners entering into voluntary management agreements to conserve their meadows through maintaining (or re-introducing) traditional management and being compensated for the loss in income. The scheme had two tiers: meadows included in Tier 2 were managed traditionally whereas farmers were allowed to apply low levels of inorganic fertilizer to their Tier 1 meadows. However, research has shown that even small inputs can lead to a reduction in floral diversity by favouring more competitive grasses.

So, although importantly the loss of meadows in the ESA area was largely halted, it became clear that many meadows were simply being maintained in their species-poor state. Additionally it was found that many Tier 2 meadows that had lost some of their botanical diversity were not increasing in species richness. Research showed that this is because seed of over 80% of the species of diverse grassland communities is very short-lived, so a field that has been in unfavourable condition for more than a few years will not have a 'bank' of desirable seeds in the soil from which the meadow can re-generate under favourable management. There is also a poor input of seed of desirable species from surrounding land - the dramatic loss of meadows means that the few that remain are generally isolated and surrounded by intensively-managed, species-poor fields. As meadow species have relatively low dispersal ranges (e.g. one or two metres a year), species are unlikely to spread to sites where traditional management has been re-instated.

Traditional, low-input meadow management maintains the botanical diversity of hay meadows but simply re-instating traditional management to a degraded meadow is usually not enough to restore it to its former species-rich condition. In most cases, once the management is right, it is necessary to introduce seed of desirable species to a meadow lacking these species. Seed of a range of species can be harvested in July/August from species-rich 'donor' meadows and spread on nearby 'receptor' meadows that have become species-poor.

A Dentdale meadow (P Rayner, YDMT)

Why was the project needed? 3

Although agri-environment funding for meadow restoration involving seed addition had been available to Dales' farmers for some years, very little work had actually been carried out. A small number of schemes had used seed harvested by a commercial seed supplier from meadows in Walden, a side valley off Wensleydale. Although the aims of the company are laudable, this source was less appropriate for a programme of Dales-wide schemes, as seed quantities were limited and costly (and is now no longer available). In addition, there is the widely-recognised habitat restoration principle to keep the seed source and receptor as close as possible. For the Dales we interpret this as within the same dale whenever possible. Projects in other parts of Britain, such as the High Weald Meadows Initiative, had already been using a variety of methods to harvest and spread seed but these complex schemes had dedicated staff to co-ordinate them, and specialist machinery and trained operators were readily available. This 'infrastructure' was lacking in the Dales.

It was clear that staff, machinery and contractors would need to be on hand before any extensive meadow restoration would take place in the Dales, so in 2003 YDMT[2], YDNPA, Farming and Wildlife Advisory Group North Yorkshire, English Nature (now Natural England) and Flora locale started to develop a project to promote meadow conservation and meadow-related tourism (called Step into the Meadow). Not long after, YDMT was commissioned by the North Pennines AONB Partnership and English Nature to research and develop a project to conserve and enhance the hay meadows of the North Pennines AONB and increase public awareness, enjoyment and understanding of meadows. Large parts of both the Yorkshire Dales National Park and the North Pennines AONB were included in the Pennines Dales ESA scheme so the obvious conclusion was to develop a joint initiative, as a way to maximise the impact and the nature conservation gain. YDMT undertook extensive research into existing meadow projects and the restoration methods and machinery they used, asked farmers for their views and suggestions on how the project could work best within their farming requirements, and organised meadow management and restoration demonstration events.

All of this work led to a detailed project proposal being drawn up. Major funding bids were submitted and by early 2006 funding had been secured. In May of that year Hay Time 'sister' projects based in the Yorkshire Dales National Park and the North Pennines AONB were launched. The projects were originally planned to finish in October 2009 but their success led to further funding being awarded which enabled the projects to continue - funding for the Yorkshire Dales' project finally came to an end in December 2011.

Cautley meadow (D Gamble, YDMT)

Hay Time

The Yorkshire Dales project was a partnership between YDMT and the Yorkshire Dales National Park Authority, and was supported by Natural England, Yorkshire Wildlife Trust, the National Trust, and others. The project's 'strapline' was *Working with farmers to restore meadows across the Dales*. This summed up the project's approach and ethos: we recognised and valued the central role of farmers (and other land managers) in the long-term management of meadows; we appreciated farmers' intimate knowledge and experience of upland farming; and we aspired to see a Dales-wide network of species-rich meadows.

Hay Time aimed to restore at least 200 ha of upland and lowland meadows within and close to the National Park.[3] The Hay Time project officer, Christa Perry, was responsible for providing specialist advice to land managers, identifying seed donor and receptor meadows, liaising with partner organisations, land managers, agricultural advisors and contractors, co-ordinating receptor meadow preparation and seed harvesting and spreading, monitoring donor and receptor meadows, encouraging land managers to upgrade or enter into agri-environment schemes, and implementing or supporting community and education initiatives. The first project officer was Pippa Rayner. Despite being a complex and innovative project (and with the added complication of the transition of English Nature into Natural England), Pippa's efforts and enthusiasm helped get the project established with farmers and conservation organisations. Pippa left in May 2009 after three successful years and Don Gamble, Hay Time Project Manager who led on developing the project and writing funding bids, co-ordinated the programme of restoration schemes for that summer. Recruitment for a new project officer started later in the year - in December Christa was appointed and she successfully delivered the last two years of the project.

The Project Officer marshalled the necessary resources - farmers, machinery, contractors, agri-environment funding, botanical data, licences - to enable the successful delivery of annual meadow restoration programmes, thereby enabling land managers to conserve and restore these important habitats. This led to a much greater area of meadows undergoing restoration than would have happened in the absence of the project. Annual programmes of restoration schemes were developed, co-ordinated and implemented over the lifetime of the project, and this practical restoration work was backed up by the provision of meadow management advice to farmers and land managers.

A complementary aim of the project was to increase public awareness, enjoyment and understanding of meadows, and to do this several community and education 'spin-off' projects were run, such as the Flowers of the Dales Festival, which has been superbly delivered by Tanya St Pierre.

The project benefited from have a steering group comprising representatives of the Yorkshire Dales National Park Authority, Natural England, the Yorkshire Wildlife Trust and Flora locale. This group guided project delivery, reviewed progress and outputs, provided advice and expertise on areas such as agri-environment funding, assisted in identifying and monitoring donor and receptor sites, ensured the project complemented the work of partner organisations, identified opportunities for the project to link in with community and education activities, and promoted the project to land managers and others. Meetings were held three or four times a year.

Hay Time had its own specialist seed harvesting and spreading machinery which was operated by Marsden Agricultural and Environmental Services Ltd, an agricultural contractor based in Long Preston on the south west edge of the National Park. Steve Marsden successfully tendered for the contract when it was first put out to tender in 2006. Steve and his team were reliable and enthusiastic and this was an important factor in the project's success. In 2009, to ensure best value and to give other contractors an opportunity to become involved, the contract was put out to tender again. Steve successfully tendered once more.

Protecting the donor meadows

To ensure that a donor meadow isn't damaged by taking seed from it, Hay Time followed recommendations made by Natural England and Flora locale, which are to harvest seed from no more than a third of the donor meadow and to leave harvested areas for at least three years before they are harvested again. Seed was also only harvested when conditions were suitable. Botanical monitoring of donor meadows has indicated no negative impacts.

Agri-environment schemes such as Higher Level Stewardship provide grants to farmers wishing to restore their meadows. These grants paid for Steve and his team to operate the seed harvesting and spreading machinery, for the receptor meadows to be prepared, and for the quantity of seed harvested from a donor meadow (an incentive for farmers to maintain their species-rich meadows). Farmers also receive a payment to traditionally manage their restored meadows.

Every summer since 2006 there was a programme of meadow restoration schemes. What quickly became clear was that implementing a single scheme can often be straightforward but doing a programme of schemes is challenging. There were lots of constraints and factors to take into account, lots of which affected the outcome and many were outside of our direct control.

For instance, the weather. Just like hay-timing, meadow restoration schemes are very dependent on good weather. If the weather is poor, farmers may be delayed in cutting and clearing their receptor meadows in preparation for seed addition. Water-logged ground can make access to donor and receptor meadows difficult and care needs to be taken not to damage fields during the meadow restoration work. Poor weather may also lead to farmers who had previously agreed to sell part of the hay crop as green hay changing their minds, as they decide that they can't afford to lose any further hay out of an already poor crop. Five of the six summers (2007-11) when restoration schemes took place were poor! On the other hand, the summer of 2006, when the first Hay Time schemes took place, was almost too dry.

Lack of rain resulted in a poor hay crop and not much new growth in the mown meadows, meaning that some farmers were forced to use some of their winter hay far earlier than they wished. The impact on restoration schemes was that some donor farmers weren't willing to sell any green hay.

Despite the weather, the project has helped implement 69 restoration schemes, resulting in locally-harvested seed being added to 141 fields (279 ha) located throughout the National Park and Nidderdale AONB. Seed was collected by several methods which ranged from field-scale seed addition (green hay, hay concentrate, and brush harvester) to inoculation of plots within the field (leaf vacuum and by hand). Field-scale seed addition was the preferred method and this was achieved on almost 60% of the fields (170 ha). In time this will lead to the meadows becoming species richer, and comparison of botanical surveys carried out before and after seed addition has revealed that this is happening.

Seed addition and a return to traditional management is just the start, of course. Meadows are very easy to destroy but much more difficult to restore. It only takes a few days for a centuries-old flower-rich meadow to be ploughed up, reseeded with a few agricultural grasses and enriched with inorganic fertilizer, but it can take years for such a meadow to be restored to its previous condition.

Bumblebee on melancholy thistle (D Gamble, YDMT)

Seed harvesting and spreading methods 5

For convenience, we refer to schemes as restoration schemes, but they actually fall into one of two broad categories - restoration or enhancement:

Meadow restoration involves adding seed to introduce or greatly increase populations of key functional species such as yellow rattle *Rhinanthus minor*, red clover *Trifolium pratense*, sweet vernal grass *Anthoxanthum odoratum* and meadow buttercup *Ranunculus acris* in meadows that have declined following more intensive management, such as addition of inorganic fertilizer. Restored meadows are returned to traditional management.

Meadow enhancement involves adding seed of characteristic species 'missing' from an already fairly species-rich, traditionally managed meadow, species such as wood crane's-bill *Geranium sylvaticum*, globeflower *Trollius europaeus* and great burnet *Sanguisorba officinalis*.

Potential receptor meadows were prioritised in accordance with Natural England guidance and generally a suitable meadow had low residual soil fertility, especially phosphorous (index 2 or less), had few competitive species in the sward and no pernicious weed problems, and was (or was about to be) subject to traditional management practices.

If a potential receptor meadow met these requirements, the next step was to identify a suitable donor meadow. The seed source had to be carefully chosen. Ideally the donor meadow was as close as possible to and at least in the same dale as the receptor meadow. This ensured that the seed was adapted to local growing conditions and that genetic variation was conserved as far as possible.

Next the harvesting method was determined by weighing up several factors: the 'starting point' of the receptor (its existing flora), the distance between the receptor and donor meadows, the access and topography of the fields, how close the timing of haymaking tallied between the two sites, the receptor farmers' requirements, and the willingness of the donor farmer to sell (and therefore lose) part of their hay crop.

Over the six summers we collected seed by several methods, which ranged from field-scale seed addition (green hay, hay concentrate, and brush harvester) to inoculation of plots within the field (leaf vacuum and by hand). The methods are described below. Whenever possible we aimed to implement field-scale seed addition involving donor and receptor sites in the same dale. All methods have their advantages and disadvantages (see Appendix 1 for a comparison) but having a range of equipment at our disposal enabled the best method to be used for each individual scheme.

Green hay

An agreed area is staked out in the donor meadow. Shortly after the receptor meadow has been cut, cleared and harrowed, the tractor-pulled Amazone flail-mower is used to cut and collect the green hay. When the hopper is full it empties the green hay into a tipping trailer which, when full, is then transported to the receptor meadow. The trailer is emptied and the green hay loaded by mini-digger (or by hand) into the tractor-pulled Millcreek muckspreader. Initially we aimed for a 1:3 ratio (ie 1 ha of green hay spread on 3 ha of receptor meadow) but this was revised to 1:5.

We also collected green hay using a forage harvester. Shortly after the receptor meadow has been cut, cleared and harrowed, the tractor-pulled forage harvester cuts, chops and blows the material either into the tractor-pulled Millcreek spreader or into a trailer, hitched behind the harvester or towed alongside by a Land Rover. The green hay is then taken to the receptor and spread. The harvester is owned by Steve Marsden. This method has the same pros and cons as using the Amazone flail-mower but it is the quickest of the field-scale seed introduction methods and it has been able to cut a sward beaten down by heavy rain that the Amazone machine couldn't. However, it can only be used where the slope of the donor meadow is shallow enough as to allow a muck spreader or trailer to be towed alongside. Many of the donor meadows where we have used the Amazone to collect green hay would have been too steep.

Green hay is the preferred method normally, as it collects a large quantity of seed from the widest range of plants. It is the most flexible of the large-scale seed introduction methods, as the donor farmer can cut the rest of the meadow before or after we harvest the green hay. Crucially, green hay is the least affected by wet weather. As long as the ground isn't too wet for tractors, the green hay can be cut and spread during light rain. The disadvantage is that a large volume of material has to be transported and spread within an hour or so of being collected, which means that the donor and receptor sites have to be within about 40 minutes of each other.

Amazone flail-mower (D Gamble, YDMT)

Hay concentrate

This method is similar to green hay except that it only removes the top third to a half of the standing herbage from the agreed area, leaving the rest to be made into hay as usual. Obviously seed has to be collected before the donor farmer cuts the meadow. The seed also has to be collected during dry weather. The seed collected by the quadbike-pulled hay concentrate harvester is blown directly into 1m^3 builders' bags mounted on the harvester. Full bags are transported to the receptor meadow and a few bags at a time are emptied into the quadbike-pulled spreader or tractor-pulled Millcreek muck spreader. The receptor site is either harrowed or plots are scarified. We aimed for a 1:5 ratio. Normally the hay concentrate is spread the same day but it can be dried if a large enough space is available to spread it thinly on tarpaulins. Hay concentrate is used when the donor farmer wants to reduce the hay loss, or the donor site is too far away for green hay to be used, or where tractor access is difficult. However, seed can only be collected in dry weather.

Hay concentrate (P Rayner, YDMT)

Forage harvester (C Perry, YDMT)

Brush harvester (D Gamble, YDMT)

Brush harvester

The Logic quad-towed brush harvester collects ripe seed but does not cut the grass so hay can be made afterwards (although the sward is slightly flattened). Brush harvesting is a fair-weather operation that must be carried out in dry weather and once the morning dew has evaporated. Ideally there needs to be at least two dry days prior to harvest. The harvester is towed across the site and the seed brushed into a hopper. When full, the seed is emptied onto tarpaulins, spread out and raked to help it dry and to prevent the seed heating up and becoming unviable. It is then laid out in a well-ventilated barn and regularly raked through to prevent it becoming mouldy. It can take between two and seven days to dry completely. It's possible to harvest around 2 ha per day and the seed collected would be sufficient to sow 5 ha. Once dry the seed can be cleaned using a sieve to remove most of the stalky material and then stored. Seed is then spread by hand on prepared plots but it can also be broadcast using a push spinner.

Spreading green hay (P Rayner, YDMT)

Leaf vacuum

Seed is harvested from one or two circular plots marked out in the donor site. The seed is then spread on a tarpaulin in an airy barn, usually at the receptor farm, to dry. Over the course of a week or so, the seed is regularly turned so that it thoroughly dries and it is then bagged in pillow cases. When the receptor meadow has been cut and cleared the seed can be spread by hand on either plots harrowed by the receptor farmer, on patches of bare ground created during hay making, or on plots approximately 2m x 5m scarified by the Amazone flail-mower fitted with a different set of cutter blades. To enable future monitoring the location of the plots is recorded, either by measuring the distance and bearing of the centre of the plots from a fixed feature such as a gate post, or by recording the national grid reference of the plot centre using a hand-held GPS. This method can be used when the donor farmer doesn't want to lose any hay, or the donor site is too far away for green hay to be used, or when the receptor site is already fairly species-rich and only needs seed of targeted species introduced, or where the receptor is too small to justify the expense of field-scale seed addition. Although cost-effective, this method collects the least amount of seed and seed can only be collected in dry weather.

Hand-collected seed

This involves collecting seed from appropriate species in nearby road verges, such as wood crane's-bill, great burnet, melancholy thistle, lady's mantles, meadowsweet, common knapweed and water avens. Ripe seed heads are removed by hand or using scissors dried and stored in marked envelopes. Hand-collected seed is used to supplement seed collected by leaf vacuum and hay concentrate. For vacuum schemes the seed is added to the stored seed or kept separate and put on particular plots.

Christa collecting seed (D Gamble, YDMT)

The table below gives an annual breakdown by method of the total areas that have had seed added.

	Green hay (Amazone)	Green hay (forage)	Hay concentrate	Brush harvester	Leaf vacuum	Hand-collected	Management upgrade	Totals (ha)
2006			8.30[i]					8.30
2007	26.88			3.39	14.46			44.73
2008	14.97				17.01	2.63	4.20 [ii]	38.81
2009	6.78		15.25	2.22	26.89			51.14
2010		12.03			11.26	0.54		23.83
2011		41.31		31.48	11.61	28.21		112.61
Totals (ha)	48.63	53.34	23.55	37.09	81.23	31.38	4.20	279.42
	17.4%	19.1%	8.4%	13.3%	29.1%	11.2%	1.5%	100.0%

[i] The project started in 2006 with the hay concentrate seed harvester and bought further machinery in 2007 and 2011.

[ii] This scheme involved a management upgrade from ESA Tier 1 to Tier 2 without seed addition.

Has it worked? A summary of data analysis

Receptor meadows were surveyed prior to seed addition to provide baseline data on the species present and their abundances. In a few instances the baseline data were taken from a Farm Environment Plan (FEP) undertaken by the Yorkshire Dales National Park Authority. In the following summer and ideally every alternate year thereafter the receptor meadow was re-surveyed using the same methodology to check for germination of new species and changes in abundances. In 2011, 76 restoration meadows at 27 farms were monitored to produce data for a comprehensive analysis produced by Christa assisted by YDNPA staff, Roger Smith, and others. Of these meadows, 40 were classed as restoration meadows and 36 as enhancement meadows.

The aim of the analysis was to determine the effect of seed addition on species richness, species diversity and meadow composition. A number of statistical analyses were carried out using the data of the latest surveys compared with the baseline data. The key findings are provided below and details on how to obtain a copy of the full report are in Appendix 2.

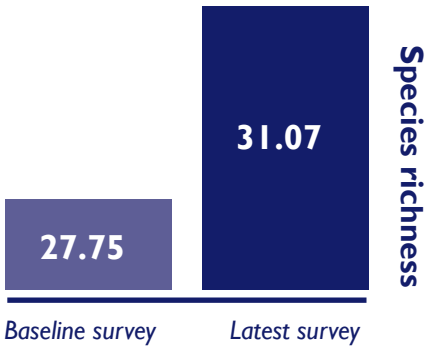
The results confirm early observations that the work is having a positive effect on treated meadows, with highly significant increases seen in species richness, species diversity and meadow composition. (In statistical terms, 'highly significant' means that there is less than one in a thousand chance of being wrong.)

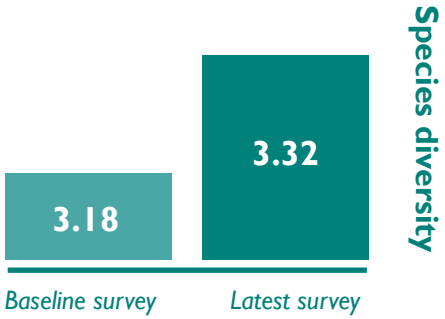
Species richness

Species richness is the total number of plant species present. It is a simple measure that does not take into account the type of species present or their relative abundances within the meadow. In restoration schemes we would expect to see the species richness increasing. We found that the average species richness had increased from 27.75 to 31.07.

Species diversity

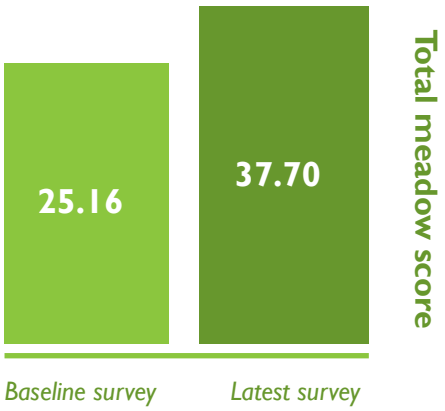
In a species-rich meadow there is a wide range of species and their abundances are relatively even, as the meadow's moderate fertility does not enable any species to out-compete others and become dominant. To measure species diversity we used the Shannon Index, which takes into account the number of species and the evenness of the species. Additional species or greater species evenness results in a higher value. In restoration schemes we would expect to see the species diversity increasing. We found that the average species diversity had increased from 3.18 to 3.32.





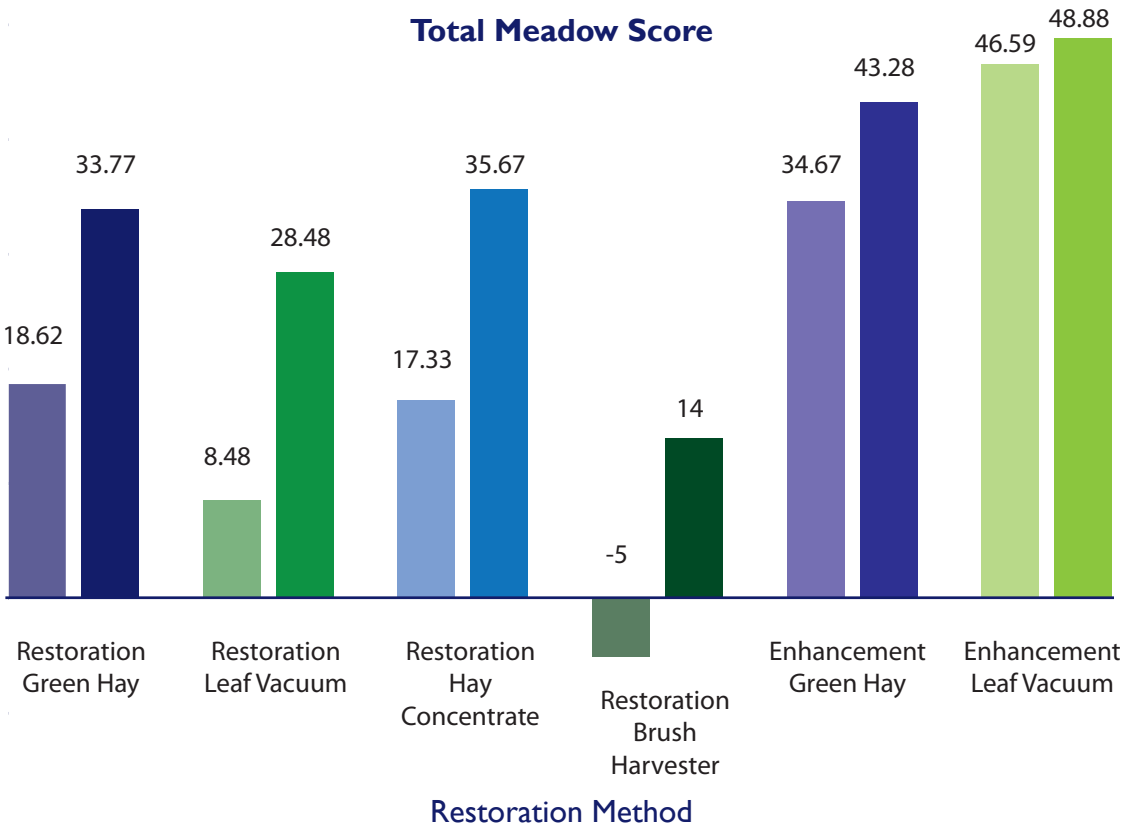
Total Meadow Score

Plant species found in meadows were allocated a value ranging from +4 for very special or rare species (positive indicator species) to -2 for troublesome weeds (negative indicator species). To calculate the Total Meadow Score for a particular meadow, the value of each species found in the meadow is multiplied by its abundance and the results for all species are added together. In restoration schemes we would expect to see the Total Meadow Score increasing, as positive indicator species are re-introduced and/or become more abundant, and negative indicator species die out or become less abundant. We found that the average Score had increased from 25.16 to 37.70.



Effect of method

All restoration methods have led to significant increases in average species richness, species diversity and Total Meadow Score (increases indicated by enhancement methods are not statistically significant). The graph below shows the effect of different methods on the Total Meadow Score. For each method, the first bar is the baseline survey and the second is the latest survey.



Has it worked? Discussion

Annual species such as eyebright and yellow rattle seem to establish very easily in receptor fields in the first summer after the seed spreading, sometimes in very large numbers. This was illustrated in restoration schemes where fields had vacuum-collected seed added to plots: when re-locating the plots for monitoring purposes they were often clearly seen from some distance due to the large populations of these species in them.

Perennial species, on the other hand, are much slower to get established and have established in smaller numbers, examples include ribwort plantain, common sorrel, sweet vernal-grass and selfheal.

The project has been successful in introducing species such as meadow vetchling, selfheal and common knapweed, which are often the first colonisers in the restoration of upland hay meadows. There has also been success in introducing species tolerant of more stressed conditions where the fertility is lower, for example yellow rattle and rough hawkbit. However, these results are from a relatively short time-frame, and many of the species mentioned above are common and may have been present (albeit in low numbers) in the grassland before restoration through the Hay Time project.

Where the project has had less success is in the introduction of mid- to late-successional species characteristic of low fertility grassland, such as great burnet and wood crane's-bill. This concurs with Roger Smith's long-term research at Colt Park, which has shown that seed addition is important but that after 20 years only modest progress has been made towards creating a really good example of an upland meadow; although some of the plots show what can be done when you get the right combination of management and ensure that yellow rattle is present.

We recognised from the start of the project that phased introductions of species over several years may be necessary once conditions have been made more favourable by initial seed addition to increase the likelihood of establishment of other characteristic species. Mid- to late-successional species that are vulnerable to competition or have seed dormancy mechanisms could be introduced as plug plants in future schemes.

There is a major trend of increasing plant diversity associated with decreasing fertility. Analysis suggests that the lower fertility and higher diversity is also associated with plots sampled after the seed treatment has been applied.

The seed addition treatments and the timing variables (before and after seed addition) accounted for 25% of the variation in the overall plant species composition and the probability that this was due to chance was very low.

With a few exceptions the vegetation of the majority of the sites is, with time, moving away from that associated with improved grassland.

This analysis is based on six years of seed addition and botanical monitoring. The relative success of meadow restoration compared to meadow enhancement suggests that future work should be prioritised on restoration schemes. Re-introduction of key species such as yellow rattle appears to be much more successful and hence more cost-effective than enhancement attempts to add late-successional species to meadows that already have a fairly wide suite of species.

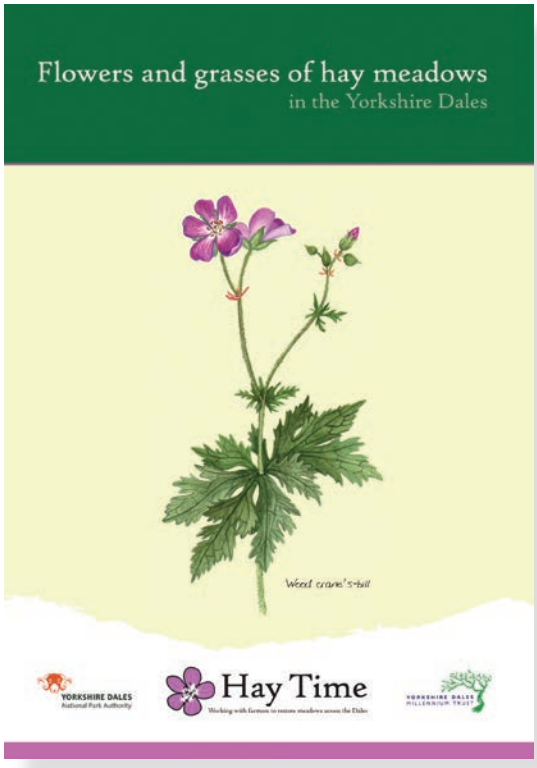
Bumblebee and yellow rattle (C Perry, YDMT)

When the Hay Time project was set up it was planned to develop and deliver a range of meadow-themed educational and community involvement opportunities, so as to raise awareness of the importance of hay meadows and why we should value them.

During the first two years of the project a series of information leaflets were produced: *Managing species-rich meadows for wildlife, Restoring species-rich hay meadows, Providing seed for restoring species-rich hay meadows, Restoring meadows using vacuum-collected seed,* and a *Hay Time Information Sheet.* These were mainly for farmers and landowners, but we also produced a *Flowers and grasses of hay meadows identification guide* suitable for anyone interested in the meadow flora.

As well as these publications we gave numerous illustrated talks and interpreted meadow walks. Then, in 2008, we collaborated with the Yorkshire Dales National Park Authority to develop the Hay Time Festival. This comprised over 50 meadow-themed events and activities run by a wide range of organisations and individuals. The Festival was very successful and demonstrated the demand for meadow-related learning opportunities.

Building on this YDMT set up the Flowers of the Dales project in 2009. The two-year project, delivered by Tanya St Pierre, had two main objectives, the first being to co-ordinate Flowers of the Dales Festivals in 2009 and 2010. The Festival had a broad remit to include any event or activity with a wildflower theme and includes wildflower, bumblebee, bat and butterfly walks and talks, wildflower photography courses and competitions, farm open days, art exhibitions, children's craft activities, quizzes, and wildflower identification courses.



The success of the Festivals encouraged YDMT and our partners to continue the Festival, indeed many event providers wanted to extend the number and range of events they offered, and so YDMT decided to also run Festivals in 2011 and 2012.

Identifying a bumblebee (T St Pierre, YDMT)

The Festival offers around 120 events per year, run by numerous organisations and individuals in locations throughout the Dales from March to October. More than 10,000 people have taken part in the 2009-11 Festivals, with numbers increasing year on year. Feedback provided by participants showed that 4 out of 5 rated their experience as excellent. To promote each Festival a free, colourful programme giving details of each event is produced and distributed widely. Half of all participants first heard about the event they took part in through the Festival programme. The Festival has become well-established and a recognised 'brand', effectively promoting a fantastic range of events as a single entity. It is also supporting sustainable tourism, as almost 80% of participants in the 2011 Festival lived outside of the Yorkshire Dales National Park, and of these 86% visited especially for the event.

The second objective of the Flowers of the Dales project was to publish a book, *Hay Time in the Yorkshire Dales,* to celebrate and explain the natural, cultural and land management history of the Dales' hay meadows in an accessible, inspiring and educational way. With a foreword by John Craven and contributions from Dales farmers, Dales authors, academics with a specialist interest, and many others, the book deals with different aspects of Dales meadows and their importance.

Chapter 1 looks at what meadows are, the kinds of meadow in the Dales, and their history and role as a vital component of upland farming. Chapter 2 describes the annual cycle of traditional meadow management, haymaking, and the implements and machinery used over the years. This chapter includes wonderfully evocative photos of Dales farmers haymaking in the past. Field barns and dry stone walls are essential parts of meadow 'infrastructure', and their history and function in meadow management are explored in Chapter 3. Many of the meadow wildflowers and grasses, their folklore and their intriguing traditional culinary and medicinal uses are described in Chapter 4, while Chapter 5 describes the exceptional range of birds, animals, insects and other fauna supported by hay meadows.

Chapter 6 describes the shift from traditional to intensive meadow management and the huge impact this has had on meadow ecology and the countryside. Agri-environment schemes and other initiatives have prevented the complete loss of hay meadows in the Dales, and Chapter 7 looks at how these measures support farmers who have continued to traditionally manage some of their meadows, as well as those farmers who have meadows that can be restored.

Chapter 8 comprehensively covers the scientific research that has been carried out to explain how meadow management affects the species composition of meadows, and how what goes on in the soil affects what can be seen above ground. This meticulous and fascinating research provides us with another level of understanding and insight, enhancing our appreciation and enjoyment of a meadow bustling with wildflowers. The research informs meadow restoration policy and practical meadow restoration projects such as Hay Time, which is the focus of Chapter 9.

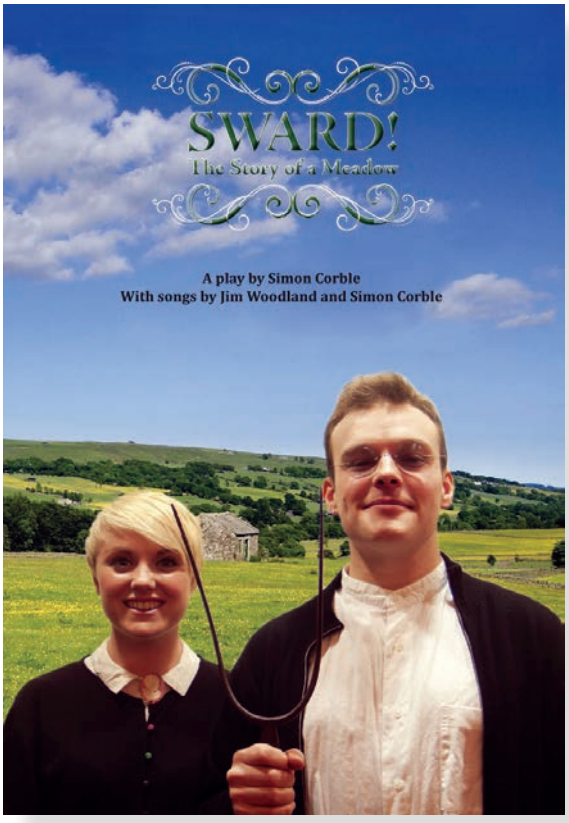
Chapter 10 concludes the book by looking to the future - the potential impacts of climate change, possible changes in farming practices, and the thoughts of local children, many of them born into farming families, on what they want and foresee for the future of hay meadows and farming in the Dales.

Appendix 1 includes details and maps of 25 superb meadows that have good public access. Although the focus is on the Yorkshire Dales National Park, also included are hay meadows on the outskirts of the National Park. Scattered throughout the book are quotes from Dales farmers interviewed as part of producing the book, and edited transcripts of the interviews are in Appendix 2.

The book is filled with superb photos, charming illustrations, beautiful artwork and evocative poetry, capturing the beauty of the meadows, the emotions they arouse, and the character of the people who manage them. The book launch was at Giggleswick School on 20 May 2010 and was attended by around 100 people. Since then it has received very good reviews and is selling well.

"... a full record of the meadows, their history, plants, fauna, current condition and prospects that will have enduring value. All this material has been well edited into an authoritative, attractive and colourfully illustrated whole." George Peterken, *British Wildlife*, October 2010

In 2011 we secured funding to develop *Sowing the Seeds*, a two-year transnational project aiming to make links with other EU regions that contain similar upland hay meadows and face the same kind of issues, and to see how other regions use their hay meadows as an educational and tourism resource. At the same time, Blaize (a community arts company) and Highlights (the North Pennine Rural Touring Scheme), had commissioned award-winning playwright Simon Corble[4] to write a play based on the history and complex web of life of an upland hay meadow. The idea for the play had been inspired by the historical research carried out by both of the Hay Time projects but in particular by the work of Neil Diment, the North Pennines AONB Partnership's Hay Time Community Officer. Through *Sowing the Seeds* we helped to develop and promote the play, called *Sward! The story of a meadow*. Aimed at children aged over 8 and their families and very funny with entertaining songs, it nevertheless delivered clear messages about the importance of hay meadows and their fragile nature. Of the 34 villages that the show was performed in during April to June 2011, we organised 9 performances in the Yorkshire Dales National Park and Nidderdale AONB. Almost 400 people (about a quarter were children) saw these 9 shows.



Linked with many of the *Sward!* shows we organised and as another part of *Sowing the Seeds*, Tanya provided educational activities and hay meadow visits for primary schoolchildren. Over 300 children enjoyed learning about the meadows through drama activities and interactive lessons in school, and by visiting meadows where they spent a fun day out identifying and recording wildflowers and grasses. Tanya developed the activities with Paula Horton (Blaize) and Neil.

Discovering the meadow flowers (T St Pierre, YDMT)

Accompanying the tour was a photographic exhibition by Neville Turner. Neville spent 12 months capturing fixed point, time lapse images from several locations in Upper Teesdale, starting in March 2010 with snowy scenes, through that summer's hay timing, and ending in the following winter of January 2011. The exhibition also included images of archive hay making and the flora and fauna of upland hay meadows. The exhibition was presented digitally on three screens, mounted in 'stone walls' matching the set of the play.

We also commissioned Blaize to produce a DVD of the play by filming the live performance at the Victoria Hall in Settle. The DVD includes a 4-page colour booklet with text and images about hay meadows and the importance of the National Park as a key area for hay meadow conservation and restoration. Blaize and Highlights produced an evaluation documentary of the tour which includes interviews with several enthusiastic members of the audience. The documentary can be viewed at www.youtube.com/watch?v=tStubiK8cx0.

Awards and recognition

Hay Time and related projects have had a high profile by regularly appearing in local, regional and national media, various publications, and through winning awards.

In 2007, Pippa Rayner won the Ken Willson Award, organised by the Yorkshire Dales Society, which recognises the contribution of people aged under 30 to the Dales' environment, economy, culture and social well-being. Then Steve Marsden, the contractor who operates our seed harvesting and spreading machinery, won it in 2009. We were very pleased that Hay Time won the environmental project category of the Yorkshire Rural Awards 2010, organised by Dalesman Publications. The award recognised the project's success between 2006 and 2009 and so we invited Pippa (who had left the project in 2009) to accompany Don to the presentation event. We received an engraved glass trophy and plaque from John Craven, who hosted the Awards.

We nominated Hay Time for the 2012 national Charity Awards, organised by the Civil Society, and in May we were delighted to be told that the project had been shortlisted out of hundreds of entries as one of three finalists in the Environment and Conservation category. The Awards are the charity sector's most prestigious excellence recognition programme, and shortlisted charities have been judged by a highly respected independent panel as having demonstrated outstanding best practice from which other organisations can learn. The winners will be announced at a gala dinner in London in June.

Pippa Rayner and John Craven

John Craven also supported the project by generously providing the foreword to the *Hay Time in the Yorkshire Dales* book, and interviewing Pippa for BBC Countryfile in 2008.

The project also got TV coverage when Pippa featured on Yorkshire TV's The Real Emmerdale and she was filmed seed collecting for inclusion in the regional slot of the BBC series Nature of Britain, both in 2007. In 2011 Hay Time featured again on BBC Countryfile, with Tanya and Don being interviewed by James Wong. The programme also showed school children identifying meadow plants, assisted by Tanya.

Tanya St Pierre and James Wong (S Brewer, YDMT)

The project and its spin-offs generated a lot of publicity, featuring in national publications such as British Wildlife, the Countryfile magazine, and The Times, as well as local and regional media.

Together with colleagues at the North Pennines AONB Partnership, we contributed a poster paper to the High Value Grasslands conference in 2007, organised by the British Grasslands Society, the British Ecological Society and the British Society of Animal Science. The paper was published in the Proceedings.[5]

The project was one of six biodiversity projects that featured as case studies in a booklet to celebrate some of the achievements in implementing Nature in the Dales, the first Local Biodiversity Action Plan for the Yorkshire Dales National Park. The booklet was launched at the '2020 Vision' biodiversity conference in October 2010. Buglife are using Hay Time as a case study in a B-Lines report, to show how co-ordination and support is key to the delivery of landscape-scale habitat restoration. The project will also be included as a case study in a proposed book aiming to become 'the main source of reference for a wide range of people and organisations interested in dry grassland management and restoration in Britain, including farmers, landowners and conservation organisations'. The book is being written with the support of the RSPB, The Royal Society of Wildlife Trusts, Royal Botanic Gardens Kew, Butterfly Conservation, and the Eden Project.

Further work

9

YDMT, together with our partners, has built up considerable experience and expertise in meadow restoration and education through delivery of the Hay Time project, the Flowers of the Dales Festival, and other initiatives. Although Hay Time has now ended, there is a clear demand for the work to develop and expand. Despite the initiation of meadow restoration on the scale achieved, the hay meadow resource continues to be rare and fragile and much remains to be done.

There is still the need for co-ordination of restoration schemes. This was the main reason for Hay Time being set up in the first place, as co-ordination is not a statutory obligation and partner organisations didn't have the resources to undertake it. This is still true and, in light of public spending cuts, is likely to remain so. Restoration is a complicated process that requires careful, focused co-ordination. The availability of seed harvesting machinery and expertise, together with appropriate site preparation, after-care and management, are all critical, as is time to build relationships with farmers, local knowledge of donor sites, and having an overview of the use of those sites. This is what Hay Time provided. It enabled land managers to conserve and restore these important habitats and to have better access to agri-environment funding for meadow restoration, and to manage the donor resource. The conservation actions carried out through Hay Time enabled a much greater area of meadow to undergo restoration than would have happened in the absence of the project. 2012 is a peak year for the expiry of ESA agri-environment agreements and entry into Higher Level Stewardship (HLS). We already have a long list of farmers keen to get involved in future meadow restoration schemes through HLS and literally dozens of new agreements that include meadow restoration are expected to start.

There is also high demand from the public and schools for further meadow-themed education and community involvement work. Feedback from participants of meadow events has been extremely positive and supportive of the provision of further events. Numerous schools have indicated an interest in being involved in meadow education work. Habitats like meadows, rich in wildlife and of cultural importance, are more likely to survive within a society that values them, and we have been nurturing this by raising awareness, involving the public through focussed community and education work, and delivering fun and interesting educational events for schools.

In early 2012 we put together a proposal for *Into the Meadows*, a new project to deliver further meadow restoration and education work. We set about raising funds for the work and at the time of writing we have launched the education 'side' but the restoration work remains unfunded.

The *Into the Meadows* education project will run from spring 2012 to autumn 2013 and will:

- Run at least 30 events and activities for the public (interpreted walks, talks on meadows and their history, changes in management and restoration, plant identification workshops, etc)
- Develop an educational resource pack for schools, including teachers notes and support materials, classroom delivery ideas, wildlife, cultural and land management information about the habitat, and materials for use by pupils
- Deliver 4 teacher training days on using the resource pack
- Deliver 32 *Into the Meadows Discovery Days*, incorporating activities in the classroom and nearby meadows
- Develop downloadable resources such as self-guided walks, quizzes, and family activity sheets, making use of technologies such as Bluetooth and QR codes.

Tanya St Pierre is the education officer.

Despite funding bids to support restoration work being unsuccessful, we are determined that priority schemes will still go ahead and we are discussing with partners how this might happen. Although funding to support the coordination of restoration schemes in the Yorkshire Dales National Park has now finished, we have been working with the adjoining protected areas of the Forest of Bowland Area of Outstanding Natural Beauty (AONB) to the west and Nidderdale AONB to the east. In partnership with the Forest of Bowland AONB we have secured funding from the Lancashire Environmental Trust to run the Bowland Hay Time project. This will implement meadow restoration schemes in the AONB in the summers of 2012 and 2013 and is based on the Hay Time model of delivery. Community and education work linked to the project will be delivered by AONB staff. Last year we helped to coordinate restoration schemes in Nidderdale AONB and building on the success of these, the AONB is aiming to raise funds to run a Hay Time-like project there as well. These are both exciting developments that will help to protect the

hay meadows in those areas and expand the total resource in the north of England.

So although the Hay Time project itself has now ended, YDMT continues to be involved in meadow restoration and education, by working with new partners and building on our experience and commitment to protecting these superb grasslands.

We are very proud of what Hay Time has achieved.

Meadow sward (P Rayner, YDMT)

Notes

1. Upland hay meadow (National Vegetation Classification MG3 *Anthoxanthum odoratum - Geranium sylvaticum* sweet vernal grass - wood crane's-bill) is the most distinctive of all the meadow types found in the Yorkshire Dales and is largely confined to the North Pennines, the Lake District and County Durham, with some outliers further north in Northumberland and Scotland. In the Dales, these meadows are generally found in valley heads between 200 and 400 m in the 'in-bye' fields around the farms. Sometimes fragments of this meadow vegetation remain around the edge of improved fields and quite rich assemblages of the meadow flora can be seen on road verges and in graveyards where there can be an approximation of meadow management with a single early summer cut of the herbage.
Wood crane's-bill *Geranium sylvaticum*, melancholy thistle *Cirsium helenioides* and globeflower *Trollius europaeus* are some of the most distinctive of the colourful herbs to be found in these meadows, species having a European distribution that is largely confined to mountainous and northern climes. Also striking are some local or very rare Lady's mantles (*Alchemilla* species). Along with these, it is herbs such as the commoner Lady's mantles *Alchemilla glabra* and *A. xanthochlora*, great burnet *Sanguisorba officinalis*, pignut *Conopodium majus*, common sorrel *Rumex acetosa*, wild white clover *Trifolium repens* and red clover *T. pratense*, bulbous buttercup *Ranunculus bulbosus*, meadow vetchling *Lathyrus pratensis*, rough hawkbit *Leontodon hispidus* and yellow (or hay) rattle *Rhinanthus minor* that give these meadows their distinctive richness and variety, with plants such as water avens *Geum rivale*, common bistort *Persicaria bistorta* and marsh hawk's-beard *Crepis paludosa* marking out more poorly drained places in the fields. However, equally distinctive is a great diversity of grasses: sweet vernal grass *Anthoxanthum odoratum*, cock's-foot *Dactylis glomerata*, rough meadow-grass *Poa trivialis*, red fescue *Festuca rubra*, Yorkshire fog *Holcus lanatus*, crested dog's-tail *Cynosurus cristatus* and common quaking grass *Briza media.*

Two types of species-rich lowland meadow and grassland are found in the Dales, termed MG5 *Cynosurus cristatus - Centaurea nigra* crested dog's-tail - common knapweed grassland and MG8 *Cynosurus cristatus - Caltha palustris* crested dog's-tail - marsh marigold grassland. While these meadow types are more widely distributed throughout England and Wales, they have also been subject to massive decline and are of very high nature conservation value, recognised by their classification as UK BAP priority habitats. MG5 grassland shares many mowing- and grazing-tolerant species with upland hay meadows and also has a rich mixture of grasses and herbaceous dicotyledons. However, the contingent of mountain and northern species is absent here, so it is plants such as common knapweed *Centaurea nigra*, common sorrel, oxeye daisy *Leucanthemum vulgare*, red clover and autumn hawkbit *Scorzoneroides autumnalis* that provide the distinctive diversity and colour to the developing sward before it is cut. Where the meadow extends on to soils that are a little more calcareous, as on shallower ground over limestone, then lady's bedstraw *Galium verum* and yellow oat-grass *Trisetum flavescens* can feature and, on sandier drift which is a little more acidic, devil's-bit scabious *Succisa pratensis* and betony *Stachys betonica*.

MG8 grassland occurs on less well-drained situations within the meadows or flushes where ground water issues out on slopes over impermeable drift. With the widespread drainage of old meadows it is now very local. The colourful kingcup or marsh marigold *Caltha palustris* is prominent here, along with cuckoo flower *Cardamine pratensis*, meadowsweet *Filipendula ulmaria*, creeping buttercup *Ranunculus repens* and northern marsh orchid *Dactylorhiza purprella.*

2. YDMT works in partnership with farmers, local communities and other organisations to support the environmental, social and economic well-being of this special area. We deliver projects directly, raise and distribute funds to projects, and manage and distribute others' funds to projects. Conserving the physical heritage features which make up the Dales landscape has been the core of our work, and we have an excellent track record of enabling projects to happen. Over the last 14 years we have developed and delivered over 1200 capital and educational landscape and heritage projects worth around £25m, including wildlife habitats, access improvements, barns, walls, and historic buildings and features. YDMT is a registered charity (1061687) based in Clapham in the Yorkshire Dales National Park. It has 18 Trustees drawn from a wide range of backgrounds, it currently employs 16 people and has over 35,000 supporters.

3. The target has been revised during the course of the project. The original target, when the project was expected to run for three and a half years, was 220 ha. This target was reached through wide consultation and was based on the best available estimate of the donor meadow resource (the number and area of sites and their suitability as a seed donor) and the number of degraded meadows that the project could realistically work with. However, following the first year of surveying we revised the target to 140 ha, as it became clear that the original target was over-ambitious: many SSSI meadows (sites of specific scientific interest considered the best examples of the habitat and hence potential donor meadows) were actually in 'unfavourable condition' (generally meaning that competitive, undesirable plant species were too common and/or that they contained low populations of key, desirable species), and many potential receptor meadows were smaller than anticipated. These findings reinforced the need for the project to help arrest any further loss and expand the resource. When further funding was obtained in 2009 enabling the project to continue for another two years we added a further 60 ha onto the target, hence the 200 ha target that we refer to.

4. Simon co-wrote an adaptation of John Buchan's The 39 Steps. Originally performed in village halls with just stepladders, planks and a big sheet, it won a host of awards: an Olivier Award in 2007 (and is still running in the West End), and it has done very well in New York, being nominated for six Tony Awards including best play.

5. P.E. Rayner, J. O'Reilly, R.M.T. Barrett and D.M. Gamble (2007) *Hay Time: Hay Meadow Enhancement and Restoration in the Pennine Dales, Northern England.* 'High Value Grassland: providing biodiversity, a clean environment and premium products'. In: Proceedings BGS/BES/BSAS Conference. Occasional Symposium, 38, Keele University, Staffs.

Colt Park meadow (T St Pierre,YDMT)

Appendix 1 A comparison of seed harvesting and spreading methods

	Green hay: mower-collector	Green hay: forage harvester
Seed range and quantity	Collects good range and quantity	Collects good range and quantity
Machinery needed	Mower-collector and Millcreek muck spreader, both tractor-pulled	Forage harvester and Millcreek or other muck spreader
Seed harvesting / collecting	Cuts and collects rapidly	Fastest green hay harvesting method on level sites
Transport to receptor	Material dumped straight into muck spreader or high-sided trailer	Material blown directly into muck spreader or high-sided trailer
Spreading	Seed needs to be spread within one hour of harvesting Material dumped in a heap and loaded into spreader by digger / hand Receptor farmer can do the spreading with their own muck spreader	Seed needs to be spread within one hour of harvesting If material blown into a trailer, it is then dumped in a heap and loaded into spreader by digger / hand Receptor farmer can do the spreading with their own muck spreader
Weather dependency	Can be operated in light rain if ground not too wet	Least affected method if ground not too wet
Impact on hay crop	Takes 100% of harvested area	Takes 100% of harvested area
Summary	Gets widest range of seed Cuts and collects easily but large quantity of material to be transported and spread Least weather dependent method The donor farmer can cut the rest of the field before or after seed harvesting, so more flexibility than other methods Specialist machinery so needs trained operators Available through YDMT	Gets widest range of seed Cuts rapidly but large quantity of material to be transported and spread Least weather dependent method The donor farmer can cut the rest of the field before or after seed harvesting, so more flexibility than other methods Uses normal farm machinery Available through Marsden

Hay concentrate	Brush harvester	Leaf vacuum
Only collects seed from taller plants so more limited range	Only collects seed from taller plants so more limited range	Collects wide range of seed or seed of targeted species
Ian Fletcher harvester and spreader, both quad-bike pulled	Quad-pulled Logic brush harvester and possibly a spinner to spread seed	Hand-held leaf vacuum
Slower than mower-collector as have to replace bags frequently	Fairly rapid	Manual operation
Bags lifted by hand onto trailer	Least bulky mechanical method	Very little material harvested
Seed can be either spread on same day or dried and spread later Bags emptied straight into quad-bike pulled spreader	Seed can be either spread on same day or dried and spread later (but seed may be scorched because no chaff to protect it) If unprocessed (same day spreading), spreading is by hand If processed, by hand or seed spreader	Seed spread by hand, either on same day or dried and spread later
Needs dry conditions	Needs dry conditions	Needs dry conditions
Takes up to 50% of crop from harvested area – potentially difficult for farmer to harvest remainder	Takes less than 20% of crop although can flatten crop	Negligible loss and very little impact on crop
Best used for short donor swards Intermediate option between green hay and brush harvester Donor farmer may need to delay cutting Specialist machinery so needs trained operators Available through YDMT	Main problem is spreading a small amount of material evenly over site Reduced range of species Donor farmer may need to delay cutting Specialist machinery so needs trained operators Available through YDMT and Dinsdale Moorland Services	Relatively small amount of seed collected Cheap and effective method to inoculate a receptor Easiest method to implement Available through YDMT

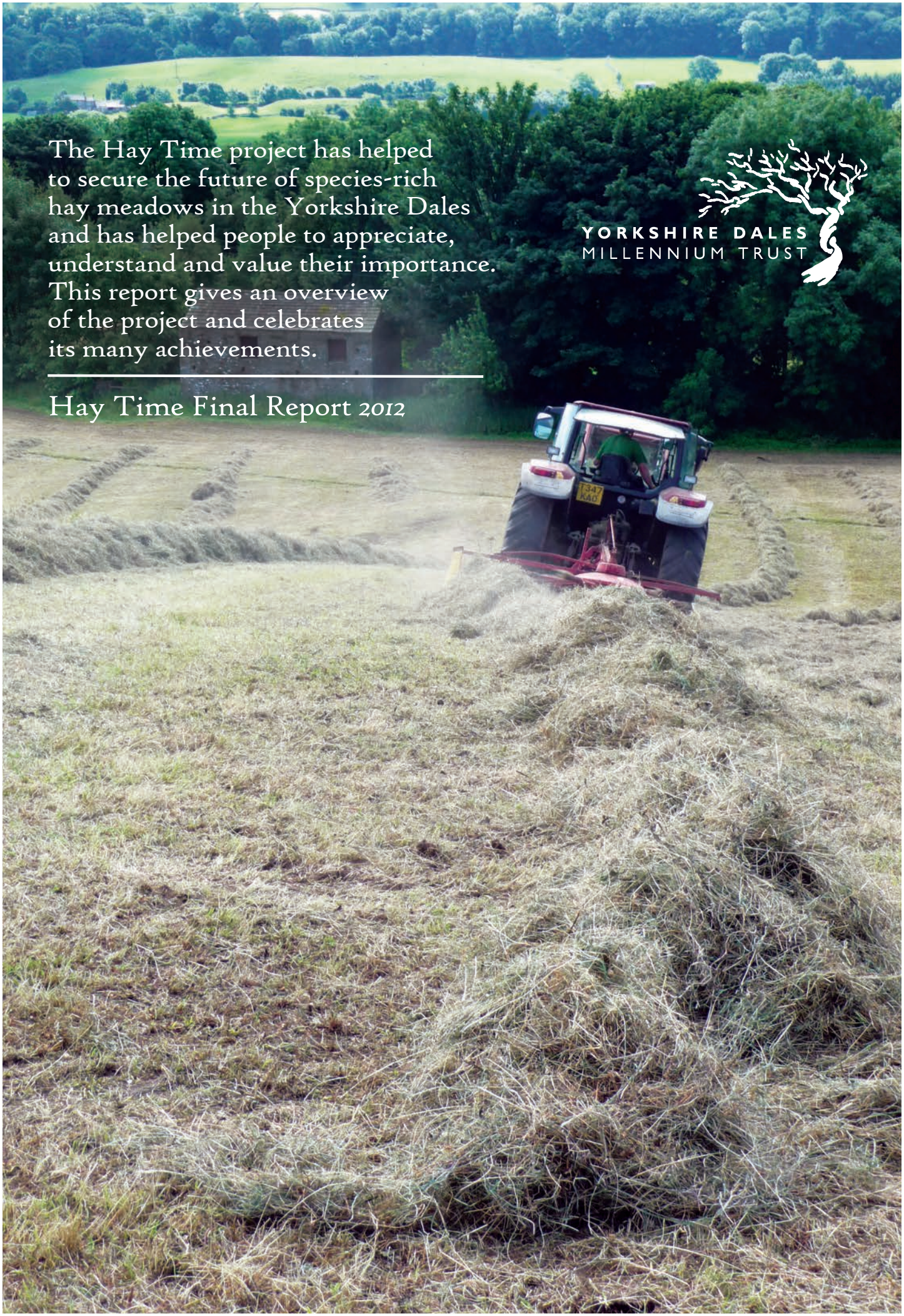
Appendix 2 Hay Time publications and resources

Here are details of all of the publications and resources linked to the Hay Time project that YDMT has produced. We are planning to produce more resources in the future. For further information phone 015242 51002, email info@ydmt.org, visit www.ydmt.org, or write to YDMT, Old Post Office, Main Street, Clapham, LA2 8DY.

Please note that the Hay Time project run by North Pennines AONB Partnership has also produced a range of superb resources: phone 01388 528801 or visit www.northpennines.org.uk for further details.

	Price	P&P (if ordered through YDMT)	Free download from www.ydmt.org (resources section)	Order through the online shop at www.ydmt.org	Available from some visitor centres, bookshops, etc.
Managing species-rich meadows for wildlife (A5, 4-sided leaflet, full colour)	free	sae	✔		
Restoring species-rich hay meadows (A5, 4-sided leaflet, full colour)	free	sae	✔		
Providing seed for restoring species-rich hay meadows (A5, 4-sided leaflet, full colour)	free	sae	✔		
Restoring meadows using vacuum-collected seed (A5, 4-sided leaflet, full colour)	free	sae	✔		
Hay Time Information Sheet (A4, 4-sided leaflet, full colour)	free	sae	✔		
Hay Time - Analysis of survey data 2006-2011 (A4, 32pp, full colour)	free	£1	✔		
Hay Time: Final Report 2006-2011 (A4, 32pp, full colour)	free	£1	✔		
Hay Time in the Yorkshire Dales (270pp, paperback, full colour)	£12	£2		✔	✔
Flowers and grasses of hay meadows (A5, 8-sided identification guide, waterproof, full colour)	£1	£1		✔	✔
Flowers of the Dales Festival programme (A5, full colour, available annually from March)	free	£1	✔	✔	✔
Flowers of the Dales Festival Report 2011 (A4, 15pp)	free	£1	✔		
Sward! The story of a meadow (DVD, 90 mins)	free / £4*	£1		✔	

* Apart from the £1 to cover p&p, the DVD is free to schools and community groups. For other organisations and individuals we suggest an additional £4 donation. All orders for the *Hay Time* book come with a free copy of the DVD.



The Hay Time project has helped to secure the future of species-rich hay meadows in the Yorkshire Dales and has helped people to appreciate, understand and value their importance. This report gives an overview of the project and celebrates its many achievements.

YORKSHIRE DALES
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Hay Time Final Report *2012*