European Innovation Partnership (EIP) Wales

Pasture for Pollinators

Final report

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Executive summary

The Pasture for Pollinators project looks at how dairy farmers can manage their forage resources to conserve and enhance populations of pollinators, bumblebees in particular, as an integral part of their commercial production systems.

The practical work is based on six organic farms, all part of Calon Wen Organic Milk Cooperative, based in north east Wales, Ceredigion and Pembrokeshire. Management practices included:

- Using a **specialised seed mixture** (Dual purpose four year herbal ley from Cotswold Seeds) which included flowering species such as: bird's-foot trefoil; clovers (red, white, sweet and alsike); yarrow; and chicory. Where possible and appropriate these were compared to 'standard leys' based predominantly on rye grass and clover.
- **Leaving uncut field margins**. When the fields were cut for silage/ grazed, a 4 metre (m) strip down one side of the field, at least 100m long, was left uncut/ un-grazed to provide a refuge for pollinators. This strip was allowed to mature, and cut/ grazed when the next silage cuts were taken/ the field grazed down; when an uncut margin was left the opposite side of the field. This was carried out from first silage cuts/ grazing through to the last cuts/ grazing to help provide continuous forage for pollinators.
- **Habitat management:** Opportunities to manage other habitats on the farm (e,g, hedgerow, deferred grazing on unimproved or semi-improved pastures) were identified.

In each data collection season, two surveys were carried out on each of the farms, although in 2020 some surveys were not undertaken because of COVID 19 restrictions. The surveys were carried out by Bumblebee Conservation Trust researchers Anna Hobbs and Sinead Lynch. Transects were carried out on both standard and herbal leys on: margins left uncut/ un-grazed after cutting/ grazing; and cut/ grazed margins on the opposite side of the cut/ grazed field to the uncut/ un-grazed margin. In addition, plant surveys were undertaken by placing fifteen 1m x1m quadrats in each margin and listing plants used as a nectar or pollen source by pollinators; and estimating percentage cover and counting the number of floral units for each plant species.

In addition, potential habitat for bumblebees and other pollinators was noted during the site visits, or additional whole farm surveys.

The data showed higher numbers of individual bumblebees and other pollinators, and numbers of pollinator species were recorded in uncut/ un-grazed agricultural ley margins compared to cut/ grazed ley margins when surveyed within two weeks of silage being cut/ grazing. The results indicate that leaving uncut/ un-grazed margins in agricultural ley fields could help support bumblebee and other pollinator populations, especially in terms of 'bridging gaps' in forage (nectar and pollen resources) during the season when a continuous supply of forage is required by these species (from around March through to October).

Whether the diverse herbal leys attract a greater of number of pollinator species compared to standard rye grass/ clover leys was less clear. Research elsewhere has indicated that this is the case. It was only possible to make direct comparisons on some of the farms. On the farms where a comparison was made, in some instances there was a greater abundance and diversity of pollinators on the project mix; in other cases the reverse was true; and on a number of occasions there was no detectable difference. Reasons for this may include: the fact that it was not possible to survey both leys on the same day; and farms using their own herbal mixes instead of standard rye grass clover leys, and the 'standard' leys being as rich floristically, or richer, than the project herbal ley.

The whole farm surveys identified a range of habitats that could support bumblebees and other pollinators, including: unimproved and semi-improved grasslands, e.g. hay meadows, hedgerows, bare earth, tussocky grass, hedge banks, woodland margins, trackside verges, ditches and scrub. Recommendations were made on a farm specific basis to manage these habitats to enhance pollinator populations.

This project has generated a substantial amount of interest, and considerable effort has gone into communicating the project and its findings, including preparation of knowledge exchange materials, media campaigns (broadcast, print and social), presentations at conferences and events, and on farm open days.

Contents

1. Introduction

The Pasture for Pollinators project looked at how dairy farmers can manage their forage resources to conserve and enhance populations of pollinators, bumblebees in particular, as an integral part of their commercial production systems. It is managed by an Operational group that includes six farmers, all members of the Calon Wen Organic Milk Co-operative, and RSBP Cymru, with technical expertise being provided by the Bumblebee Conservation Trust.

The project ran from 1 January 2018 to 31 December 2020. This report

- Details the project methodology
- Summarises the results
- Reports on the knowledge exchange
- Highlights some of the lessons learned

2. Project outline

2.1 Participating farms

The practical work was based on six organic farms in Flintshire, Wrexham, Ceredigion and Pembrokeshire.

2.2 Management options

2.21 Specialised seed mixtures

It was intended that each farm would establish at least 1 ha of a dual purpose four year herbal ley from Cotswold Seeds which included the following species:

- Bird's-foot trefoil
- Clovers (red, white, sweet and alsike)
- Yarrow
- Chicory

Additionally, a standard rye grass/ clover ley was to be established at the same time as a comparison/ control 'plot', or an existing rye/ clover ley identified as the 'control'. In one case, the farmer was already only using herbal leys, and the comparison plot identified is an older herbal ley. Two farmers did not plant the project ley. On one of these farms, an existing multi-species herbal ley, similar to the project ley, was compared with an old rye/ clover ley. On the other farm, a new rye grass/ clover mix was planted in place of the herbal ley and that was compared with an older clover ley. On another farm, the herbal project ley has been compared with a lucerne/ white clover ley.

2.22 Leaving uncut field margins

When the fields (both herbal and standard leys) were cut for silage/ grazed, a 4m strip down one side of the field, at least 100m long, was left uncut/ un-grazed to provide a refuge for pollinators. This strip was allowed to mature, and cut/ grazed when the next silage cuts were taken/ the field grazed down; and an uncut/ un-grazed margin left on the opposite side of the field.

2.23 Habitat management

Opportunities to manage other habitats on the farm (e,g, introducing rotational management of hedgerows, deferred grazing on unimproved or semi-improved pastures) were identified and farmers have started to implement these.

2.3 Data collection

2.31 Field & field margin surveys

In each data collection season, two surveys were carried out on each of the farms, where the farmers had managed to leave the margins. N.B. In year 1, the project leys were establishing and not ready to be cut/ grazed, so margins left on other farm leys were surveyed and the methodology tested and refined. The

pollinator surveys were carried out by Bumblebee Conservation Trust researchers Anna Hobbs and Sinead Lynch, by carrying out 'transects'. This involved walking the margin/ field and recording the types of pollinator and the number of individuals observed. Bumblebees and Lepidoptera were identified to species level, and other pollinators were identified to species level where possible, or to family (e.g. 'hoverflies').

Transects were carried out on both standard and herbal leys on:

- Margins left uncut/ un-grazed after cutting/ grazing
- Cut/ grazed margins on the opposite side of the cut/ grazed field to the uncut/ un-grazed margin

In addition, plant surveys were undertaken by placing fifteen 1m x1m quadrats in each margin and listing plants used as a nectar or pollen source by pollinators; and estimating percentage cover and counting the number of floral units for each plant species. A floral unit is the area of flowers, which are able to produce nectar and pollen, which a medium-sized bee has to fly, rather than walk between.

In 2020, the COVID 19 pandemic restrictions disrupted data collection to some extent. Most of the early season surveys were not carried out at all, and sub-contractors carried out surveys in north Wales in the summer to reduce the distance travelled and remove the need for overnight accommodation.

2.32 Whole farm habitats survey

On each farm, potential habitat for bumblebees and other pollinators was noted during the site visit. This included, for example, flower and nectar sources along wooded blocks; generous margins alongside hedgerows; flowers such as black knapweed (an important later flowering plant) present on tracks; areas of willow scrub; forage in semi improved/ unimproved pastures; and pollinator nesting habitat.

3. Results

3.1 Field/ Margin surveys

3.11 Overview

Across all farms in all years, the data clearly showed higher numbers of bumblebees and other pollinators, and greater numbers of pollinator species in uncut/ un-grazed margins compared to cut/ grazed ley margins when surveyed within two weeks of silage being cut/ grazing. The results strongly indicate that leaving uncut/ un-grazed margins in agricultural ley fields helps to support bumblebee and other pollinator populations, especially in terms of 'bridging gaps' in forage (nectar and pollen resources) during the season when a continuous supply of forage is required by these species (from around March through to October). Other research demonstrates that diverse herbal leys support greater numbers of species and abundance of individual pollinators compared to 'standard' (rye grass and clover) leys. This was certainly true in some cases during the project, but in others no clear difference was apparent, or indeed the reverse was true. Possible reasons for this are discussed below.

3.12 Species recorded

Table 1 shows the species recorded in all three project years (2018 – 2020) combined. A high proportion of all the commonly occurring bumblebee species (those recorded since 2000) were found on the farms.

			Farm Number					
Class	**Common Name**	**Scientific Name**	**1**	**2**	**3**	**4**	**5**	**6**
Bumblebees *Bombus* spp (Hymenoptera)	Buff-tailed bumblebee	*Bombus terrestris*						
	Common carder bee	*Bombus pascorum*						
	Early Bumblebee	*Bombus pratorum*						
	Garden bumblebee	*Bombus hortorum*						
	Red-tailed bumblebee	*Bombus lapidaries*						
	Southern cuckoo bee	*Bombus vestalis*						
	Tree Bumblebee	*Bombus hypnorum*						
	White-tailed bumblebee	*Bombus leucorum* agg.						
	White-tailed/ buff-tailed bumblebee	*Bombus lucorum/ terrestris* worker						
Other bees & wasps (Hymenoptera)	Honey bee	*Apis mellifera*						
	Saw fly species	*Unknown*						
	Solitary bee species	*Unknown*						
	Wasp species (parasitoid)	*Ichneumon* species						
Beetles (Coleoptera)	7 Spot ladybird	Coccinella septumpuctata						
	14 Spot ladybird	*Propylea quattuordecimpunctata*						
	16 spot ladybird	*Tytthaspis sedecimpunctata*						
	Beetle species	*Unknown*						
	Common red Soldier beetle	*Rhagonycha fulva*						
	Green dock beetle	*Gastrophysa viridula*						
	Ground beetle	*Carabidae species*						
	Harlequin ladybird f succinea	*Harmonia axyridis f. succinea*						
	Harlequin ladybird f spectabilis	*Harmonia axyridis f. spectabilis*						
	Thick legged flower beetle	*Oedemera nobilis*						
Bugs (Hemiptera)	Common nettle bug							
	Gorse shield bug	*Piezodorus lituratus*						
	Leaf Hopper species	*Unknown*						
	Meadow froghopper	*Philaenus maerkelli*						
	Pied shield bug	*Tritomegas bicolor*						
	Red and black froghopper	*Cercopis vulnerata*						
	Shield bug species	*Unknown*						
	Sloe shield bug	*Dolycoris baccarum*						

			Farm Number					
Class	**Common Name**	**Scientific Name**	**1**	**2**	**3**	**4**	**5**	**6**
Butterflies & moths (Lepidoptera)	Blood vein moth	*Timandra comae*						
	Carpet moth	*Larentiinae species*						
	Cinnabar moth	*Tyria jacobaeae*						
	Common blue butterfly	*Polyommatus icarus*						
	Comma butterfly	*Polygonia c-album*						
	Dark green fritillary butterfly	*Argynnis adlaja*						
	Five spot burnet moth	*Unknown*						
	Gatekeeper butterfly	*Pyronia tithonus*						
	Green-veined white	*Pieris napi*						
	Holly blue butterfly	*Celastrina argiolus*						
	Large skipper butterfly	*Ochlodes venata*						
	Large white butterfly	*Pieris brassicae*						
	Meadow brown butterfly	*Maniola jurtina*						
	Micromoth species	*Unknown*						
	Orange tip butterfly	*Anthocharis cardamines*						
	Painted lady butterfly	*Vanessa cardui*						
	Purple hairstreak butterfly	*Neozephrus quercus*						
	Peacock butterfly	*Inachis io*						
	Red admiral butterfly	*Vanessa atalanta*						
	Ringlet Butterfly	*Aphantopus hyperantus*						
	Silver Y moth	*Autographa gamma*						
	Small copper butterfly	*Lycaena phlaeus*						
	Small skipper butterfly	*Thymelicus sylvestris*						
	Skipper Butterfly species	*Unknown*						
	Small tortoiseshell butterfly	*Aglais urticae*						
	Small white butterfly	*Pieris rapae*						
	Speckled wood butterfly	*Pargarge aegeria*						
	Wall butterfly	*Lasiommata megera*						
	Yellow tail moth	*Euproctis similis*						
	Yellow shell moth	*Camptogramma bilineata*						

			Farm Number					
Class	**Common Name**	**Scientific Name**	**1**	**2**	**3**	**4**	**5**	**6**
Damsel & Dragonflies (Odonata)	Banded demoiselle	*Caloteryx spelendens*						
	Beautiful demoiselle damselfly	*Caloteryx virgo*						
	Brown hawker dragonfly	*Aeshna grandis*						
	Common blue damselfly	*Enellagma cyathigerum*						
True flies (Diptera)	Broad centurion fly	*Chloromyia formosa*						
	Blow fly							
	Crane fly	*Tipula paludosa*						
	Deer fly species	*Unknown*						
	Drone fly	*Eristalis tenax*						
	Flesh fly species	*Sacrophaidae species*						
	Fly species	*Unknown*						
	fly species	*Unknown*						
	Hawthorne fly	*Bibio marci*						
	Hoverfly	*Rhingia campestris*						
	Hoverfly - Pied							
	Hoverfly species	*Unknown*						
	Hoverfly – Bumblebee mimic	*Eristalis intricarius*						
	Hoverfly - Marmalade	*Episyrphus balteatus*						
	Hoverfly – thick legged	*Syritta pipiens*						
	Marsh snipefly	*Rhagio tringarius*						
	Horse fly	*Unknown*						
	Horse fly – Large marsh	*Tabanus autumnalis*						
	Notch horned cleg fly	*Haematopota pluvialis*						
	Saw fly							
	Striped slender robber fly	*Leptogaster cylindrica*						
	Tachnid fly							
	Scorpion fly	*Xylota segnis*						

Table 1: Species recorded (2018 - 2020 seasons combined)

3.13 Number of pollinators recorded

The results, across all six farms and in all three years, consistently showed that abundance of bumblebees Figure 1) and other pollinators (Figure 2) was much higher in the uncut margins than in the cut margins. This correlates closely with the number of floral units in each habitat (Figure 3). There were a small number of cases (4 out 30 surveys) where pollinators were higher on cut compared to uncut. This was explained as follows:

- Two cases recorded large numbers of flies on cow dung in the recently grazed margins which skewed the results.
- The timing of the survey and its implications for the number of floral units in cut compared to uncut margins. In the case of Farm 5 in 2019 for example, the length of time between the silage cut, when the uncut margin was left and the survey date was approximately four weeks. During this time the flowers in the uncut margin had ceased producing nectar and pollen and the plants in the cut margin had grown up and were in flower.

A fundamental requirement of bumblebees is a continuous source of high energy pollen and nectar from when the new queens from the previous year emerge from hibernation (around February/ March), through to October when most of the colonies have died off leaving new queens from that season to hibernate. The results from the project, provide an encouraging indication that leaving uncut/ un-grazed margins from May onwards, when ley fields are grazed, or silage is taken, could supply the bumblebees/ pollinators with a food source during the period when the cut/ grazed plants are re-growing, and before they start flowering again. If margins are not left, then such fields go from 'feast to famine' for invertebrates, unless there is suitable alternative forage nearby. This has obvious negative results on the local invertebrate populations, when considering that many cannot travel large distances to find a new forage source (and other local farms will likely be cutting silage at the same time). Thus, if margins can be incorporated into the farming system, it will be of benefit to the bumblebees and other pollinators.

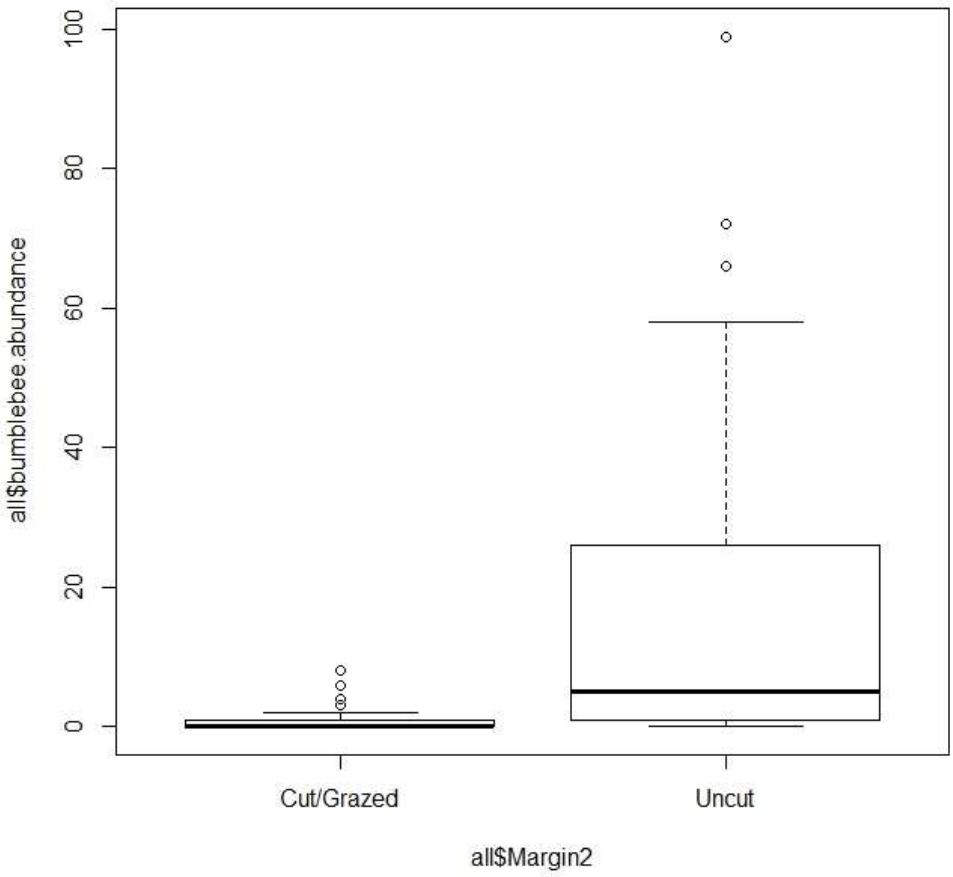

Figure 1: Bumblebee abundance in uncut compared to cut field margins

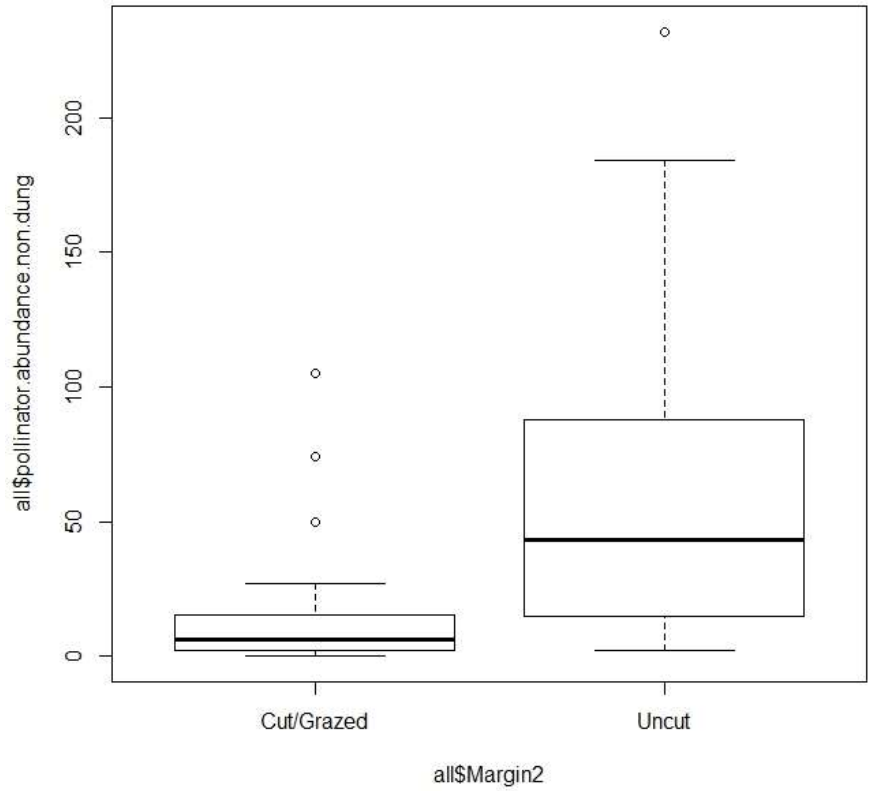

Figure 2: Pollinator (all species) abundance in uncut compared to cut field margins

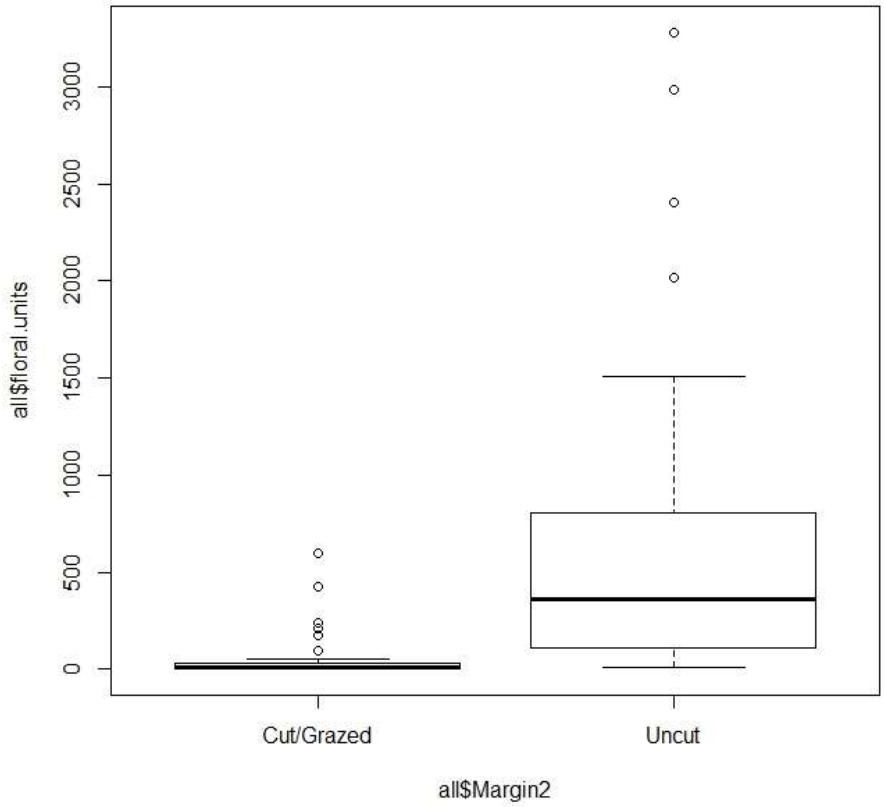

Figure 3: Floral abundance in uncut compared to cut field margins

3.14 Diversity of pollinators recorded

Data across all farms in all years strongly indicated that the number of species recorded on uncut/ un-grazed margins was substantially higher compared to those on cut/ grazed margins. (Figure 4).

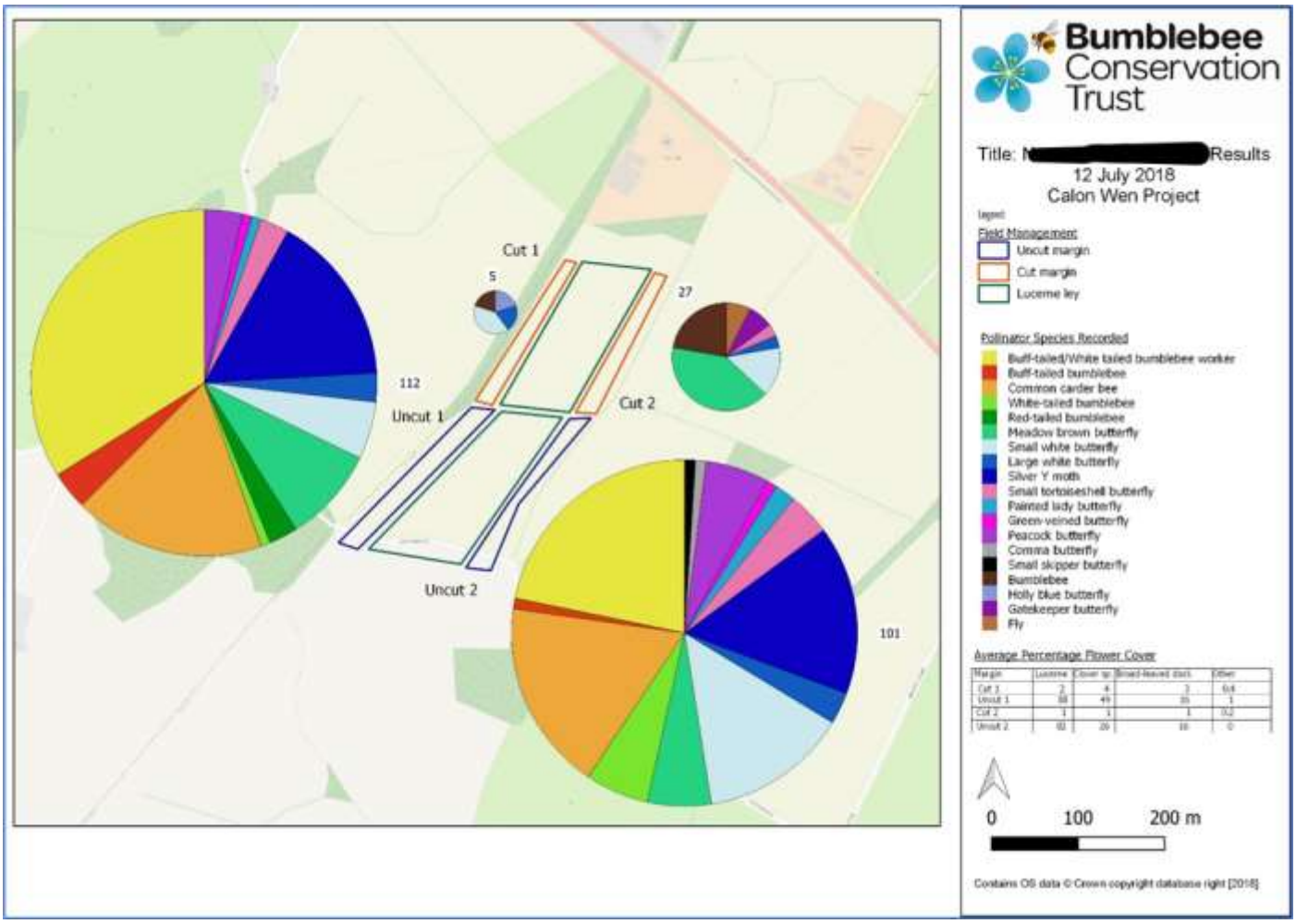

Figure 4: Map showing the location of the field margins that were surveyed and pie charts of the pollinator species recorded in the margins alongside the corresponding margin location (all years combines). The overall size of the pie chart is proportional to the total number of pollinators recorded (given as a figure next to the pie chart).

Whether or not the diverse herbal leys attract a greater of number of pollinator species compared to standard rye grass/ clover leys is less clear from our data, although research elsewhere has indicated that this is the case. It was only possible to make direct comparisons on some of the farms for several reasons.

- It was not possible to survey both leys on the same day in some cases
- Some farms were already using diverse leys as their usual practice, so ‘standard’ rye grass/ clover leys were not available as a comparison.

On the farms where a comparison was possible (Table 2), there was no clear relationship between pollinator numbers/ diversity and the type of ley.

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Farm/Date	Total Number of Pollinators		Number of Different Species	
	Cut/ Grazed	Uncut/ Un-grazed	Cut/ Grazed	Uncut/ Un-grazed
Farm 1: 26/6/19				
Lucerne/ clover ley	5	57	1	10
Farm 1: 27/8/19				
Herbal ley	1	113	1	13
Farm 2: 16/7/19				
Clover ley	8	78	4	28
Herbal project ley	12	232	3	27
Farm 2: 11/9/19				
Clover ley	1	34	1	5
Herbal project ley	0	111	0	10
Farm 3: 5/6/19				
Farm's herbal ley	17	43	5	12
Herbal project ley	2	31	2	7
Farm 3: 30/6/19				
Herbal project ley	62* (grazed)	33	6*(grazed)	13
Farm 4: 14/5/19				
Clover ley	105*	15	5*	6
Farm's diverse herbal mix	50*	8	1*	4
Farm 4: 25/6/19				
Clover ley	0	86	0	25
Farm's diverse herbal mix	4	85	4	27
Farm 5: 3/6/19				
Clover ley 1	5	11	1	6
Clover ley 2	15	15	4	8
Farm 5: 7/8/19				
Clover ley 1	1	78	1	22
Clover ley 2	7	90	7	17
Farm 6: 22/5/19				
Clover ley	0	14	0	3
Herbal project ley	2	14	2	8
Farm 6: 9/7/19				
Clover ley	771*(grazed)	61	8* (grazed)	14
Herbal project ley (uncut margin) vs neighbouring clover ley (grazed margin)	22	106	8	20

Table 2: Pollinator numbers and diversity (2019 data)

N.B. Cut/ grazed margins are presumed cut, unless noted as '(grazed)' alongside data entries.
** Denotes anomalous data due to large numbers of flies being recorded during transects (especially on cow dung in the recently grazed margins).*

3.2 Whole farm surveys

The whole farm surveys identified a number of habitats on the farm that could support and enhance pollinator populations, and these are summarised in Table 3.

Habitat	Role	Details	Farm					
			1	2	3	4	5	6
Unimproved neutral grassland/ hay meadow	Forage	Biodiverse including flowering species	■	■				
Semi improved grazing	Forage	Biodiverse including flowering species	■	■	■	■	■	■
Ley fields	Forage	Contains white and red clover, lucerne	■	■	■	■	■	■
Fenced out wet patches	Forage	Flowering species e.g. greater bird's-foot trefoil, marsh thistle, ragged robin, herb willow, black night shade	■					■
Bare earth	Nesting	Nesting sites for solitary bees	■	■	■	■	■	■
Tussocky grass	Nesting	Nesting and hibernation sites	■	■	■	■	■	■
Kitchen garden and orchard	Forage	Flowering horticultural species	■					
Hedgerows managed on rotation			■		■	■	■	
Hedge banks	Forage	Nectar source in summer	■	■	■	■	■	■
Gorse and bramble	Forage	Nectar source in summer	■	■	■	■	■	■
Woodland margins	Forage	Nesting sites, tree pollen	■	■	■	■	■	■
Trackside verges	Forage	Wildflowers	■	■	■	■	■	■
Ditches	Forage	Wildflowers	■	■	■	■	■	■
Scrub	Forage	Biodiverse including flowering species		■	■	■		■
Unimproved marshy grassland	Forage	Biodiverse including flowering species		■				■

Table 3: Summary of pollinator habitats

Recommendations were made to manage these habitats in order to benefit pollinators including:

- **Hay meadows:** Remove or reduce grazing pressure during the flowering season to increase wildflower abundance. Take later cuts in some years to allow later flowering plants such as common knapweed to flower and set seed.
- **Restoration of improved grassland**. Allow soil fertility to fall by managing the grass to reduce its vigour, especially the coarse grasses; cut later in the summer to allow wildflowers to set seed; allowing some poaching by livestock to create bare earth patches into which wildflowers may seed.
- **Diversifying leys**: Introduce herbal ley flower seed into less diverse, more agriculturally improved grassland is another possible way of increasing pollinator forage. This will be more effective rather than trying to introduce wildflowers as wildflowers are not suited to improved soil. 'Scratch' in herbal ley seed into the older white clover/ rye leys to increase the floral diversity.
- **Hedgerows**: Increase the width of hedgerow margins where possible. Cut on 2-3 year rotations, cut into an 'A' shape. Ensure that there are standards within the hedgerows that are managed in order that they provide pollinator forage. If species like grey and goat willow are allowed to flower, they can provide vital food for queen bumblebees when they emerge from hibernation in spring. Other species that are beneficial to pollinators if allowed to flower within a hedgerow are hawthorn, blackthorn, crab apple and wild roses. Some of these hedgerow shrubs are particularly important for pollinators in the spring when there may be less forage elsewhere across the farm.

- **Field margins**: Cut or graze any margins that are rich in wildflowers after the plants have set seed. For summer flowering areas, cuts/ grazing should be undertaken after the 15 July, ideally delaying in some years to September/ October, to allow late-flowering plants, e.g. black knapweed, to flower and set seed. Cuts can be made in spring before the end of April to manage grass-dominant areas, to reduce competition with summer wildflowers.
- **For areas with spring flowers,** (e.g. bluebell, primrose), cuts/ grazing should not be undertaken between the end of January and mid-July in order to allow seed to set. The arisings should be removed so as not to add nutrients to the soil which does not favour wildflowers.
- **Arable flowers.** Organic management favours the persistence of these plants, due to fertilisers and herbicides not being used. Cultivated, but uncropped plots or margins can provide the soil disturbance required by these plants to bring their seeds to the surface and minimise shading or competition from the crops. Alternatively sparsely sow a headland with cereal.
- **Tracksides:** Introduce red clover to tracksides that contain fewer wildflowers to increase the amounts of pollinator forage available. Cut the tracksides after the summer flowering season, from July to September/ October, in order to reduce competition from grasses and help the wildflowers to spread. Bramble and burdock are valuable nectar sources that should be retained for pollinators.
- **Tussocky grass:** Retain tussocky grass and allow it to develop in both south and south-east-facing sites (for bumblebee nesting habitat) and north-facing sites (for bumblebee hibernation habitat). Leave these areas for longer before cutting and ensure that some tussocky grass is retained across the farm at any one time. A stocking density of 0.2 cows/hectare/year is recommended as a starting point and may be varied in order to achieve the desired sward length.
- **Enhance woodland edges** by allowing shrub species, such as bramble, ivy and rose to grow, as well as longer vegetation, including grasses and herbs. Encourage spring woodland wildflowers in these areas to by cutting or grazing after the flowering season in order to allow the spring flowers to grow and set seed.
- **Retain bare earth** across the farm. It does not have to be in the same place every year as long as it is not compacted by livestock. Bare earth on south-facing banks is particularly valuable for pollinators.
- Include **plants that will provide forage from early in the year** when queen bumblebees come out of hibernation, to October when the colonies die off and the new queens enter hibernation. Plants such as comfrey are extremely valuable food sources for bumblebees and other pollinators.
- **Marshy grassland** is a valuable resource worthy of conservation both in its own right and for the variety of species it supports. Fence off the main area of marshy grassland and reduce or prevent scrub encroachment (outside the breeding bird season). The aim is to gradually open up the vegetation by grazing and/or cutting to encourage the spread and density of wildflowers. Mowing may be appropriate in some circumstances and some additional management of scrub or ranker sward may be required periodically (ideally removing arisings).
- **Ponds:** Ensure the water is clear and has low levels of nutrients. The most productive ponds, in terms of biodiversity, are those with a generous shallow margin or drawdown zone. Manage bulrush and common reed, and other invasive species, to prevent them from taking over the pond and reducing the amount of open water, as this is valuable to many species. Manage ponds between November and the end of January. Do not clear more than a third of the silt or pond vegetation in any one year.
- **Banks and ditches**: Allow tussocky grass to develop in places on both south/ south-east-facing and north-facing banks to provide nesting and hibernation sites for bumblebees, respectively. Manage ditches on rotation so that there will always be ditches at different stages across the farm. Do not manage the whole length of a ditch in one season. Allow a buffer strip either side of the ditch to protect it. Cut the bank vegetation on a two to five year rotation and ideally only cut half of the vegetation of a ditch in any one year.

4. Knowledge exchange

This project has generated a substantial amount of interest, and considerable effort has gone into communicating the project and its findings.

4.1 Preparation of knowledge exchange materials

- Summaries of project approach and findings (Appendix I)
- An animation explaining the principles of the project, in particular managing the herbal leys and field margins
- A guide to pollinator friendly grassland farming
- A series of habitat signs

4.2 Press (broadcast and print)

- An on-farm event was organised for press and the general public and a press release issued (Appendix II)
- Articles have appeared in numerous publications including: Farming UK; Calon Wen RSPB and Bumblebee Conservation Trust blogs; Daily Post;
- The project has been featured on Farming Today (February 2019)

4.3 Presentations at conferences and events

- Pollinator task force meetings (March 2018)
- Exhibition at Pollinator Festival, National Botanic Gardens (July 2018)
- Fab Farmers herbal ley networking event (November 2019)
- Wales Real Food and Farming Conference (November 2019)
- Oxford Real Farming Conference (January 2020)

4.4 Open days

- Farming Connect Focus Farm event (August 2019)

5. Lessons learned

On the whole the project ran smoothly and a large volume of quality data has been collected as evidenced in the previous sections. However, there have been some practical difficulties experienced along the way.

- It has been difficult to coordinate survey visits across six geographically dispersed farms such that researcher and farm availability, flowering of ley and margin, and favourable weather conditions all coincide. We have worked to improve communication between farmers and researchers to get the timing right and have some success, but we have had to accept that the conditions were not ideal on every farm on every occasion.
- In some cases, margins were not left in error, and this been largely because contractors were not aware of the project or had forgotten they were supposed to leave margins. We addressed this by improving communication and improving the boundary marking of the border between the margin and the main field.
- COVID 19 restrictions presented some challenges in the early part of the 2020 data collection season. By working through local sub-contractors (to avoid overnight stays), nearly all the surveys were completed, although some were later than ideal.

Appendix I: KE Materials and activities

- Pasture for pollinators Infographic (December 2019): Benefits of multi species …
- Pasture for pollinators Infographic (December 2019) : Bee friendly silage harve…
- Video (December 2019): Pasture For Pollinators project
- Audio (February 2019): (BBC Radio 4) Farming Today - Anna Hobbs, Bumblebee Cons…
- Video (January 2019): Becky Holden (Bwlchwernen Farm) & Tony Little (ADAS)
- Article (December 2018): Organic dairy farmers are “buzzing” to help bumblebees
- Video (August 2018): Sinead Lynch, Bumblebee Conservation Trust.
- Technical Publication, Issue 16 (July / August 2018): Pasture for Pollinators
- A guide to pollinator friendly grass farming (2021)