A RESEARCH PROJECT ON

Meadow Monitoring

IN DERBYSHIRE

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INTRODUCTION

Around 90% of European semi-natural grasslands were lost during the 20th century, driven principally by conversion to 'improved' grassland or arable land for agricultural use (Lawton, 2010). In Derbyshire 91% of the unimproved grasslands found in 1983 had disappeared by 1999 (Fuller, 1987; Lawton, 2010).

The complex plant communities of lowland grasslands are an invaluable 'life support' system for insects, pollinators, birds and mammals and have potentially contributed more to UK scientists' ecological knowledge that any other ecosystem, thanks to their high density of UK BAP priority species. Studies have also shown that more complex, diverse botanical composition can increase the effectiveness of other eco-system services, such as improving carbon sequestration, removing pollutants such as reactive nitrogen and even helping with pest control for adjacent farmland (Bullock et al., 2011; Plantlife, 2018).

Surveying in Belper Coppice meadow

Only since the start of the 21st century has habitat loss caused by changes in land use slowed down, partly thanks to legal protections on semi-natural grassland, 68% of which is now within Sites of Special Scientific Interest (SSSI) (Bullock et al., 2011). Evidence shows that the threats to semi-natural grassland have changed, and the biggest threats now are nitrogen deposition, fragmentation and lack of adequate conservation management, with only 21% of English non-SSSI grassland found to be in favourable condition (Hewins et al., 2005).

Projects such as the Wildlife Trusts' 'Living Landscapes' initiative and the agri-environment scheme ensure that habitat creation and restoration is strategic, with the aim of reconnecting isolated habitat fragments in order to protect local biodiversity. Over 3,500 ha of species-rich grassland have now been created since the launch of the UK Biodiversity Action Plan in 1995 (Lawton, 2010; Wildlife Trusts, 2018).

Although many projects use ecological surveying to define whether a meadow restoration or meadow creation project is successful, there is often a lack of investment in long-term monitoring and research, which could give important insights into the success of such projects, the best conservation management styles and how we define 'success' at all in this context (Lindenmayer and Likens, 2009; Bullock et al., 2011). These are important questions considering the limited resources available in the conservation sector.

Species-rich meadow known as 'The Water Meadow' in Derbyshire including *Dactylorhiza fuchsii, Rhinanthus minor, Anthoxanthum odoratum* and *Conopodium majus* © Charlie Fothergill 2022

DERBYSHIRE STUDY

This project looks at six different neutral lowland meadows in my local area of Derbyshire, all within a comparable character area and underlying geology (Derbyshire Peak Fringe and Coal Measures). I have chosen three species-rich semi-natural meadows and three meadows that were sown 5+ years ago, and in summer 2022 I completed over 100 quadrat surveys to compare plant communities between sites. The sites have varying designations (some are LWS or potential LWS, some are not), owners (private or council-owned) and management (whether hay-cut or grazed) which may prove to be significant explanatory variables.

Semi-natural grasslands

- **The Water Meadow** is a privately-owned LWS managed as a traditional hay meadow near Tibshelf with a rich mix of species, in 'favourable' condition
- **Hammersmith Meadows** is within a LWS near Ripley, with a rich, complex sward of species managed traditionally. Recorded as 'recovering' condition.
- **Carsington Water** lowland meadows, managed by Severn Trent, are not designed as LWS but part of a popular nature reserve. No recorded condition or surveys.

Created meadows

- **The Coppice** in Belper Park (LWS) was sown with a seed mix in 2007 with input from the Derbyshire Wildlife Trust. Seen as a 'success' when last surveyed in 2011
- **The Old Sheep Field** in Allestree Park (LNR) was created in 2014 also with input from Derbyshire Wildlife Trust. A survey in 2020 showed that it did not meet the LWS selection critera for area of created grassland.
- **The Whistling Meadow** near Tibshelf was re-seeded in the 1990s and is classified as a 'potential LWS'. Surveys in 1999-2005 did not find sufficient indicator species to designate it as a LWS.

Photos from Belper Coppice, a meadow created in 2009, including *Rhinanthus minor* - yellow rattle or the 'meadow-maker' plant © Charlie Fothergill 2022

METHODOLOGY

All sites were mapped in QGIS and a grid overlaid in order to select and record survey points using a stratified random sampling technique, with provisions made to reduce edge effects. Sites will be visited an equal number of times (with ten 2x2m quadrats recorded on each visit) with the goal of visiting at least five times, which will obtain 50 quadrats for each site. Every species is recorded for each quadrat, as well as percent cover estimated. Statistical analyses will be carried out using R.

LESSONS & CHALLENGES

Accompanied by *The Wildflower Key* by Rose, *Plants and Habitats* by Avery, *Grasses* by Hubbard and a number of other guides and books (including the excellent FSC fold-out guides) the three months during which I completed my summer surveys was brilliant for my identification skills. The project particularly pushed my knowledge of grasses - I became quick to recognise the usual suspects such as *Festuca rubra* and *Cynosurus cristatus* but I would also have some species pop up less regularly such as such as *Trisetum flavescens* and *Festuca arundinacea*, keeping me challenged. I also had the chance to learn the differences between vetches, clovers & trefoils, hawk-bits and many other groups.

Cynosurus cristatus and *Anthoxanthum odoratum*, typical grasses found in British NVC community MG5 (*Cynosurus cristatus - Centaurea nigra*) grassland © Charlie Fothergill 2022

Despite the fact that the overall species composition was generally that of an MG5 meadow, there was a surprising amount of variation between sites - one particularly damp meadow was scattered with *Silene flos-cuculi* and some dominating tufts of *Deschampsia cespitosa.* It also seemed to be a haven for cleg-flies, which caused me some grief along with the 30+ degree temperatures on the days I had set aside for surveying. As a result of the unusually hot couple of months, the meadows were also cut earlier than I expected, which left me unable to do a second visit to two of the sites this summer. On the bright side, it was also a haven for butterflies, moths and bees, which I enjoyed learning to identify at the same time. As I work at the Derbyshire Biological Records Centre, I was able to add all of my records to the DBRC database.

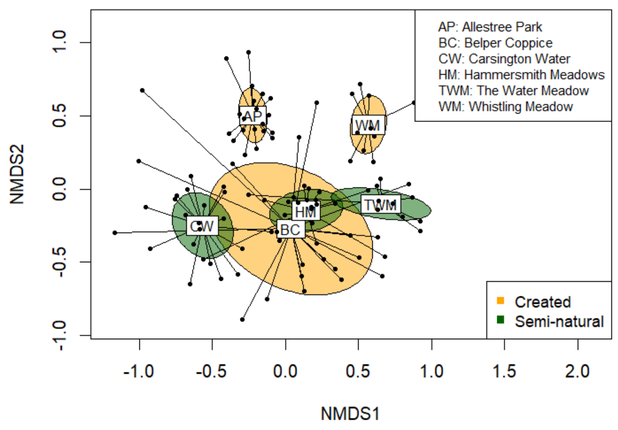
Overall, I'm glad to have started working on my final master's project a year early. It means that I'll have time to continue surveying in the spring and summer 2023, increasing and evening out the number of visits to each site and dealing with any issues I had this year. Plus, most importantly, I've strengthened my identification skills - meaning I should be a lot faster at the surveys next year.

INITIAL RESULTS

Variation in meadow plant communities

Some initial tests using R revealed significant differences in the plant communities both between individual sites and between the created and semi-natural sites. This chart represents the six sites surveyed and shows that the plant communities in Allestree Park and the Whistling Meadow were the most distinct from the others - because the standard deviation around each cluster centroid for these two sites do not overlap with any other site. These sites are both 'created' meadows. The semi-natural meadows were generally closer in community composition to each other (because the standard deviations overlap) - although Belper Coppice is the exception, overlapping with all three semi-natural meadow communities. This suggests Belper Coppice could have the most naturalistic meadow community out of the created meadows.

Figure 1: Non-metric multi-dimensional scaling (NDMS ordination stress=0.23) **plot showing that the meadow plant community composition differed significantly between the surveyed sites** ($F_{5,94}=13.5$, $P=0.001$)**. Differences between sites explained 41% of the variation in meadow plant community composition.**



NEXT STEPS

It took longer than expected to set up the project this year - including identifying and gaining permissions to access six appropriate sites, establishing a methodology, learning to map the sites in QGIS, and writing a research proposal & risk assessment. I'm looking forward in 2023 to being able to focus more on my field surveys, and will be able to start earlier in the season and capture some of the earlier species, such as *Primula veris*.

Over the winter I will start a deep dive into the academic research on this topic and will begin working on my literature review and the introduction for my paper. I'm also planning to use the data I have gathered so far to write some analysis using RStudio, both to get an idea of what the data is indicating and so that the some of the code is written ready to plug in the full dataset next summer. I'm also planning to do a bit more study around some of the trickiest plant groups that I struggled with over the summer while I have more time this winter.

Once I finish my field surveys in July 2023 (when the hay meadows are cut) I will have until September 2023 to write up the full paper including the results and discussion sections. Once the project is completed, I will be submitting the results to BSBI's journal 'British & Irish Botany. Finally, many of the land owners and managers of the sites I am studying are interested in knowing more about the condition of their meadows, and I plan to talk to them about how I can report the results in a format that works for them.

Lotus corniculatus - bird's foot trefoil, a positive meadow indicator © Charlie Fothergill 2022

SUPERVISION & SUPPORT

The project is under the supervision of Dr. Emma Coulthard from Manchester Metropolitan University, with support from the Derbyshire Wildlife Trust. This project has benefited from a BSBI 'Plant Study Grant' based on the project's contribution to a better understanding of the British and Irish flora.

Botanical Society of Britain & Ireland

Manchester Metropolitan University

Derbyshire Wildlife Trust

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