

MSc Environmental conservation and management

ACFA 7004 – Postgraduate research methodology

A Research Proposal

The development of a model to be used as a communication tool for decision making in amenity grassland management.



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Introduction

There are many different pressures on land managers at public authorities such as local councils to manage their amenity grasslands differently, and these are summarised by the diagram in figure 1.

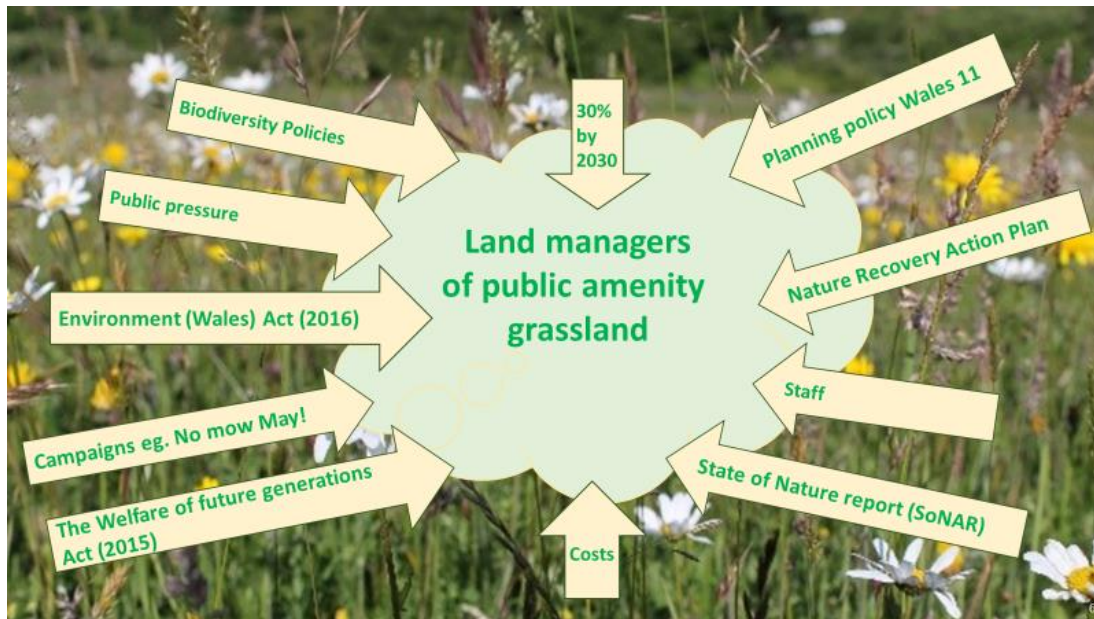


Figure 1 - An infographic showing the pressure on amenity grassland managers (Carter, 2023)

Welsh Government legislation arising from both the UN SDGs and EU directives mean that local authorities (LAs) have a legislative duty to embed biodiversity in all decision making, and report on efforts to increase ecosystem resilience (*Environment (Wales) Act 2016*).

This research will support the aims of some key legislation in Wales which is mirrored across the UK and internationally. The increase in botanical diversity created by no mow methods could meet the objectives of UN SDG 14, Section 6 of The Environment Act (Wales) 2016, The Welfare of Future Generations Act 2015 and the Nature Recovery Action plan (NRAP) objectives. In particular, LAs managing amenity grassland are required to meet the Section 6 duty of the Environment Act, aligned with the DECCA framework (Diversity, Extent, Condition, Connectivity, and Aspects of ecosystem resilience). No-Mow methods could offer a simple cost effective method of meeting these duties.

The introduction of a cut and collect method of land management across amenity grassland is therefore an attractive option for many public authorities. The comparison of the traditional and cut and collect methods is shown below in figure 2.

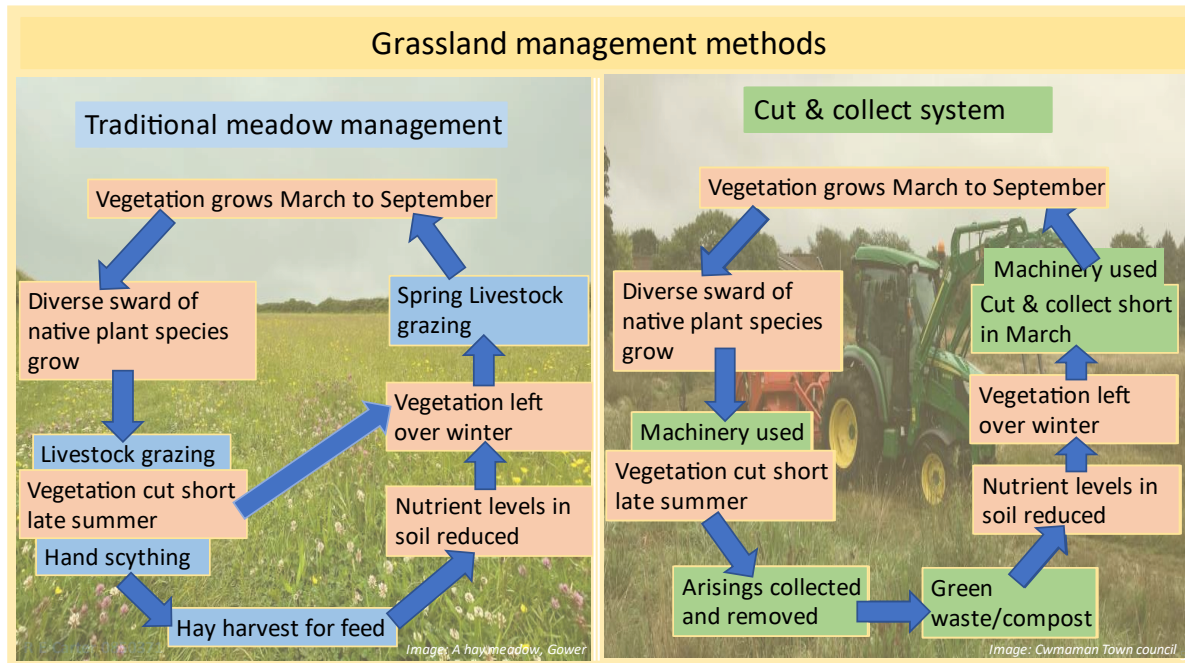


Figure 2- Comparisons between traditional hay meadow management and the cut and collect mowing method (Carter, 2023)

By replicating the grazing impact of animals such as sheep, horses and cows, a species rich meadow can be created at amenity grassland sites and road verges by reducing dominant grasses and scrub and exposing soil (poaching) by trampling and grazing.

Local authorities leaving grass to grow throughout the summer can cause conflict with residents and other stakeholders. This can lead to complaints and the increased change of LAs cutting too early to reduce complaints. It may be beneficial if LAs and their residents could understand what to expect from such management changes and it may be useful to have clear guidance on the change on both the botanical diversity and abundance that can be expected. This idea has led to the development of this research proposal and the hypothesis below:

Hypothesis

We can predict the plant species diversity changes following a change to a ‘Cut & Collect’ mowing method with a cut twice per year to produce a model of these changes to inform best practice.

Collecting data from local authorities in Wales already engaging in these changes to mowing could produce a model for meadow creation. This could aid management decision making by explaining the process of change in botanical diversity and the importance of the species to biodiversity and the resilience of ecosystems. Research into observed changes in plant diversity and abundance on amenity grassland in Wales have not been fully explored and this research proposal would aim to provide reliable data that could be used for future management guidance in Wales and beyond. The parameters of this research will be confined to public amenity grasslands in Wales and the policies and procedures available to local authorities in Wales. The research and rationale will be informed from a broad scope of UK and international research into grassland restoration.

Aims and Objectives

	Aims	Objectives
1	To conduct a literature review on current research and guidance into the benefits of managing amenity grassland to increase the area of species diverse grasslands and their value to pollinators.	To understand the importance of increasing the area of species rich meadow like grasslands and the value to pollinators and ecosystem services.
2	To collect and analyse primary and secondary data on amenity grassland under a cut & collect twice per year management plan.	To map the changes in species diversity and abundance over time in different areas across Wales that have been managed under a cut &

- | | |
|---|---|
| | collect system. Assess the value as foraging habitat for pollinators using an accepted index. |
| 3 | <p>To observe and analyse the changes to plant species diversity and abundance over time.</p> <p>To construct a model of plant species diversity changes that may be observed following a change to a cut & collect management system. Producing clear pictorial guidance for land managers on best practice and the potential value of making these changes.</p> |

Literary review

In the UK, wildflower meadows declined by 97% between the 1930s and 1984 (Fuller et al, 1987), and to support a diverse population of pollinating insects it is important that there is pollen and nectar available throughout the summer months. Semi natural hay meadows are one of the most important sources of forage for pollinators so vital to ecosystem services (Line et al, 2019)

There have been many studies into the restoration of species rich grassland and semi-natural hay meadows, and many have shown that increases in soil fertility from farmyard practices such as the addition of chemical fertilizers or spreading of manure can cause a decline in species diversity. This increased fertility favours fast growing species which can crowd out and out-compete native wildflowers such as scabious, orchids and knapweed. (Critchley et al, 2002; Janssens et al, 1998). High fertility causes tough grass species to dominate the sward and inhibit growth of species important for nectar and pollen production so vital to supporting pollinators.

According to the State of UK butterflies report 2022, there has been a 25% decline in overall butterfly species numbers since 1993 (Fox et al, 2023) The Welsh Government value the loss of pollinator services as high as £1.8 billion per year to the agricultural industry (Welsh Government, 2018)

Research by Larsson and Franzen (2007) showed that many bee species rely on considerable amounts of pollen for their reproduction and that any reduction in flower resources by mowing of amenity grassland and road verges etc could have significant negative effects on their populations.

As well as the importance to pollinators, having species rich grasslands can fulfil important ecosystem functions such as food for livestock, protection of soil, reducing surface water runoff, carbon sequestration and provide aesthetic appeal. (Carlier et al, 2009, Hönigová et al, 2012, Gossner et al, 2016, Simons et al, 2017) There are also well recognised health and welfare benefits to humans (Fuller et al, 2007).

In urban areas the public park movement started in the 1830s and was born out of a desire to improve the health and welfare of urban populations in polluted industrial communities. Between 1885 -1914 large numbers of green spaces were gifted to communities and local authorities for the public use for a variety of activities (Jordan, 1994). These amenity grasslands have historically been managed as ‘neat’ public spaces with well mown lawns, the use of pesticides and herbicides seeding with commercial grass seed (Jordan, 1994). Many of these park spaces are used for sport and recreation and as such may have to be maintained along regulatory guidelines for health and safety e.g., Football and cricket pitches. The Welsh Government define amenity grassland as ‘An open grassy area (park, playing field, green space) used by the public.’ (Welsh Government, 2022) and by Norton et al (2019) as frequently mown short-sward grassland that is managed for recreation. Amenity grassland has been estimated to cover 25% of U.K. urban land area (Evans et al, 2009). Recently there has been a movement to change the management of these amenity spaces to replicate the lost traditional hay meadows that were once a common feature of communities. These open spaces would have been traditionally managed with grazing animals and hay harvest. Welsh government guidance advises that ‘Cut and collect’ mowing methods can replicate traditional hay meadow management and create species rich grasslands in our towns and cities. (Welsh Government, 2022) This has been supported by funding schemes such as ‘Local Places for Nature’ which provides capital funding to local authorities to manage their green spaces in this way.

Internationally there have been efforts to restore natural and semi natural grasslands and hay meadows by using a mixture of grazing and mowing methods, as well as through green hay and seed applications. In 2019, Plantlife UK launched its 'No Mow May' campaign, encouraging the public as well as local authorities to stop mowing for the month of May. The effect on pollen and nectar resources was shown to be limited, with the most pollen and nectar being recorded in June (Hemings et al, 2022). This research looked at 30 'No mow May' sites in Cirencester and calculate their pollen and nectar yields.

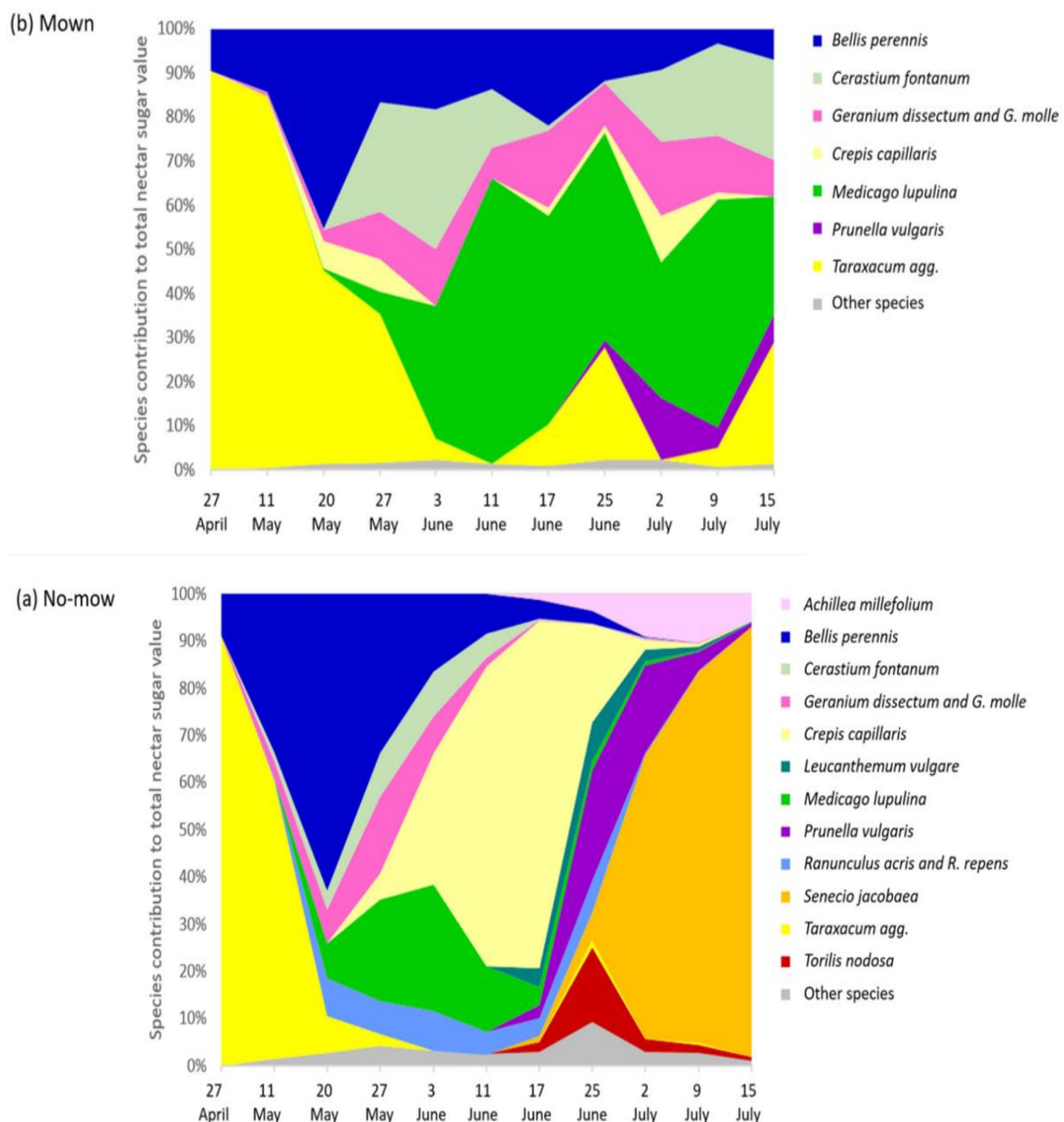


Figure 3 – A comparison of plant diversity between No-Mow and Mow sites, Hemings et al, 2022

As shown in Figure 3, plant diversity and nectar and pollen resources were greatest on the 'No-Mow' sites after June.

Key findings - May - 'No Mow' plots yielded 3 x the nectar of traditionally mown sites.

Mid-June – This increased to 8 x the nectar value.

There is more nectar value to pollinators if 'No Mow' is extended through until the end June. The resulting increase in botanical and structural diversity and the resulting variety in sward height has been shown to potentially increase pollinator habitats (Garbuzov et al, 2015)

In 2016 Hicks et al undertook research into the resource value of annual and perennial seeded meadows. The findings showed that perennial meadows seed mixes produced 20 times more nectar than annual seed meadow mixes, and that the native 'weeds' naturally present produced 3000 times the pollen of both seed mix species. Griffiths-Lee, Nicholls and Gouber, 2022 found that even a mini meadow of 4m² could attract 111% more bumblebees and 87% more solitary bees than regularly mown grassland. These species rich meadows are vital to provide nesting capacity and forage to pollinators. (Splitt et al, 2021). Habitat loss and fragmentation through expanding urbanisation is a significant driver of this habitat loss for pollinators (Vie et al, 2019; Ganser et al, 2019).

Significant plant species have been identified as being important in meadow restorations. Research by Pywell et al (2002; 2004) showed the importance of *Rhinanthus minor* (Yellow rattle) in the increase in species richness by reducing the dominance of some non-favourable grass species. Yellow rattle is a hemi-parasitic herbaceous annual that grows from the roots of common amenity grass species such as *Poaceae* (barley and rye grasses). Pywell et al, 2003 also identified 10 key species that could drive meadow restoration but stressed the importance that meadows should be restored using naturally propagated, localised populations to reduce uniformity in restored meadows.

It is also important to consider that some plant species show species specificity. Plants such as *Lathyrus pratensis* (Meadow vetchling) was identified as attracting mainly *Bombus terrestris* (buff tailed bumblebee) with 87% of visits being from this particular bee species (Dicks et al, 2002). Other species noted in this research are *Succisa pratensis* (Devil's bit scabious) and *Senecio jacobaea* (Common ragwort) both species are vital for obligate species

such as Marsh fritillary butterfly and cinnabar moth respectively to complete their life cycles (Dicks et al, 2002).

The literary review identifies the vital role that species rich grassland could play in supporting pollinator species and other fauna. There is also a demonstratable commonality in species in the different grassland types. The restoration and creation of species rich meadows could be of high conservation importance in Wales because of the diverse floral and faunal assemblages they support. (Duffey et al, 1974)

Methodology

Data will be collected from secondary sources across Wales from the following sources:

- Plant life Cymru
- National botanic gardens of Wales
- Torfaen County Council
- Neath - Port Talbot County council
- Carmarthenshire meadows group
- Monmouthshire meadows group
- Flintshire county council
- Big meadow search

As a variety of survey methods will have been used to collect the data, mostly a species list and DAFOR scale or the Plant life UK Rapid assessment (RA) method or variant thereof (See Appendix 1).

To create a commonality in the data, the common plant species recorded will be plotted against time since a change in mowing methods. There will be an emphasis placed on the important plant indicator species for each grassland type. The plant species provided in the RA handbook will be adapted to suit the locally abundant species in each area.

Grassland types:

- Lowland meadows
- Upland hay meadow

- Floodplain meadows
- Sedge pasture
- Calcareous grassland
- Rush pasture

Grassland will be categorised by the indicator species present as defined by the Rapid assessment handbook (Plantlife UK)

Primary data will be collected using the RA method during the optimal time of year on a small number of amenity sites that are 3 years post-change in management. This will be collected using 1m x 1m quadrats at a W pattern across the site. Each quadrat will be surveyed using the prescribed RA method and DAFOR scale.

Figure 4 shows an example of the kind of data that will be collected during each survey.

Site:				PD101																												
Time since cut and collect introduced?				1	Positive indicator species (high quality)																		Negative indicator species (lower quality)									
Quadrat no.	Grid reference	Is sward height <15cm	Is the cover of herbs and sedges >50%?	<5% bare ground?	common birds foot trefoil	comon knapweed	common rock rose	dwarf thistle	fairy flax	fied scabious	lady's bedstraw	harebell	milwort	red clover	ribwort plantain	rough hawkbit	salad burnet	self heal	thyme	wild basil	quaking grass	shepps red fescue	Positive indicator score /18	comon nettle	Docks	Creeping thistle	Ragwort	less than 10% false wood brome/for-grass?	Negative indicator score /5	Total score /18		
1		1	1	0	0	0	0	0	0	1	1	1	0	0	1	1	1	1	1	0	1	1	10	0	1	1	1	0	3	7		
2		0	1	0	1	1	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	6	0	0	0	0	0	0	6		
3		0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	1	0	0	0	4	1	1	0	0	0	2	7		
4		1	0	1	0	0	0	1	0	1	0	0	0	0	1	1	0	1	1	0	0	1	7	0	1	1	0	0	0	2	9	
5		1	1	1	0	1	0	0	0	1	1	0	0	0	1	0	0	1	0	0	0	0	5	0	0	0	0	0	0	5		
6		1	1	0	1	1	0	0	0	0	1	0	0	0	1	1	0	1	1	0	0	1	8	1	1	0	0	0	0	2	6	
7		1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	1	4	1	0	0	0	0	1	3		
8		1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	2	1	1	0	0	0	0	2	6	
9		0	0	0	1	1	0	0	0	1	1	0	0	0	0	1	1	0	1	1	0	0	8	0	1	0	1	0	0	2	6	
10		0	0	0	0	0	0	0	0	0	1	1	0	0	1	1	1	1	1	0	0	0	8	0	1	1	0	0	0	2	6	
11		1	1	1	0	0	0	0	0	0	1	1	0	0	0	1	0	1	1	0	1	0	7	0	0	0	0	0	0	0	7	
12		1	0	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	4	1	1	0	0	0	0	2	2	
13		0	1	1	1	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	0	0	1	6	0	1	1	0	0	0	2	4
14		0	0	1	0	1	0	0	0	0	1	1	0	0	1	1	0	1	1	0	1	0	8	0	1	0	0	0	0	1	7	
15		1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	0	0	0	4	1	1	0	0	0	0	2	2	
16		1	1	0	0	0	0	0	0	1	0	1	0	0	1	1	1	1	1	0	0	1	8	0	0	0	0	0	0	0	8	
17		1	1	0	0	0	0	0	0	0	1	1	0	0	1	0	0	1	1	0	0	0	5	0	0	1	0	0	0	1	4	
18		0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	3	1	1	0	0	0	0	2	1	
19		0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	2	-1	
20		1	1	0	1	0	0	0	0	1	1	0	0	0	1	1	0	1	1	0	0	1	8	0	1	0	0	0	0	1	7	
Positive indicator species present on site?					1	1	1	1	0	1	1	1	0	0	1	1	1	1	1	0	1	1										
																						Total positive score =					116					
																						Relative value =					24%					
																						Total score for site=					87					

Figure 4 - Data collection based on the Rapid assessment method developed by Plantlife UK.

The data will be codified using a binary scale, this will aid analysis. A relative value can be collected as a percentage of the maximum score for positive indicator species to provide an indicator of the quality of each site. As multiple data sets will be recorded there is a testing using methods outlined by Hurlburt, (2004) should be undertaken during analysis.

Data analysis

The data for each site will be collated and the presence of positive indicator species will be plotted over time to show how plant species changes evolve as soil fertility reduces, and the dominance of negative indicator species reduce. The relative value gives an indication of the quality of the grassland with higher scores being more favourable. A model will be constructed based on the changes for the different grassland types. The model can be used to inform stakeholders and land managers of the expected timescale for change and increase confidence in the process of grassland restoration. The model can be used as an essential communication tool with communities to manage expectations, explain the benefits to pollinators and as an onsite display for interpretation. This model will be used alongside existing strategies such as the 'Its for them' stakeholder tool kit. (Appendix 2). An example of the model, expected to be created as a result of data analysis is shown in figure 5. Colloquial and common names for botanical species and photographic and infographic representation will be used to maximise engagement with the model. Public participation in the planning process and decision making can greatly increase the success of such planning decisions by local authorities (Rall et al, 2019).

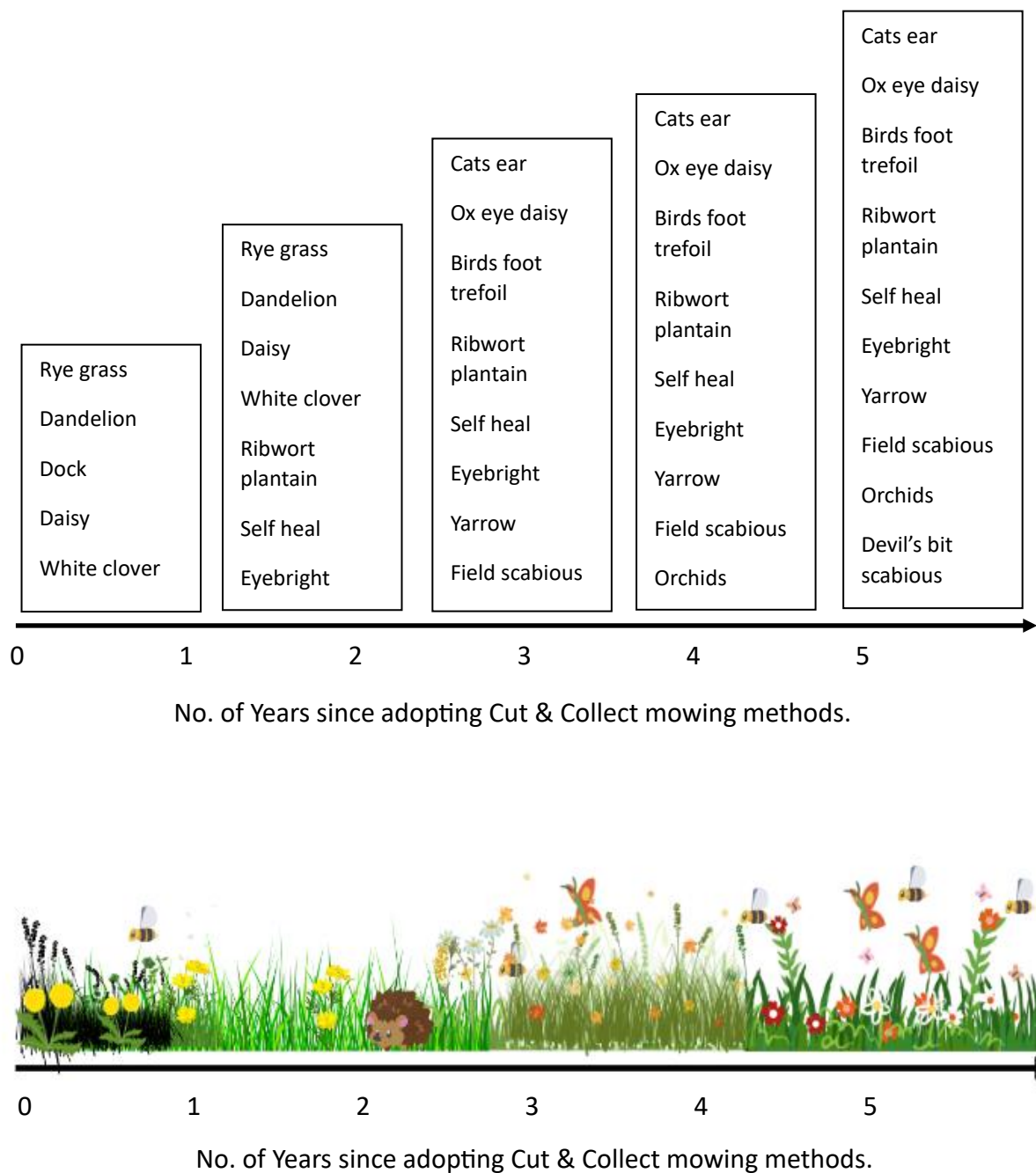


Figure 5 - The proposed models of species rich grassland development on amenity grassland.

Data limitations

The variability of data may cause some problems with the analysis and reliability of the data collated. Some data will have been collected via citizen science schemes such as the 'Big meadow search' and there is a risk of misidentification. Another limitation is the time scale for data collected may not be equal across the data sets. Some data has been collected over 1-2 years and others over more than 5 years. Collecting a wide range of data may account for any gaps in data.

Each site will display variables that may be difficult to control such as:

- Topography
- Microclimate
- Soil type
- Previous management
- Disturbance or disruption.

Each site has the potential to have been managed differently before adopting cut and collect. This may have involved the use of pesticides and fertilisers, and methods of mowing such as previous regular cut and collect or cut and fly. This historical management could affect the seed bank and baseline floral diversity. The model would seek to give a general expectation for areas that have been managed most intensively.

Data analysis

Results for the sites will be digitised in Boolean form using a simple spreadsheet software application. Statistical analysis on the data collected will be confined to the Baseline surveys and repeat monitoring surveys for the amenity grasslands withing the scope of the investigation. Data will be organised into scatter plots of increasing quality of plant species over time. Statistical analysis to test strength of correlation will be applied using slope value calculations, R values/correlation values and then to assess distribution standard deviation and standard error will be calculated and evaluated. The Positive Indicator Species Score, Negative Indicator Species Score, and the Ellenberg Fertility Score (N) for each data set will also be evaluated.

Expected results.

Aim 1

To conduct a literature review on current research and guidance into the benefits of managing amenity grassland to increase the area of species diverse grasslands and their value to pollinators.

Current and relevant research will be thoroughly analysed, and key researchers identified. All literature will be scrutinised, and methodologies and observations critically reviewed using the CRAAP matrix (Appendix 3, Appendix 4)

Aim 2

To collect and analyse primary and secondary data on amenity grassland under a cut & collect twice per year management plan.

Data will be collated from the sources listed and recognisable patterns will be identified and recorded. There will be an obvious trend observed in the plant species observed with increasing time. Some anomalies will be recorded and variables such as microclimate, topography and soil type will be recorded. The research undertaken will build on previous findings and theories, developing the body of knowledge on species rich grassland restoration techniques. The research will enrich the body of knowledge of using amenity grassland for meadow restoration and creation.

Aim 3

To observe and analyse the changes to plant species diversity and abundance over time.

A model will be constructed which will educate and inform key stakeholders in amenity grassland management. This can be used as a communication tool to explain and improve understanding of increasing the area of species rich grassland.

The research parameters are specific, measurable, and achievable in the time available for completion with data collection taking place over the optimal survey season, and data collation, analysis and evaluation following. The approximate timetable for the completion of the dissertation is outlined in the Gantt diagram shown in Figure 6.

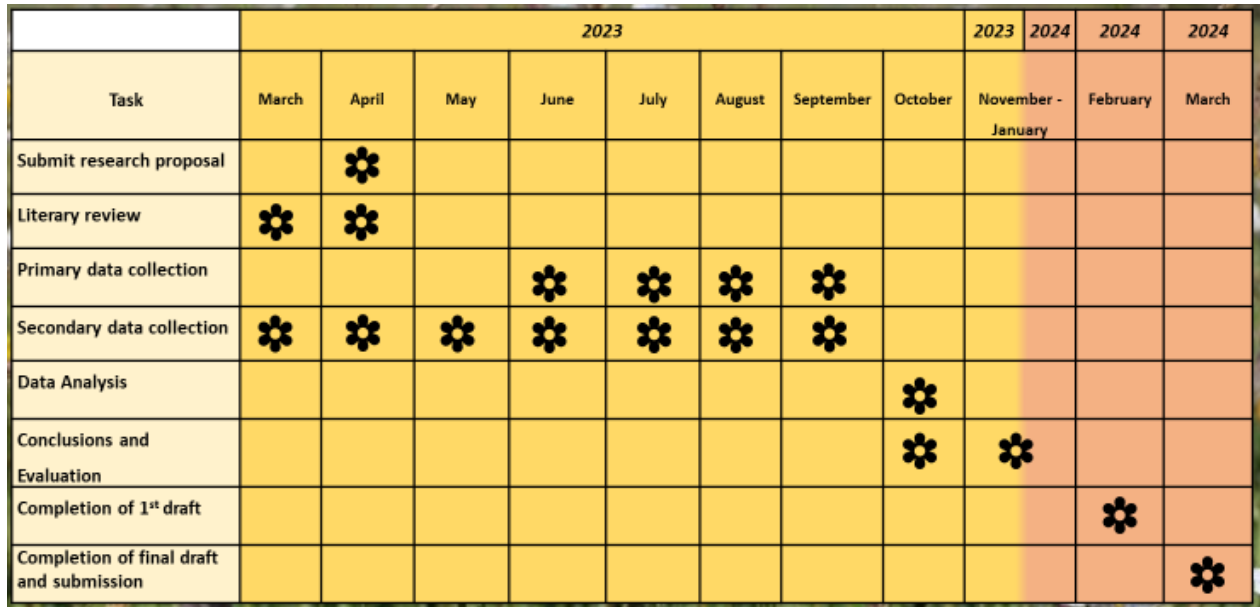


Figure 6 - Gantt chart showing the timeline for the research.

Conclusion

The population of vital pollinator species are declining across the world. These pollinators provide essential ecosystem services to agriculture. In Wales alone this could be worth as much as £1.8billion (Welsh Government, 2013) if hand pollination had to replace natural pollination. This recorded decline has been attributed to many causes including the decline in forage and pollinator resources such as pollen and nectar. (Powney *et al*, 2019). It has been estimated that 97% of species rich meadows were lost between 1930 and 1984 in England and Wales (Fuller, 1986). These diverse grasslands are of high conservation importance due to the diversity of floral and fauna present (Duffey *et al*, 1974) and were once widespread over much of western Europe (Van Dijk, 1991). Their loss has been partly attributed to an increase in high intensity farming practices and use of herbicides (Pywell, 2002). There has been a great deal of research into the restoration of meadows on depleted grasslands, arable land, and improved agricultural land across the world but at a local level

there is little data is available on the efficacy and benefits of creating species rich meadows on our urban amenity grasslands.

Recent UK biodiversity action plans and legislation have reflected the need to restore these important habitats, and in Wales, emphasis has been placed on increasing plant diversity on amenity grasslands and road verges where possible. The 'No Mow' movement started by Plantlife UK in 2018 mainly in domestic gardens have been shown to increase pollinator habitat as well increase the structural diversity on grassland by introducing variety in sward height. (Garbuzov *et al*, 2015)

These popular campaigns have been shown to increase early-season forage resources for pollinators in urban green spaces however Land managers have to balance the benefits to biodiversity with economic pressures and providing accessible amenity spaces for recreation (Hemmings *et al*, 2022) The research done by Hemmings *et al*, 2022 showed the importance of extending 'No-Mow' schemes into June to protect the highest pollen and nectar resources. This method has also been proven to increase early season floral diversity, and abundance in domestic lawns which when expanded to amenity spaces could support a greater population of bees (Hemmings *et al*, 2022).

The expansion of 'No-Mow' into cut and collect across the Spring and summer requires key stakeholders to be engaged and supportive. It is important that land managers understand the importance of the work they are being asked to carry out and so that this can be effectively communicated to the public. The data collected during this research will enable to the production of a model to illustrate the expected changes, educate, and inform decision makers and manage expectations following a change to cut and collect methods on amenity grassland.

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Appendices

Appendix 1

[Microsoft Word - How to design, undertake and analyse rapid assessment FINAL.docx](#)
[\(magnificentmeadows.org.uk\)](#)

Appendix 2

[It's for Them campaign: stakeholder toolkit | GOV.WALES](#)

Appendix 3

Evaluating Resources: the CRAPP TEST

Introduction

- This is a useful starting point to assessing the relevance and authority of any paper/information.
- Select an article from an assignment/your research proposal topic.
- Go through the following questions to develop your skill of evaluating the quality and applicability of the source.

Cite the source you are evaluating:

- Harvard reference in full.
- Hyperlink to source or pdf
- Did you use a library accessible database? Which?

Currency: the timeliness of the information

- When was the information published or posted?
- Has the information been revised or updated?
- Is the information current or out-of date for your topic?
- Are the links functional

Relevance: the importance of the information for your needs

- Does the information relate to your topic or answer your question?
- Who is the intended audience?
- Is the information at an appropriate level (i.e. not too elementary or advanced for your needs)?
- Have you looked at a variety of sources before determining this is one you will use?
- Would you be comfortable using this source for a research paper?

Authority: the source of the information

- Who is the author/publisher/source/sponsor?
- Are the author's credentials or organisational affiliations given?
- What are the author's credentials or organisational affiliations given?
- What are the author's qualifications to write on the topic?

- Is there contact information, such as a publisher or e-mail address?
- Does the URL reveal anything about the author or source? Examples:
 - com (commercial),
 - .edu (educational),
 - .gov government),
 - .org (nonprofit organization),
 - or .net (network)
- Is there an Impact Factor to the Journal?

Accuracy: the reliability, truthfulness, and correctness of the content

- Where does the information come from?
- Is the information supported by evidence?
- Has the information been reviewed or refereed?
- Can you verify any of the information in another source or from personal knowledge?
- Does the language or tone seem biased and free of emotion?
- Are there spelling, grammar, or other typographical errors?

Purpose: the reason the information exists

- What is the purpose of the information? To inform? Teach? Sell? Entertain? Persuade?
- Do the authors/sponsors make their intentions or purpose clear?
- Is the information fact? Opinion? Propaganda?
- Does the point of view appear objective and impartial?
- Are there political, ideological, cultural, religious, institutional, or personal biases?
- What is the science?

After evaluating this source, do you think you will use it for your paper? Why or why not? If you are not sure, explain why.

Chris House adapted from Benedictine University 2020

Appendix 4

CRAAP Test for evaluation of resources								
Citation	Link	Source	Currency	Relevance	Authority	Accuracy	Purpose	Inclusion in research?