



Three Hagges Wood-Meadow

Open areas incorporated into a newly designed wood-meadow at Three Hagges Jubilee Wood provide pollen, nectar and larval food source for invertebrates. The original seed mixes are enhanced by plug planting and direct sowing, using plants from locally collected wild seed. *Lin Hawthorne*

Inset: Common Blue is one of several species now recorded with a breeding population at the site. *Pat and Jim Bone*

a model project for the potential of wood-meadows for sustaining biodiversity

An ambitious project to mimic the ancient and rare land-management system of wood-meadow on formerly arable land has resulted in the creation of a large, thriving woodland ecosystem with benefits for the local Selby community. **Lin Hawthorne** of the Hagge Woods Trust explains how the project took shape and outlines its potential for contributing to conservation and to the greater understanding of woodland creation.

The Hagge Woods Trust project at Three Hagges Wood-Meadow originated from a 2012 Woodland Trust campaign to celebrate the Queen's Diamond Jubilee by planting six million trees across Britain. It was obvious to the Trust at the planning stage, however, that simply planting trees alone would not achieve their own aim of creating healthy and biodiverse woodland that would measure up to the model of British ancient woodlands, where much biodiversity lies in the understorey and the vital but often overlooked ground flora.

The Trust took the view that much new woodland planting in recent decades has been lacking, since more emphasis has been placed on increasing tree cover than on improving woodland ecosystems as a whole. Dismayed by the parlous losses in biodiversity during the past century, we decided that a methodology for new woodland creation should be formulated in response to some of the issues highlighted by the *State of Nature* (2013) – a report compiled by 25 wildlife organisations to take stock of all our native wildlife. Among other concerns, the report documented

declines in the area of managed coppice woodland (90% from 1900 to 1970) and lowland meadows in England and Wales (97% between the 1930s and 1984). Hedgerow losses are more difficult to quantify; the reduction in overall length of British hedgerows (from 624,000km to 477,000km between 1984 and 2007, Carey et al. 2008) is only part of the picture. The loss of species-rich ancient hedgerows pre-1984 is a more elusive figure. Much new planting was of single-species hawthorn/blackthorn – significantly less valuable to invertebrates, including pollinators.

Our opportunity to act arose in June 2012, when Charlie Forbes Adam offered a long-term lease at a peppercorn rent on a 10ha site on the Escrick Park Estate to his wife Rosalind, Project Director of Hagge Woods Trust. The creation of a biodiverse woodland ecosystem on fertile, formerly arable, land was never going to be a simple undertaking, and we found no adequate literature to help achieve it. But, during the design and planning sequence, we had an epiphany. In describing our plan to the eminent woodland ecologist George Peterken, he commented that we

appeared to be creating a wood-meadow, and this typically perceptive observation has guided much of the subsequent development at the site.

What constitutes a wood-meadow?

A type of managed ecosystem with an ancient history, wood-meadows probably originated in periods of early settlement around 7,000–8,000 years ago. They were once widespread in temperate Northern Europe in communities that depended on animal husbandry, and in Estonia they reached peak area at the end of the 19th/beginning of the 20th centuries. Typically, these Northern European ecosystems were multifunctional: sources of hay, medicines, wood, berries, mushrooms and nuts. Their decline in area reflects an increase in population density and agricultural intensification, but several of those in existence are still managed or have been restored, notably at Lailatu and Tagamõisa, in Estonia, and at Råshult, in Småland, Sweden. This last, emblematically for Hagge Woods, was the birthplace of that great ecologist and botanist, Linnaeus. It prompts the question: would he have grown into such an observant ecologist without access to this diversity on his doorstep? Our concerns have seldom been higher regarding our own disconnection from nature; how would it be if we could provide every child with similarly free and ready access to the natural world?

Wood-meadows are fairly sparsely wooded areas of mixed-species copses with a regularly cut and/or grazed herb layer. The species composition of the systems reflects longstanding agricultural activities of hay making and grazing, along with rotational coppice-with-standards management of wooded areas. It is this continuous management that sustains biodiversity. Especially pertinent to the thinking of the Hagge Woods Trust is the fact that wood-meadow ecosystems include some of the most diverse plant communities on the planet,

with over 70 plant species per m² recorded in some systems (Peterken, 2013). They were also originally created and managed using a set of skills that are still familiar to farmers and land managers today, and are an excellent demonstration of how it is possible for humans to interact with ecosystems for their own benefit, whilst maintaining a high level of diversity (in terms of number of species). If we take lessons from one of the oldest forms of human land management, our attempt to recreate this ecosystem in the interests of biodiversity without significantly reducing productivity seems eminently achievable.

Creating a new wood-meadow ecosystem

Hagge Woods Trust's aim has been to plant a combination of permanent grassland and woodland with meadow margins that transition through a graduated, light-demanding edge of flowering and fruiting small trees and understorey shrubs to a high canopy of forest trees. The transitions where wood and meadow meet, and the rides and glades incorporated into the design, offer a range of niches and potential doubling of floral diversity, and create a perfect set of pollinator habitats. Collectively, our native trees, grasses and meadow perennials are host to a wealth of invertebrate life.

In the wake of a comprehensive site and soil survey undertaken for the Escrick Park Estate in 2010, we began to plan the wood-meadow creation work around what we knew we eventually wanted to achieve: a ground layer of fine meadow grasses and perennials based on the lowland meadows that were once characteristic of our location on the Ouse-Derwent floodplain. Mixes based on National Vegetation Classification (NVC) 'wet' (MG4) and 'dry' (MG5) grassland were sown with a nurse crop of cornfield annuals. The density of the resulting sward reduced ingress of undesirable weed species during the slower establishment period of the perennials. We used the NVC assemblages as a guide only. Critically, our seed mixes were formulated in pursuit of competitive balance, without which we could not have hoped to achieve botanical richness. They excluded vigorous, deep-rooting grasses usually seen in lowland meadows, such as cock's-foot, Yorkshire-fog and rye-grass. The concept of 'matched vigour' (as developed on our site, and based on Grime's C-S-R Triangle theory, (1979, 2012)) is especially important on fertile soil, and vital when planting trees directly into the sward. The perennials, in contrast, were selected for robustness, based on observations of species that thrive in selected rural verges in the same part of North Yorkshire – they are often all that remains of meadows past.

It is worth noting that the soil fertility at the Hagges Wood-Meadow site, at 72ppm of phosphate (Index 5), far exceeded the upper limit that is



← Far left: Copses were laid out in 'lazy-S' formation, with 2.5m between rows. Since meadow inevitably risks creating 'vole heaven', the trees are protected with 40cm wraps. *Lin Hawthorne*

← Left: Simple and inexpensive deer and rabbit fencing surrounds the site. In a wood-meadow scenario it has the advantage of allowing low growth on trees that are to be coppiced, and costs are little more than for guarding individual trees. *Lin Hawthorne*

usually recommended for meadow establishment (26–45ppm (Index 3)), and that the site had been in arable use for decades (the last barley crop was harvested in the summer of 2012). If we had waited until phosphate levels had fallen to within 'acceptable' limits, the project could have been delayed by twenty years or more. Instead, after the last barley harvest, the site was ploughed and a seedbed prepared in the usual agricultural manner. At this point, we employed the 'stale seedbed technique', which is frequently used for sowing sugar beet in the area – a major weapon in our armoury. In essence, this involves allowing a flush of weed species to germinate before spraying them off (with glyphosate), and very shallow drilling of seed directly into the aftermath, with minimal soil disturbance. Any weed seed present is likely to be in the top 2–3cm of soil, but is usually unable to germinate unless exposed to light. The aim of this technique is to minimise any subsequent infestation of the meadow crop by common, vigorous and competitive weed species: the docks, creeping thistle, and nettle that would compromise both meadow and woodland and preclude the establishment of desirable and less robust wildflowers and grasses.

Continuous rain during the winter of 2012–13 prevented immediate sowing (and sorely tested our patience), but in early May 2013 the seed was eventually rolled in. Our first Lammas cut (late July 2013) produced 89 bales of material (each weighing 400kg), and was regarded as a sacrificial 'crop'. It was inedible as hay for animals since it contained so much 'arable weed' – the conventional term for the cornfield annuals that we used as a nurse crop – but it did represent considerable biomass, and we suspect the removal of 35,600kg of material helped to reduce soil fertility. The regrowth between July and October 2013 was lush, and a second hay crop was taken in October 2013.

By December 2013, we had planted 10,000 native broadleaf trees (24 species of native tree, and 7 shrub species) into the close-mown sward, with some 40% planted by volunteers from the community. The trees have been planted in twelve mixed-species compartments, dispersed to form open glades and broad rides to maximise the area of woodland edge (the preferred habitat of up to 60% of woodland flora). We reserved 40% of open space as meadow. The disposition of open meadow and copses is designed for ease of access for hay cutting and baling with agricultural machinery; the irregularly shaped copses, rides and glades are wide and connected enough to allow for a tractor width. The areas within the copses are cut by brushcutter. We are confident that at maturity, and with sensitive thinning, we can achieve dual aims of naturalistic effect and practical management.

One of the major problems in planting new woodland for naturalistic effect is that random placings and spacings make subsequent management difficult. We also wanted to avoid the grid pattern of plantation. So the woody species were categorised into 'shrubby edge', 'light-demanding edge mix', and 'tall canopy species', and they were planted in formations of 'lazy-S' rows, marked out by sports-field liner 2.5m apart, with in-row spacings varying between 2.5m for larger species and 1m for shrubs. The naturalistic appearance will be further enhanced at the stage of first thinnings, and when the coppice cycle commences (depending on species, 10-to-25-year rotational coppice cycles are projected).

The management mantra

Whilst considerable attention was necessarily paid to the detail of design (from ground preparation to species selection), and clear communication of intent to practitioners, ultimately the key to the project's success lies in how the site is managed

Hagge Woods Trust

Hagge Woods Trust is a registered charity who aspire to the successful creation of woodland through more than the simple mass planting of trees.

Broadly, the objectives of the Trust are:

To research and practise the ecological and holistic creation of new native woodlands, properly structured from high canopy to shrub layer, including the establishment of a ground flora, thus addressing the threatened biodiversity of woodland and grassland wildflowers that once were typical of ancient woods and meadows.

To establish procedures and promote education in innovative practices in the creation and management of biodiverse woodlands on formerly arable land.

To provide open access for the benefit of the public, and to deliver woodland education by means of our website, and on site to schools, families and community groups.

Websites

Hagge Woods Trust: <http://www.haggewoodstrust.org.uk>

Three Hagges Wood-Meadow: <http://threehaggeswood-meadow.org.uk>



The brushcutter, an AS-Motor Sherpa, is used to cut between tree rows; it mulches finely and litter is left in place. The machine is slow but manoeuvrable, and the spring cut of inter-rows takes approximately 16 hours. *Lin Hawthorne*

↓ Ellie Mason, one of the young citizen scientists from the local community, took part in our small-mammal survey in the summer of 2014. Hagge Woods Trust have developed a site-specific educational programme in association with the Open Air Laboratories (OPAL) project at the Stockholm Environment Institute at the University of York. *Paul Mason*



into the future. Considered, consistent, timely and responsive is our mantra.

In brief, open meadow areas are managed for hay, and an annual Lammas cut (late July) will be followed by aftermath grazing – probably with Shropshire Down sheep – when the trees form a canopy and are large enough to withstand the company of grazers. The rides and inter-rows in wooded areas are managed by brushcutting, rotating around the compartments, leaving arisings *in situ*. This will ultimately increase the organic matter between the trees, and we are studying the effect of this on the development of woodland soil.

The brushcutting has two purposes: it controls the most competitive weed species around and between the trees (although by far the most effective tool in this respect is the clean start achieved by the ‘stale seedbed’ technique); it also prolongs the flowering period of the wood-meadow after the open areas are cut for hay. We have 60% of the site flowering on into October this year, to the benefit of invertebrate populations. It will take around 15–20 years before the canopy closes over and the flora beneath the trees changes significantly in

response to increasing shade; in the interim period, the differential cutting regime (between meadow and wood) ensures maximum provision of pollen, nectar and invertebrate host plants. We begin brushcutting in April, rotating round each copse in turn, with a final fairly close cut in late autumn, when grass growth has ceased.

The initial weed control – that is the spraying off of the stale seedbed before the meadow was sown – was the only time we applied glyphosate on site, other than spot treatment of occasional docks as necessary. Planting trees directly into the close-mown meadow that had been sown the previous May resulted in a very dense sward, its establishment much aided by the first-year nurse crop of annuals. This limited the ingress of weed species from seed. We chose not to spray the tree bases since this inevitably leaves bare soil into which ruderal/weed species will seed freely, and they compete far more strongly for light, water and nutrients than do the selected fine grasses in the seed mix. Our weed control is achieved by timely, consistent and responsive management rather than by chemical application.

Long-term tree growth will be monitored on selected 30×30m quadrats within the compartments. On such a small scale, our wood-meadow is unlikely ever to be hugely productive in terms of furniture-grade timber, but it will allow us to produce coppice products and provides a site for the teaching of this and other woodland skills. The project has open public access from dawn to dusk year round, and has been undertaken with the help of grants awarded in 2012, including a Farm Woodland Payment (FWPS) for land taken out of arable, and an English Woodland Grant Scheme (EWGS). The novel approach of undersowing with meadow flora carries a higher than usual establishment cost, but, based on our budget analyses and projections, is nevertheless possible within the grant award, indicating that it would be possible for other land managers and community projects to achieve wood-meadows elsewhere.

Research and the potential beyond Three Hagges Wood

The component parts of the wood-meadow ecosystem relate directly back to our concerns regarding the losses of meadow, hedgerow and ancient woodland in Britain during the last century. Recreating them offers an opportunity to start redressing those losses, and to leave the country’s natural capital in a better state. If applied in a tapestry across the rural landscape, the assemblage could help to create new nature networks and mosaics, and link existing isolated or fragmented habitats, without significant depletion of productive land. The methodology is also eminently suited to urban locations, pocket parks and community

wood-meadows. Hagge Woods Trust’s ambition is to see a wood-meadow in every parish!

Three Hagges Wood-Meadow is our model and prototype, and in our long-term interests of contributing to conservation and understanding of woodland management, it has also become our research base. We seek to produce robust evidence for the techniques and methodologies we have used, and are committed to monitoring changes in biodiversity that result from our work over the next ten years, by means of annual botanical, entomological, and small mammal surveys (data from surveys undertaken so far are available at: <http://threehaggeswoodmeadow.org.uk/resources>). We have already seen, within two years, a plant species count of 200 (up from a baseline of zero), and have recorded breeding populations of significant numbers of dependent pollinators and small mammals.

We aim to publish all our findings relating to the creation and development of the new ecosystem, both in book form and by means of our websites – open access to data is part of our mission. Part of our ongoing research is to investigate the effect of the arable-to-woodland transition on a whole ecosystem, and this will be undertaken in conjunction with NERC and the universities of Liverpool and York. Our seed mixes are being assessed at Liverpool for their resilience to climate change, while with York we have embarked on two studies on below-ground ecology, to monitor the impact of transition on soil microbial communities, soil physical chemistry, and nutrient recycling. The combination of data from Hagge Woods Trust above-ground studies with the below-ground data gleaned by Dr Kelly Redeker’s team at York, will give a rounded whole-ecosystem set. This is leading-edge research; very few studies have ever incorporated these disparate analyses. We have also engaged with Defra/Natural Capital Committee and the Economics for the Environment Consultancy (Eftec) to establish a baseline for the ecosystem-services value of the project. The report was published in October 2015 (see References and further reading box).

Every stage of the development of Three Hagges Wood-Meadow has brought surprises. The most remarkable of these is how straightforward the establishment – within two years – of a botanically rich and diverse environment has been. In terms of our primary aim to increase biodiversity on site, the speed with which wildlife populations have moved in to take advantage of their new ecosystem is a big cause for optimism for the future.

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↑ Pathways mown through the meadow allow examination of meadow species and their associates at close quarters. *Lin Hawthorne*