# European Innovation Partnership (EIP) Wales

# Pasture for Pollinators

**Interim 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 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, generally when flowering was over.
- **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, where the farmers had managed to leave the margins. 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 x1 m quadrats in each margin and listing plants used as a nectar/ 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 visit.

From the data analysed so far from 2018 and 2019, higher numbers of bumblebees and other pollinators, and greater numbers of pollinator species have been recorded in uncut/ ungrazed agricultural ley margins compared to cut/ grazed ley margins when surveyed within 2 weeks of silage being cut/ grazing. The results indicate that leaving uncut/ ungrazed 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).

Additionally, the results compiled so far, indicate that greater numbers of species and abundance of individual pollinators may be supported by the more species-rich herbal fertility building Project ley (or fields which have been seeded with an agricultural ley but retain a variety of wildflower species as well), compared to less species-rich agricultural leys. NB not all data has been analysed yet and when it has, the sample size is too small to test for statistical significance.

The whole farm surveys identified a range of habitats that could support bumblebees and other pollinators including; Hay fields and semi improved grazing; bare earth; tussocky grass; hedge banks; gorse & bramble; woodland margins; trackside verges; ditches; scrub; and saltmarsh. Recommendation 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

On the whole the project has run smoothly, and a large volume of quality data has been collected.
However, there have been some practical difficulties experienced and some key lessons were learned including:

- It has been difficult to coordinate survey visits across 6 geographical 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 it conditions will not be ideal on every farm on every occasions.
- 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 have addressed these by improving communication and improving the marking of making the border between the margin and the main field.

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# 1. Introduction

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. 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 runs from 1 January 2018 to 31 December 2020. This report

- Details the project methodology
- Summarises the results from the 2018 and 2019 data collection season
- Reports on the Knowledge Exchange activities undertaken so far
- Highlights some of the lessons learned

# 2. Project outline

## *2.1 Participating farms*

The practical work is 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 Cotswold Seeds including the following species:

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

Where appropriate, a standard Rye grass/ clover ley was 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, is being 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 is being 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 4 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, generally when flowering was over.

### *2.23 Habitat management*

Opportunities to manage other habitats on the farm (e,g, hedgerow, 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 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 were identified to species level, and other pollinators 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 x1 m quadrats in each margin and listing plants used as a nectar/ 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.

### *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; suitable nesting habitat in semi improved/ unimproved pastures

# 3. Results

## *3.1 Field/ Margin surveys*

### *3.11 Overview*

From the data analysed so far from 2018 and 2019, higher numbers of bumblebees and other pollinators, and greater numbers of pollinator species have been recorded in uncut/ ungrazed agricultural ley margins compared to cut/ grazed ley margins when surveyed within 2 weeks of silage being cut/ grazing. The results indicate that leaving uncut/ ungrazed 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). Additionally, the results compiled so far, indicate that greater numbers of species and abundance of individual pollinators may be supported by the more species-rich herbal fertility building Project ley (or fields which have been seeded with an agricultural ley but retain a variety of wildflower species as well), compared to less species-rich agricultural leys. NB not all data has been analysed yet and when it has, the sample size is too small to test for statistical significance.

### *3.12 Species recorded*

Table 1 shows the species recorded in 2018 and 2019 combined. Generally speaking, a high proportion of all the commonly occurring bumblebee species (those recorded since 2000) were found on the farms. In some cases, there is the potential for rare species to be detected in future surveys, notable the brown-banded carder bee (*Bombus humilis*). This is a rare species that has declined significantly in the UK and is now one of the rarest UK bumblebee species. It favours flower-rich meadows.

| Class | Common Name | Scientific Name | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|
| **Bumblebees *Bombus* spp)** | Buff-tailed bumblebee | *Bombus terrestris* | | | | | | |
| | Common carder bee | *Bombus Pascorum* | | | | | | |
| | Early Bumblebee | *Bombus pratorum* | | | | | | |
| | Garden bumblebee | *Bombus hortorum* | | | | | | |
| | Red-tailed bumblebee | *Bombus lapidarius* | | | | | | |
| | 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 spp | *Unknown* | | | | | | |
| | Wasp sp (parasitoid) | *Ichneumon* species | | | | | | |
| | | | | | | | | |
| **Beetles (Coleoptera)** | 7 Spot ladybird | Coccinella Septumpuctata | | | | | | |
| | 14 Spot ladybird | *Propylea quattuordecimpunctata* | | | | | | |
| | 16 spot ladybird | *Tytthaspis sedecimpunctata* | | | | | | |
| | Beetle spp | *Unknown* | | | | | | |
| | Common red Soldier beetle | *Rhagonycha fulva* | | | | | | |
| | Green dock beetle | *Gastrophysa viridula* | | | | | | |
| | Harlequin ladybird f succinea | *Harmonia axyridis f. succinea* | | | | | | |
| | Harlequin ladybird f spectabilis | *Harmonia axyridis f. spectabilis* | | | | | | |
| | Thick legged flower beetle | *Oedemera nobilis* | | | | | | |
| | | | | | | | | |
| **Bugs (Hemiptera)** | Gorse shield bug | *Piezodorus lituratus* | | | | | | |
| | Leaf Hopper spp | *Unknown* | | | | | | |
| | Pied shield bug | *Tritomegas bicolor* | | | | | | |
| | Red and black froghopper | *Cercopis vulnerata* | | | | | | |
| | Shield bug spp | *Unknown* | | | | | | |
| | Sloe shield bug | *Dolycoris baccarum* | | | | | | |

| Class | Common Name | Scientific Name | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|
| **Butterflies & moths (Lepidoptera)** | Blood vein moth | *Timandra comae* | | | | | | |
| | Carpet moth | *Larentiinae spp* | | | | | | |
| | 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 sp | *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 spp | *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* | | | | | | |
| | | | | | | | | |
| **Damsel & Dragonflies (Odonata)** | Banded demoiselle | *Caloteryx spelendens* | | | | | | |
| | Beautiful demoiselle damselfly | *Caloteryx virgo* | | | | | | |
| | Brown hawker dragonfly | *Aeshna grandis* | | | | | | |
| | Common blue damselfly | *Enellagma cyathigerum* | | | | | | |

| Class | Common Name | Scientific Name | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|
| **True flies (Diptera)** | Crane fly | *Tipula paludosa* | ■ | ■ | | ■ | | ■ |
| | Deer fly spp | *Unknown* | ■ | ■ | | | | |
| | Drone fly | *Eristalis tenax* | | | | | ■ | |
| | Fly species | *Unknown* | | ■ | ■ | | | ■ |
| | fly spp | *Unknown* | ■ | | | ■ | | ■ |
| | Hawthorne fly | *Bibio marci* | | | | | | |
| | Hoverfly species | *Rhingia campestris* | | | | | ■ | ■ |
| | Hoverfly species | *Unknown* | ■ | ■ | ■ | ■ | ■ | ■ |
| | Horse fly | *Unknown* | | ■ | | | | |

*Table 1: Species recorded in 2018 and 2019*

### *3.131 Number of pollinators recorded - 2018*

On the whole, the number of bumble bees and other pollinators were much higher in the uncut margins than in the cut margins, which correlate closely with the number of floral in each habitat. The graphs below in Figure 1, from 2018 data show, this very clearly

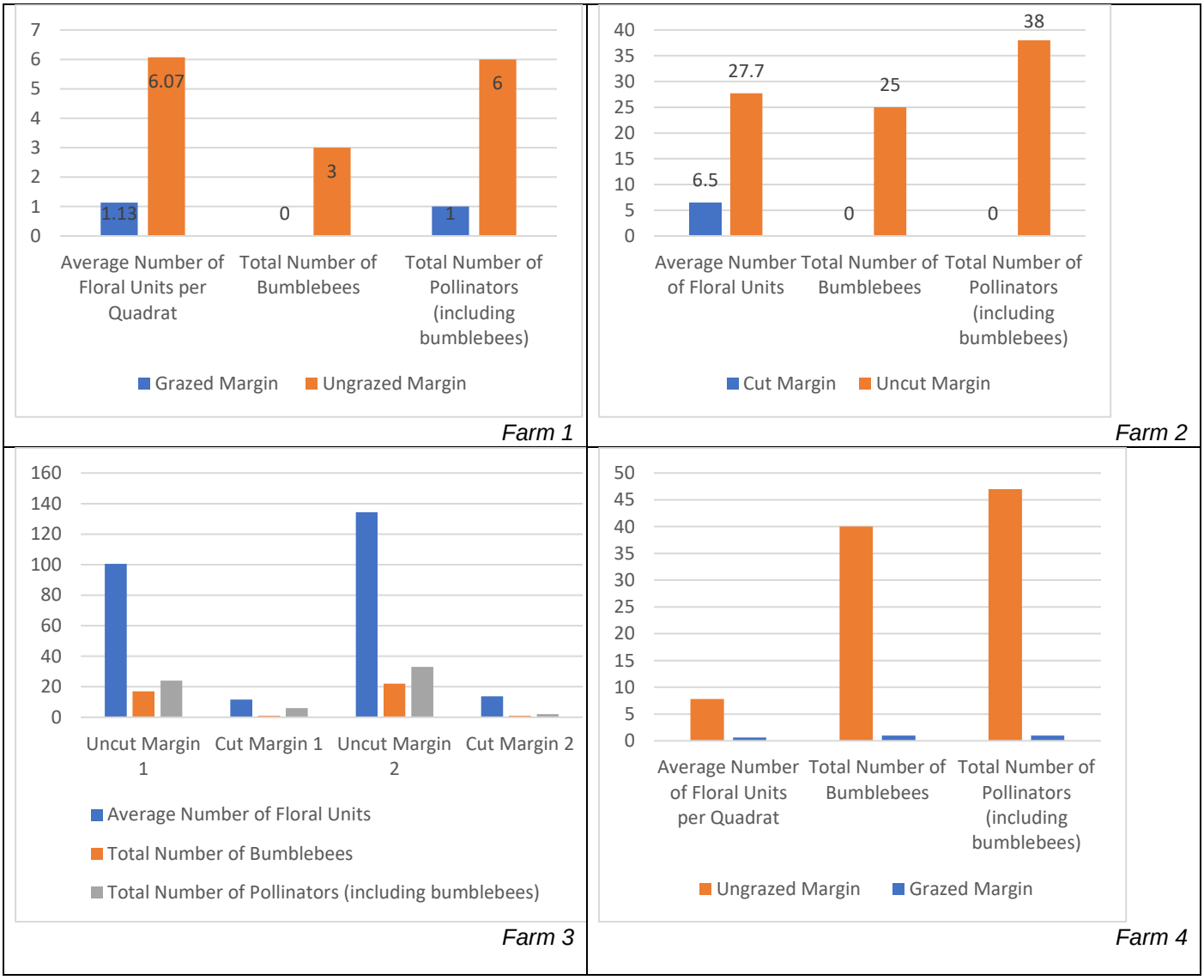



*Figure 1: Data from 4 farms showing increased floral units and pollinator numbers on uncut margins*

However, this was not universally the case. Figure 2 highlights instances on two farms where the difference less clear, or where pollinators were more abundant on cut margins

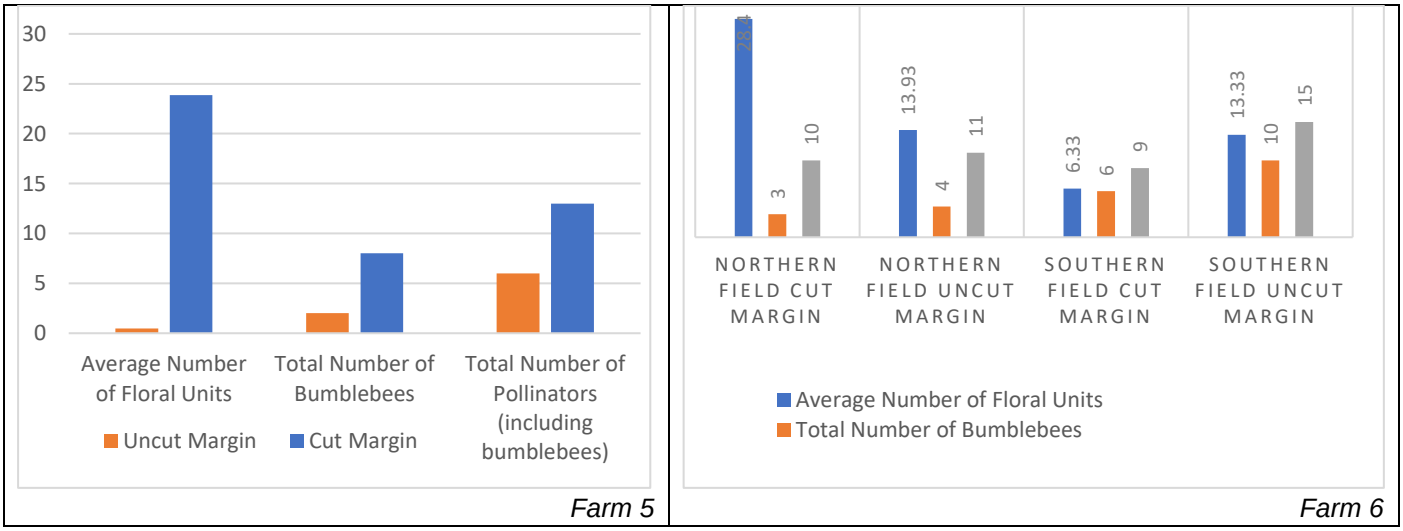



*Figure 2: Data from 2 farms showing increased floral units and pollinator numbers on cut margins*

This is related to 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, for example, the length of time between the silage cut, when the uncut margin was left, and the survey date was approximately 4 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.

Data on the number and type of pollinators were combined to produce indicative maps, as shown below for the purposes of illustration. Maps for individual farms can be found in the Appendix I.

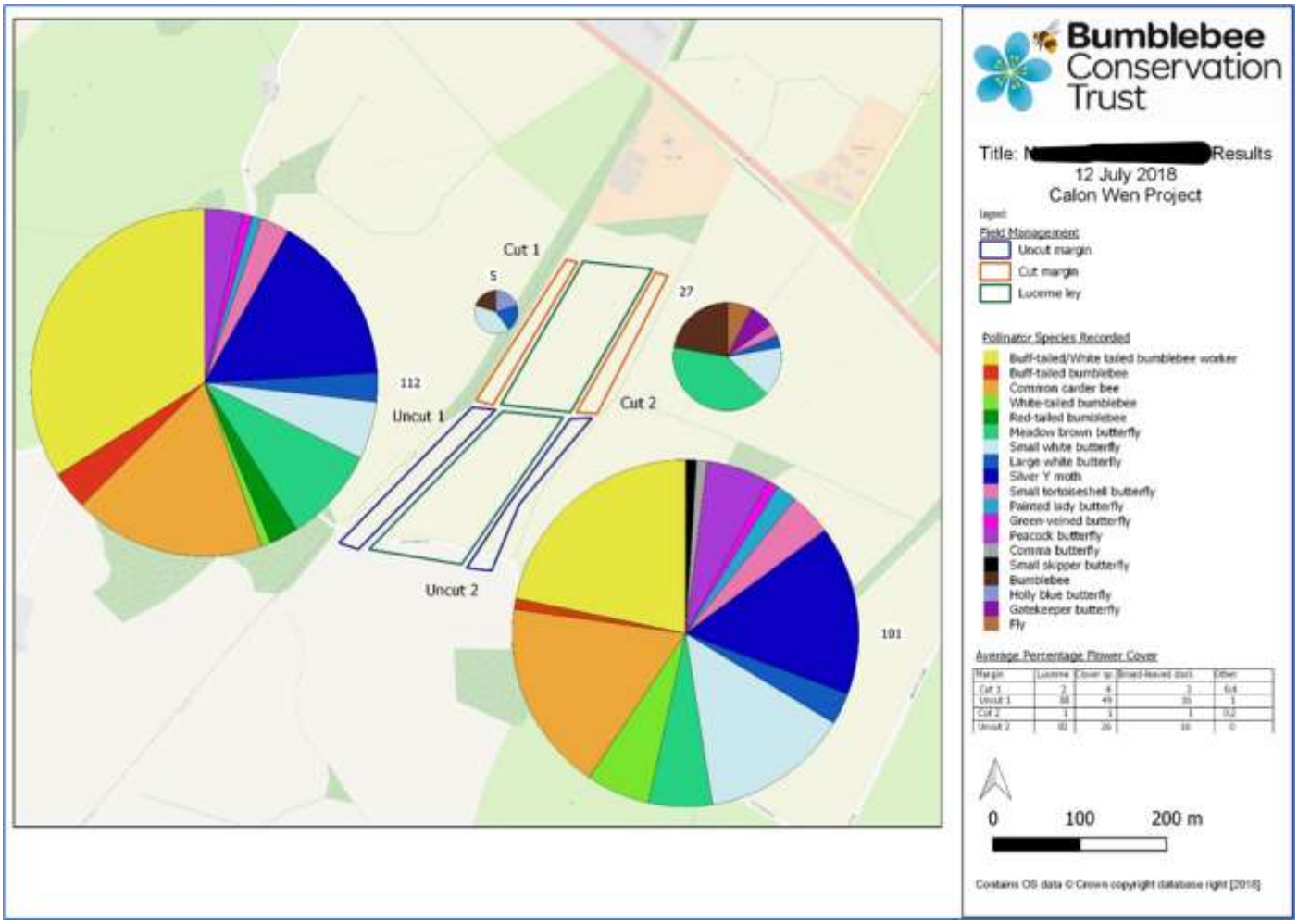



*Figure 3: Map Showing the Location of the Field Margins that were surveyed and Pie Charts of the Pollinator Species Recorded in the Margins Alongside the Corresponding Margin Location. The overall size of the pie chart is proportional to the total number of pollinators recorded (given as a figure next to the pie chart)*

### *3.132 Number of pollinators recorded – 2019*

Data from 2019 (Table 2) showed that in nearly all cases, pollinator numbers were significantly higher in the uncut/ ungrazed margins compared to cut/ grazed margins, indicating that leaving these refuges was effective in ensuring a continuous supply of food for pollinators. In cases where the reverse was true, either the survey was taken at a time when the cut/ grazed margins had started to regrow and flower, attracting pollinators back into the main part of the field, or the data was skewed by a large number of flies attracted to the grazed margins by dung.

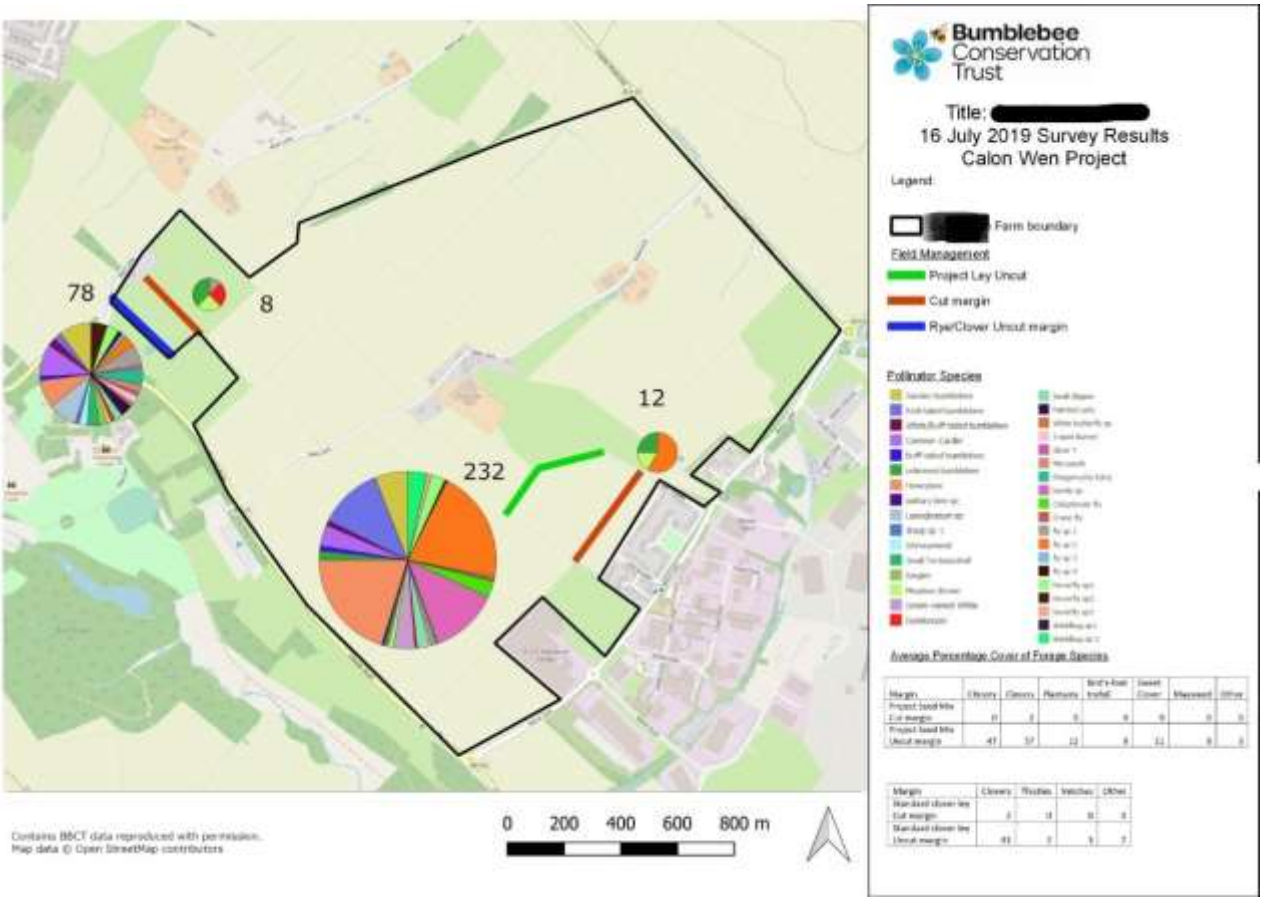
Whether the diverse herbal leys attract a greater of number of pollinator species compared to standard rye grass/ clover leys. In three cases it was not possible to make direct comparisons for various reasons (e.g. it was not possible to survey both leys on the same day, and the farms were using their own herbal mixes instead of standard rye grass clover leys). On the farms where a comparison was valid for the uncut margins: Farms 2 (Figure 4) and 6 (Figure 6) showed sustainably increased number and diversity on the project mix; on Farm 4 (figure 5) there was little difference between the two types of ley; For cut margins, there was tendency towards higher numbers of pollinators on herbal ley, but this was not always case, and

in two instances any difference was masked by large numbers of flies attracted to dung on the grazed margins

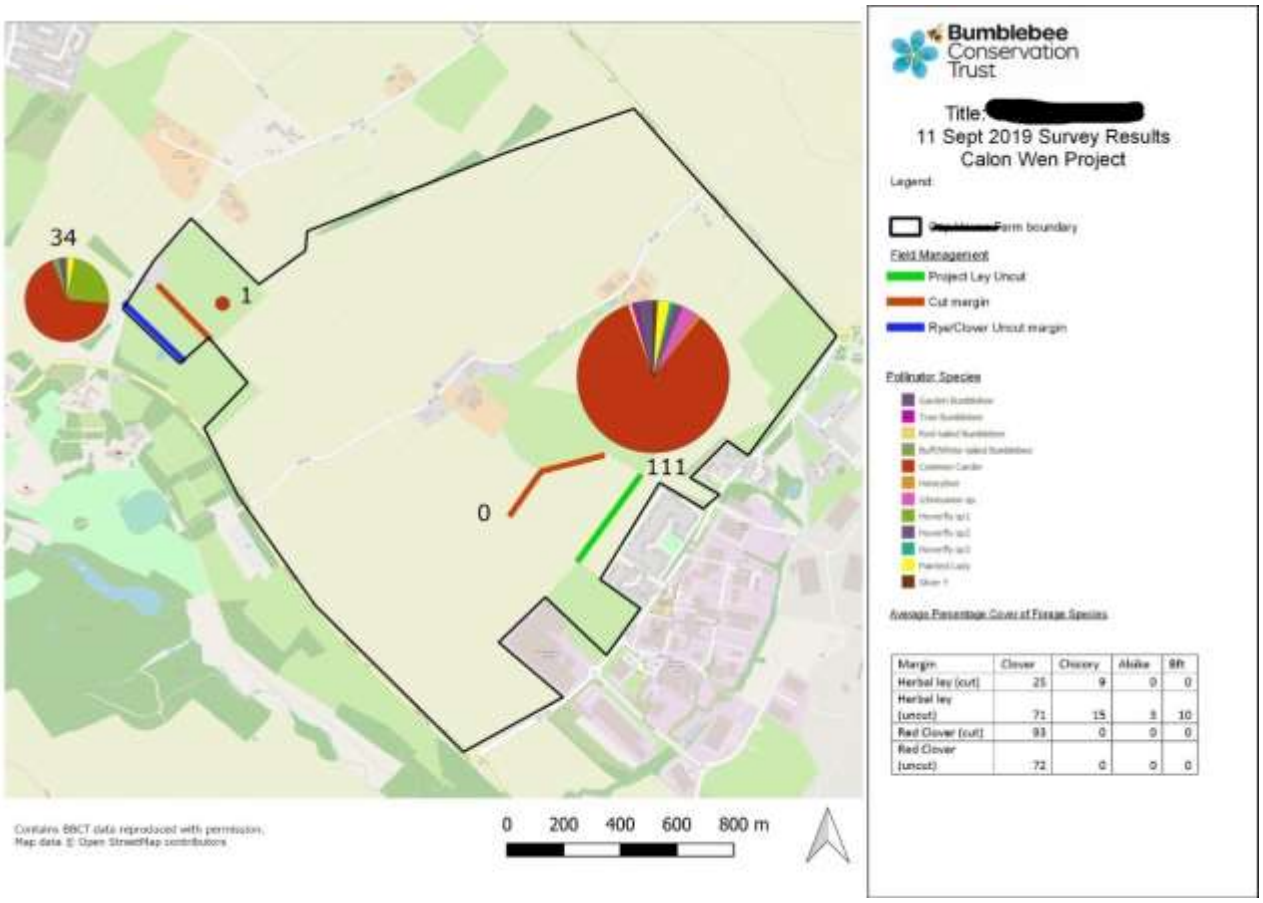
| Farm/Date | Total Number of Pollinators | | Number of Different Species | |
|---|---|---|---|---|
| | Cut/ Grazed | Uncut/ Ungrazed | Cut/ Grazed | Uncut/ Ungrazed |
| **Farm 1: 26/6/19** | | | | |
| Lucerne/ clover ley | 5 | 57 | 1 | 10 |
| **Farm 1: 27/8/19** | | | | |
| Herbal ley | 1 | 113 | 1 | 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 | 5 |
| 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).*

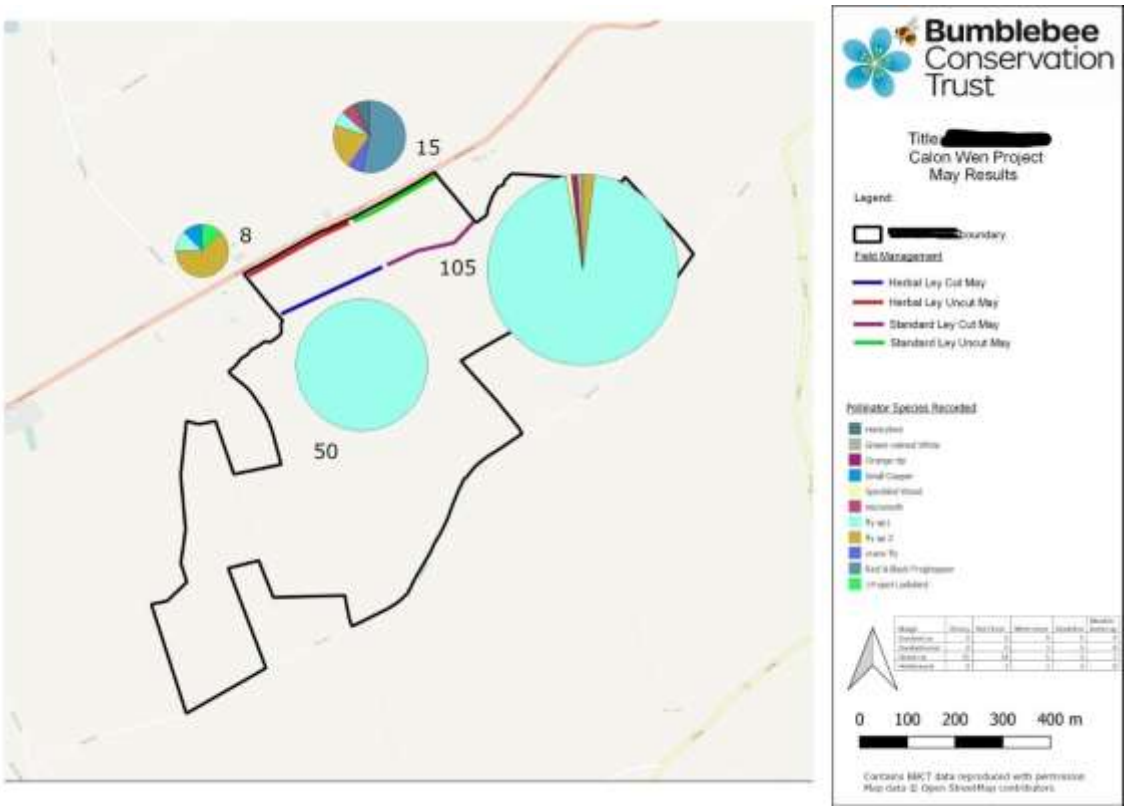



*16 July 2019*

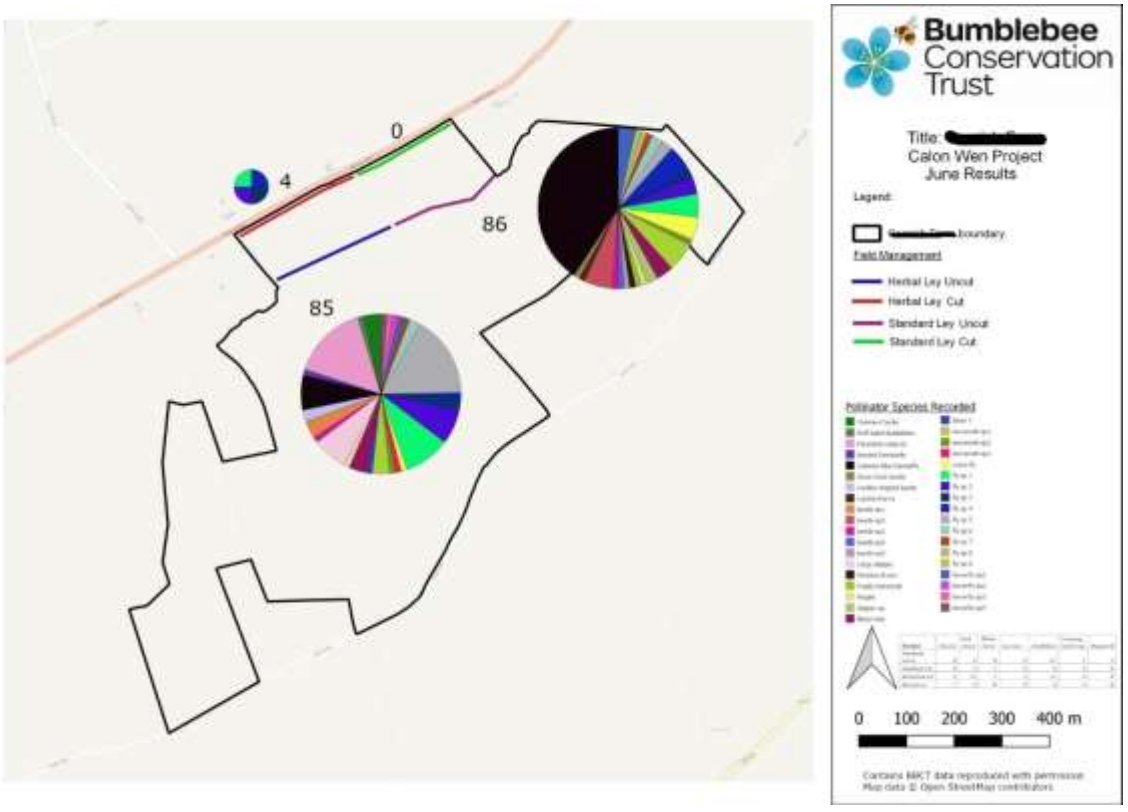



*11 September 2019*

***Figure 4: Pollinator numbers and diversity on Farm 2, 2019***

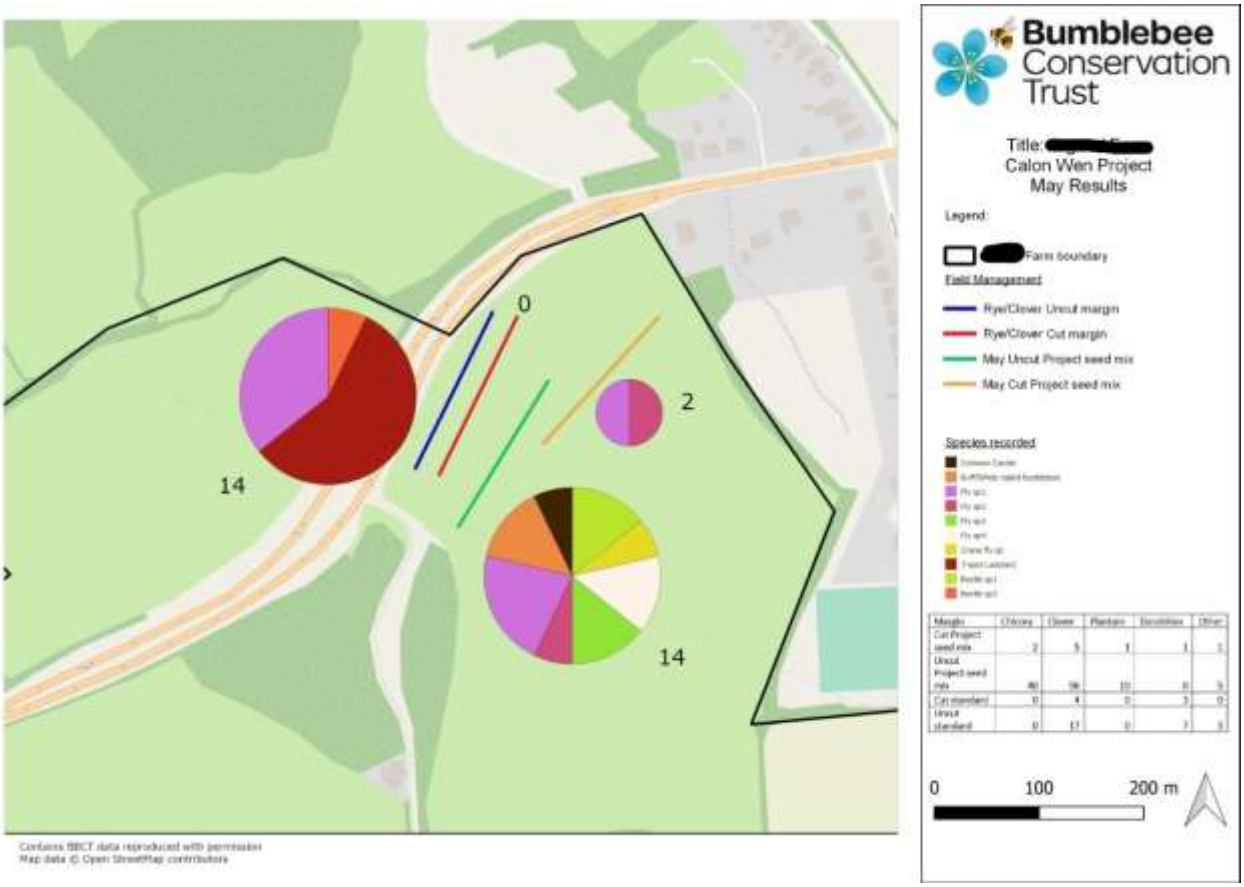



*14 May 2019*

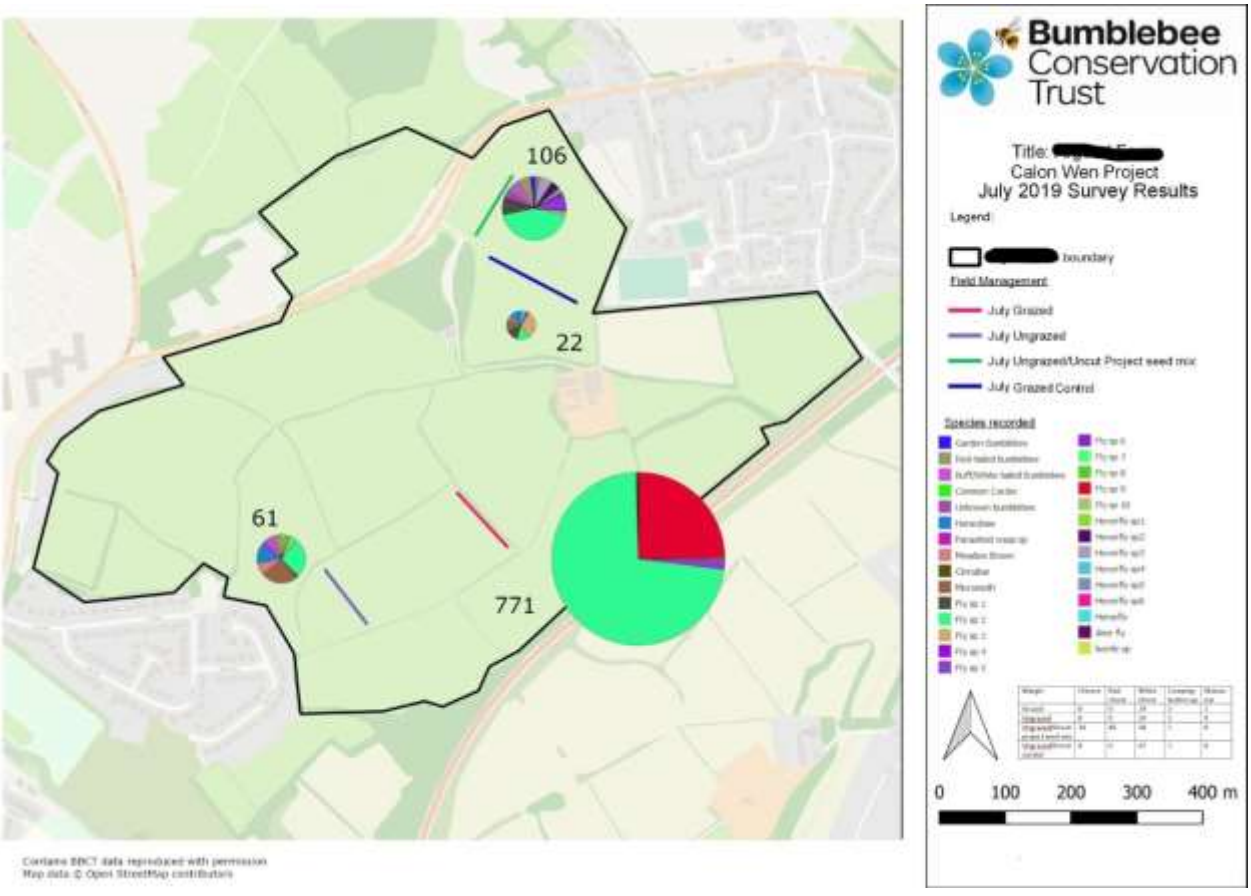



*25 June 2019*

***Figure 5: Pollinator numbers and diversity on Farm 4, 2019***




*22 May 2019*




*9 July 2019*

***Figure 6: Pollinator numbers and diversity on Farm 6, 2019***

## 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 |
| Hay fields | Forage | Biodiverse inc flowering spp | | | | | | |
| Semi improved grazing | Forage | Biodiverse inc flowering spp | | | | | | |
| Ley fields | Forage | Contains white and red clover, lucerne | | | | | | |
| Fenced out wet patches | Forage | Flowering spp, e.g herb willow, black night shade | | | | | | |
| Bare earth | Nesting | Nesting sites for solitary bees | | | | | | |
| Tussocky grass | Nesting | Nesting &hibernation sites | | | | | | |
| Kitchen garden | Forage | Flowering horticultural spp | | | | | | |
| Hedge banks | Forage | Nectar source in summer | | | | | | |
| Gorse & Bramble | Forage | Nectar source in summer | | | | | | |
| Woodland margins | Forage | Nesting sites, tree pollen | | | | | | |
| Trackside verges | Forage | Wildflowers | | | | | | |
| Ditches | Forage | Wildflowers | | | | | | |
| Scrub | Forage | Biodiverse inc flowering spp | | | | | | |
| Saltmarsh | Forage | Biodiverse inc flowering spp | | | | | | |
| Marshy grassland | Forage | Biodiverse inc flowering spp | | | | | | |

*Table 3: Summary of pollinator habitats*

Recommendations were made to manage these habitats in order to benefit pollinators. Details are available in the individual reports in Appendix I, but some examples are given below:

- Field margins (not included in the trial) contain plant species, such as greater bird's-foot trefoil, that are valuable to bumblebees and other pollinators for forage. The management of these areas could be enhanced by appropriate cutting regimes. Allowing plants to flower and set seed before cutting the areas in mid to late summer, and the cutting again in late Spring, would knock back grass growth and allow for the wildflowers to persist and potentially increase in number.
- The edges of the wooded areas on the farm could also provide important resources for pollinators, both in terms of forage and nesting habitat. These areas may be enhanced by appropriate management. Tree species, such as some of the willows, can also be an important source of pollen and nectar in Spring for bumblebees when the new queens are feeding up following hibernation and establishing their new colonies.
- Marshy grassland in Wales has become much reduced, being lost or degraded, for example, by drainage and agricultural improvement. It is, therefore, a valuable resource worthy of conservation both in its own right and for the variety of species it supports. Fencing off the main area of marshy grassland would be valuable in order that management of the parcel could be adjusted to enhance this habitat (action completed early 2019).
- Grazing should be managed to maintain species richness by grazing seasonally to levels which will create an uneven and 'tussocky' sward within the range of 5cms to 25cms height by October each year. 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. During grazing, monitor the progress and sward height regularly and adjust the number of stock and length of time they are in the field accordingly.

The sward should be no shorter than 5cm by October, allowing a long sward during the summer months.

- It would be advisable to reduce the scrub that has encroached into the field and prevent further scrub encroachment into this marshy grassland area. A small area of scrub could be cut each year between October and February (outside the breeding bird season). The ideal would be to reduce the amount of scrub around the field edges and aim for around 5% of scrub within the parcel. Scrub is valuable for other species, such as birds, and any willow and bramble within the scrub areas can provide forage for bumblebees; however, there are significant amounts of scrub near to this parcel and elsewhere on the holding to allow for scrub removal within the marshy grassland area. 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).
- Spear thistle, bramble and burdock along the track leading from the road down into the golf course and green barn are valuable nectar sources that should be retained for pollinators.
- Bare earth on the hedgebanks along the track provides suitable pollinator nest sites (with evidence of solitary bee nests seen).
- There are other pockets of less improved areas where flowers persist, such as self-heal, field scabious, black knapweed and common vetch. Again, it would be beneficial if these could be cut mid to late summer and again in late Spring to knock back grass growth and allow for the wildflowers to persist and potentially increase in number (removing the arisings after cutting).
- Introduce wildflowers or native red clover across the holding. This could be undertaken in ungrazed areas such as tracksides, or in hedgerow margins. Such areas would need to be ungrazed during the summer months to allow plants to flower; and cut and the arisings removed after the flowering season to ensure that grasses do not start to dominate, thus, ensuring the persistence of the flowering plants. It would be ideal if such areas could be grazed as well as being cut.
- Hedgerows are cut into an A-shape on the farm, which is valuable for native species. If different lengths are allowed to flower in different years, this would help to provide Spring forage for bumblebees, that is much needed when the new queens emerge from hibernation, in order to feed up and establish the new colonies. This would also provide for many other pollinator species.
- There is block of woodland, the edge of which could provide important Spring forage, in addition to forage later on in the year when the bramble comes into flower.

# 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 II)
- An animation explaining the principles the project, in particular managing the herbal leys/ margins

## *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 and 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 has run 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 6 geographical 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 it conditions will not be ideal on every farm on every occasions.
- 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 have addressed these by improving communication and improving the marking of making the border between the margin and the main field.

# Appendix I: Individual farm reports - 2018

## *Report for Farm 1*

Buff-tailed queen bumblebee on spear thistle at Farm 1

### Summary of Work

- A total of four survey days were undertaken at New Hall Farm during the summer months of 2018.
- The majority of the farm was walked by the Pasture for Pollinators surveyors, and habitat beneficial to bumblebees, and pollinators generally, was noted and pollinators seen were recorded.
- Additionally, cut and uncut 100m x 4m margins left by Farmer 1 were surveyed during the visits on 12 and 31 July.
- A desktop study was also undertaken to examine bumblebee records within a 5km radius of the farm.

### Practicalities & Compromises

- The seed obtained from Cotswold Seeds Ltd was sown during 2018 and not ready to survey during this season, so margins left in a field of lucerne and white clover ley were surveyed.
- In subsequent years, uncut and cut margins will be left in the field containing the Project Seed mix and in an additional parcel containing the farm ‘standard’ ley of rye and white clover.

### Monitoring Data Methods

- Transect surveys and quadrat surveys were undertaken in each cut and uncut margin that was surveyed (as shown on the maps in this report). The same margins were surveyed on 12 and 31 July with no cuts in-between.
- Transect surveys were used to record bumblebees and other pollinators present in a margin. Plant surveys were undertaken by placing fifteen 1mx1m quadrats in each margin and listing plants used as a nectar/ pollen source by pollinators; and estimating percentage cover and counting the number of floral units for each plant species. N.B. 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.

## Results

- Across the farm, a total of five species of bumblebee were recorded, in addition to numerous other pollinator species given in the table over.

**Bumblebee and Other Pollinator Species Recorded Across the Whole Farm During the 2018 Surveys (not exhaustive)**

| **Common Name** | **Scientific Name** |
|---|---|
| **Common carder bee** | ***Bombus pascuorum*** |
| **Red-tailed bumblebee** | ***Bombus lapidarius*** |
| **Buff-tailed bumblebee** | ***Bombus terrestris*** |
| **White-tailed/ buff-tailed bumblebee** | ***Bombus lucorum/ terrestris* worker** |
| **Garden bumblebee** | ***Bombus hortorum*** |
| **White-tailed bumblebee** | ***Bombus leucorum* agg.** |
| Hoverfly species | - |
| Fly species | - |
| 14 Spot ladybird | *Propylea quattuordecimpunctata* |
| Sloe shield bug | *Dolycoris baccarum* |
| Large white butterfly | *Pieris brassicae* |
| Silver Y moth | *Autographa gamma* |
| Meadow brown butterfly | *Maniola jurtina* |
| Small skipper butterfly | *Thymelicus sylvestris* |
| Small white butterfly | *Pieris rapae* |
| Green-veined white | *Pieris napi* |
| fly sp | - |
| Small tortoiseshell butterfly | *Aglais urticae* |
| Painted lady butterfly | *Vanessa cardui* |
| Peacock butterfly | *Inachis io* |
| Holly blue butterfly | *Celastrina argiolus* |
| Beetle sp | - |
| Honey bee | *Apis mellifera* |
| Comma butterfly | *Polygonia c-album* |
| Gatekeeper butterfly | *Pyronia tithonus* |

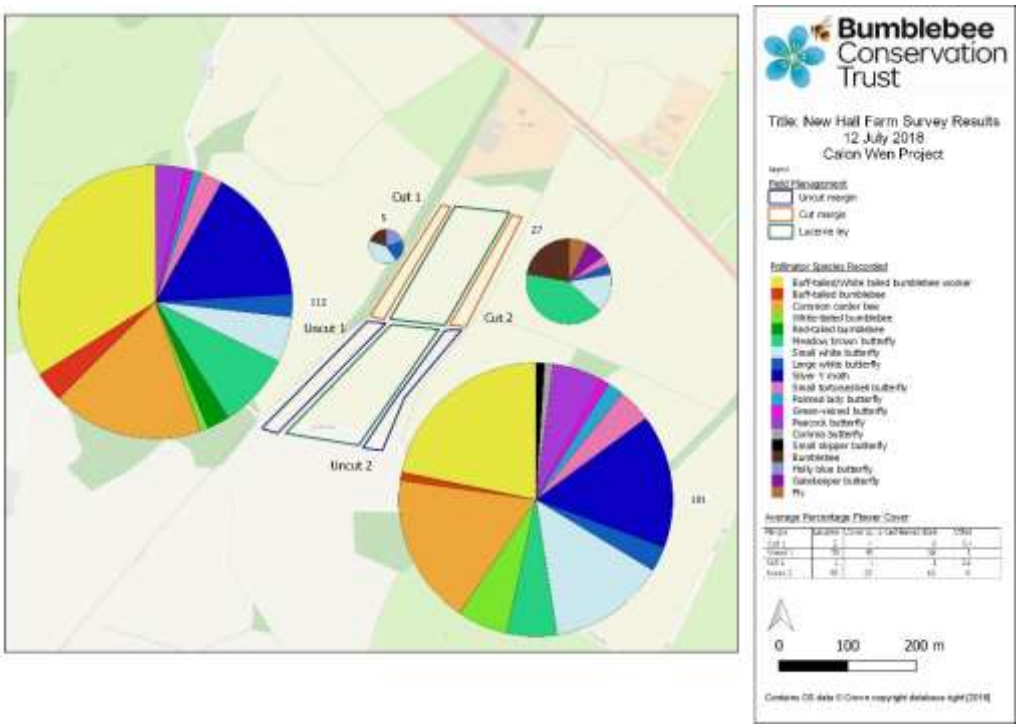
**List of Bumblebee Species Recorded Within 5km of Farm 1 Since 2000 Under BWARS and BeeWalk from the desktop study:**

| | |
|---|---|
| Common carder bee | *Bombus pascuorum* |
| Early bumblebee | *Bombus pratorum* |
| Buff-tailed bumblebee | *Bombus terrestris* |
| Red-tailed bumblebee | *Bombus lapidarius* |
| Southern cuckoo bee | *Bombus vestalis* |
| Tree bumblebee | *Bombus hypnorum* |

Bumblebee records from the desktop study show that there is a potential for additional bumblebee species to be recorded on the farm.

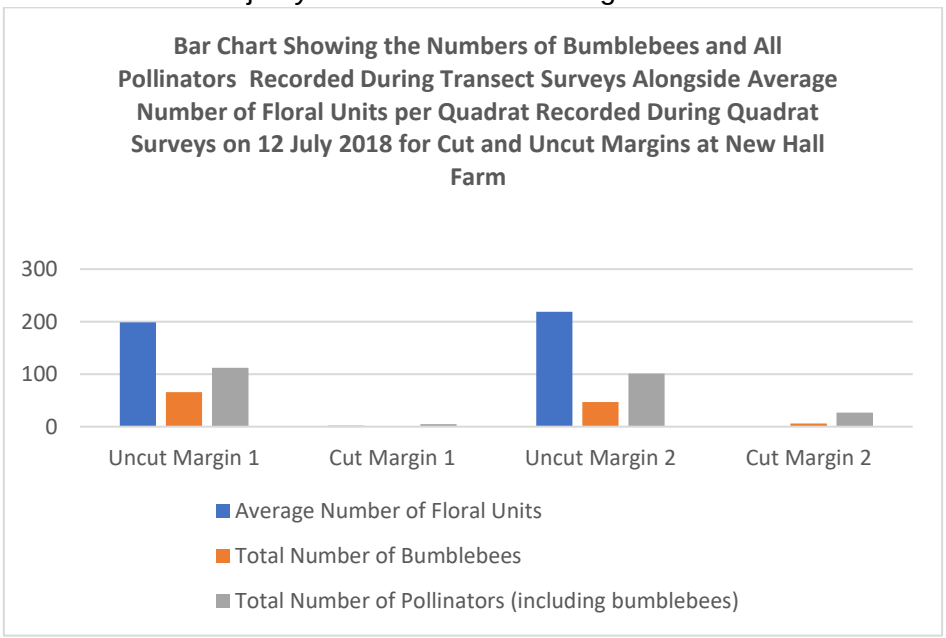
## Monitoring Data Results

**Map Showing the Location of the Field Margins that were Surveyed at Farm 1 on 12 July 2018 and Pie Charts of the Pollinator Species Recorded in the Margins Alongside the Corresponding Margin Location (the figure given next to each pie chart is the total number of individual pollinators recorded for the margin, and the size of each pie chart is proportional to that figure)**

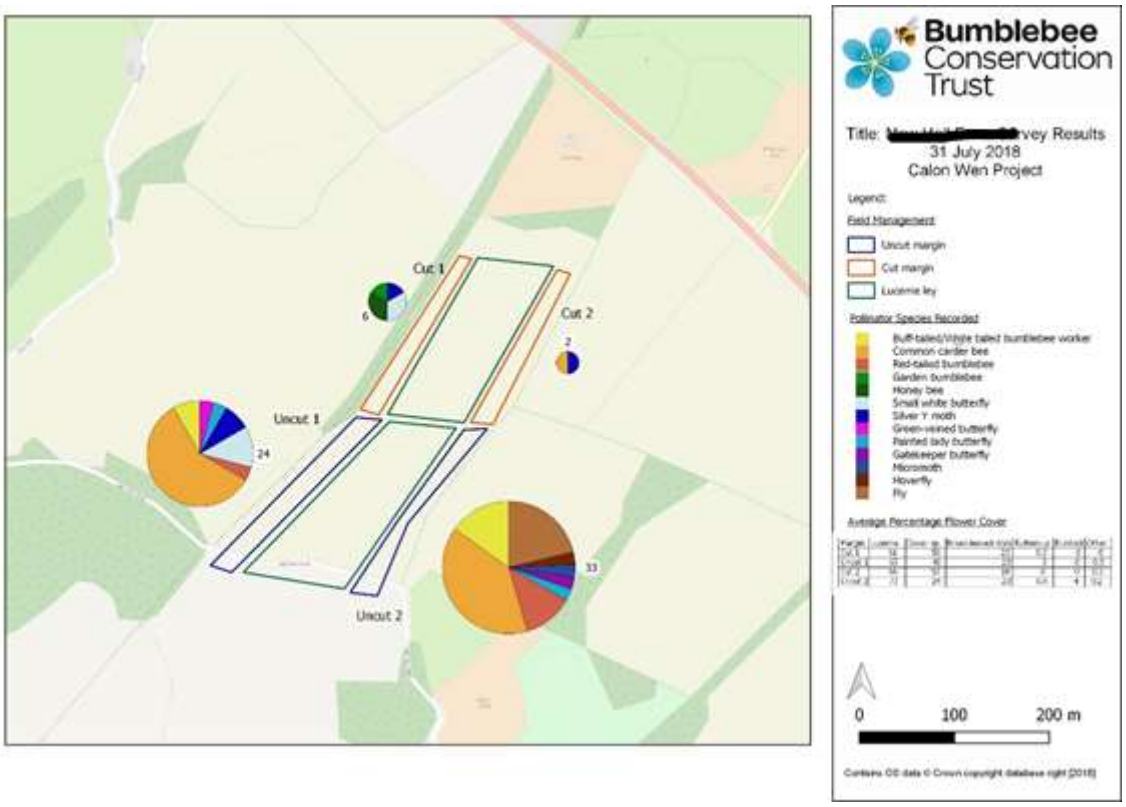



- The pie charts above show that significantly more pollinators were recorded on 12 July 2018 in the uncut margins of the field compared to the cut margins. The survey was carried out one day after the silage was cut in this field.

- The bar chart below shows the total numbers of bumblebees and pollinators next to the average number of floral units per quadrat for each of the four margins surveyed. This shows that there are more bumblebees/ pollinators and more floral units in the uncut margins, compared to the cut margins. Additionally, all pollinators recorded in the cut margins were either flying past or on the ground; not feeding on flowers as the majority were in the uncut margins.



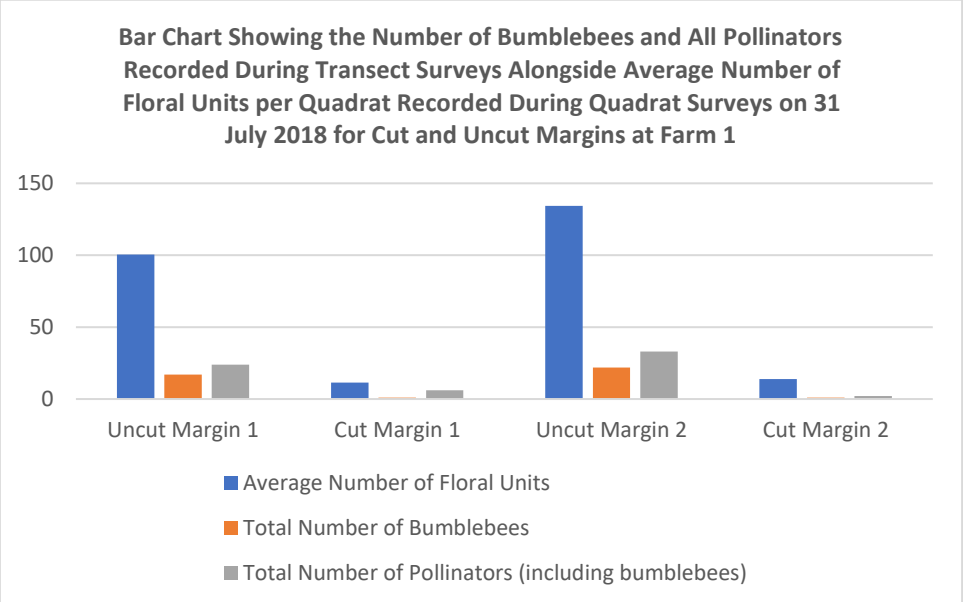
**Map Showing the Location of the Field Margins that were Surveyed at Farm 1 on 31 July 2018 and Pie Charts of the Pollinator Species Recorded in the Margins Alongside the Corresponding Margin Location (the figure given next to each pie chart is the total number of individual pollinators recorded for the margin, and the size of each pie chart is proportional to that figure)**




- The pie charts above show that more pollinators were recorded on 31 July 2018 in the uncut margins of the field compared to the cut margins.

- The differences in pollinator numbers between the uncut and cut margins are still significant 20 days after the silage cut was taken from the field and the margins left; however, they are not as pronounced as results from the surveys one day after the silage cut was taken.

- The bar chart below shows the total numbers of bumblebees and pollinators next to the average number of floral units per quadrat for each of the four margins surveyed. This shows that there are more bumblebees/ pollinators and more floral units in the uncut margins, compared to the cut margin. By day 20 after the silage was cut, both floral resources and pollinator numbers have decreased from the first survey the day after the silage was cut.



## Discussion of Monitoring Data Results

- The results indicate a positive correlation between the number of floral units and the number of bumblebees/ pollinators recorded in a field margin.
- Higher numbers of floral units and bumblebees/ pollinators were seen in the uncut margins, compared to the cut margins.
- As time from silage cut increases, it appears that the number of pollinators and average floral resources decreases. This is thought due to flowers ceasing to produce nectar and pollen as they die back.
- It was noted, across the Project farms, that the hot summer of 2018 was speeding up the reproductive phase of flowering plants, and that plants were flowering and going over earlier than would 'normally' be expected. Thus, the length of time between areas being cut or grazed and the plants growing up to flower again may vary.

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.

These results provide an encouraging indication that leaving uncut margins when silage is taken could supply the bumblebees/ pollinators with a food source during the period when the cut 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 as silage is cut. 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 pollinators.

## Whole Farm Habitats Identified and Discussed

- By far the greatest concentration of pollinators seen on 12 July 2018 was in the lucerne margins that had been left when silage was cut on 11 July 2018.
- Other habitats on the farm where a source of nectar and pollen, or suitable nesting and hibernation sites were present will be mapped in future years. Areas already identified are outlined below:
    - The majority of the golf course appears to have been re-seeded with clover/rye leys. The white clover present will provide forage for pollinators. There are still rough areas which could provide bumblebee nesting habitat if the grassland in south and south-east facing, dry areas is allowed to become tussocky. Similar north-facing habitats may be suitable for bumblebee hibernation sites. There is forage along tracks and hedges with bramble, thistle species and burdock. Next to the green barn, there is an area that could be improved for pollinators by cutting in August and April, to reduce the course grasses and allow the wildflowers that are present, e.g. black knapweed and oxeye daisy, to persist and increase in numbers. There is also a damp area near to the stream where wildflowers, such as rosebay willowherb and meadowsweet were growing. This area could be managed for the wildflowers and associated pollinators by cutting at an appropriate time.
    - Spear thistle, bramble and burdock along the track leading from the road down into the golf course and green barn are valuable nectar sources that should be retained for pollinators.
    - Bare earth on the hedgebanks along the track provides suitable pollinator nest sites (with evidence of solitary bee nests seen).
    - There are other pockets of less improved areas on the golf course where flowers persist, such as self-heal, field scabious, black knapweed and common vetch. Again, it would be beneficial if these could be cut mid to late summer and again in late Spring to knock back grass growth and allow for the wildflowers to persist and potentially increase in number (removing the arisings after cutting).
    - Some forage was identified in the Chirk Castle SSSI Parkland managed by Farm 1. The grassland is very old, with finer grasses like sweet vernal and crested dog's-tail. Yarrow and white clover were seen along with creeping thistle. As the management will have been agreed under the SSSI, it will not be discussed here.

# *Report for Farm 2*

Bumblebee on red clover at Farm 2

**Summary of Work**

- A total of two survey days were undertaken at Farm 2 during the summer months of 2018.
- The farmland near Rake Lane was walked by the Pasture for Pollinators surveyors, and habitat beneficial to bumblebees, and pollinators generally, was noted and pollinators seen were recorded.
- Additionally, a cut and uncut 100m x 4m margin left by Farmer 2 were surveyed during the visit on 22 August 2018.
- A desktop study was also undertaken to examine bumblebee records within a 5km radius of the farm.

**Practicalities & Compromises**

- The seed obtained from Cotswold Seeds Ltd was sown during 2018 and not ready to survey during this season, so margins left in a field sown with a red clover and rye ley were surveyed.
- In subsequent years, uncut and cut margins will be left in the field containing the Project Seed mix and in an additional parcel containing the farm 'standard' ley of rye and clover.

**Monitoring Data Methods**

- Transect surveys and quadrat surveys were undertaken in the cut and uncut margins that were surveyed (as shown on the maps in this report).
- Transect surveys were used to record bumblebees and other pollinators present in a margin. Plant surveys were undertaken by placing fifteen 1mx1m quadrats in each margin and listing plants used as a nectar/ pollen source by pollinators; and estimating percentage cover and counting the number of floral units for each plant

species. N.B. 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.

## Results

- Across the farm, a total of three (possibly four) species of bumblebee were recorded, in addition to other pollinator species given in the table below.

**Bumblebee and Other Pollinator Species Recorded Across the Whole Farm During the 2018 Surveys (not exhaustive)**

| **Common Name** | **Scientific Name** |
|---|---|
| **Common carder bee** | ***Bombus pascuorum*** |
| **Red-tailed bumblebee** | ***Bombus lapidarius*** |
| **Buff-tailed bumblebee** | ***Bombus terrestris*** |
| **White-tailed/ buff-tailed bumblebee** | ***Bombus lucorum/ terrestris* worker** |
| Hoverfly species | - |
| Micro moth species | - |
| Small white butterfly | *Pieris rapae* |
| Honey bee | *Apis mellifera* |

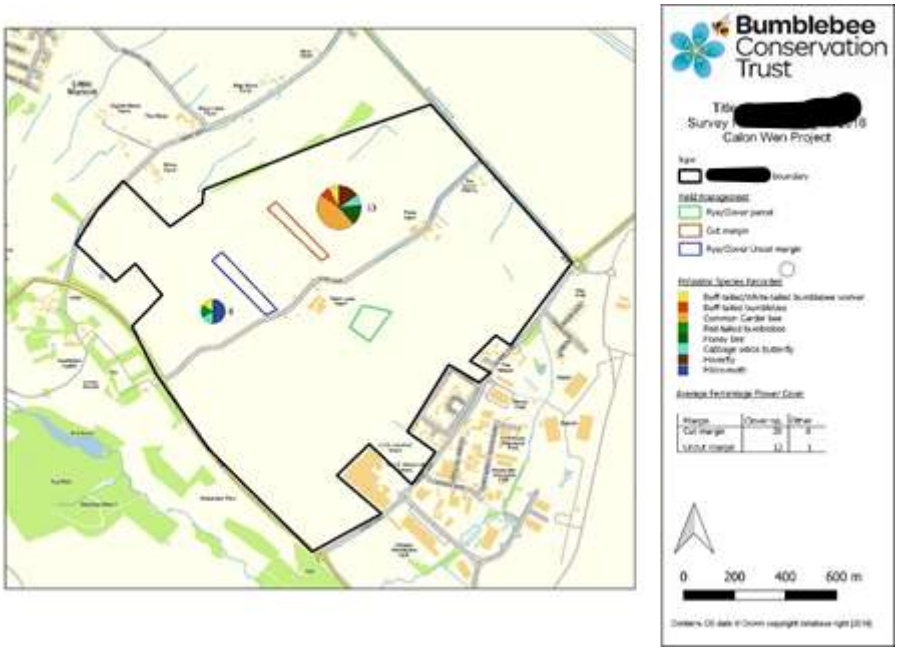
**List of Bumblebee Species Recorded Within 5km of Farm 2 Since 2000 Under BWARS and BeeWalk from the desktop study:**

| | |
|---|---|
| Common carder bee | *Bombus pascuorum* |
| Early bumblebee | *Bombus pratorum* |
| Buff-tailed bumblebee | *Bombus terrestris* |
| Red-tailed bumblebee | *Bombus lapidarius* |
| **Brown-banded carder bee** | ***Bombus humilis*** |
| Tree bumblebee | *Bombus hypnorum* |
| White-tailed bumblebee aggregate | *Bombus lucorum* sensu lato |

Bumblebee records from the desktop study show that there is a potential for additional bumblebee species to be recorded on the farm. Of particular note, is the record of the Brown-banded carder bee (*Bombus humilis*). This is a rare species that has declined significantly in the UK and is now one of the rarest UK bumblebee species. It favours flower-rich meadows.

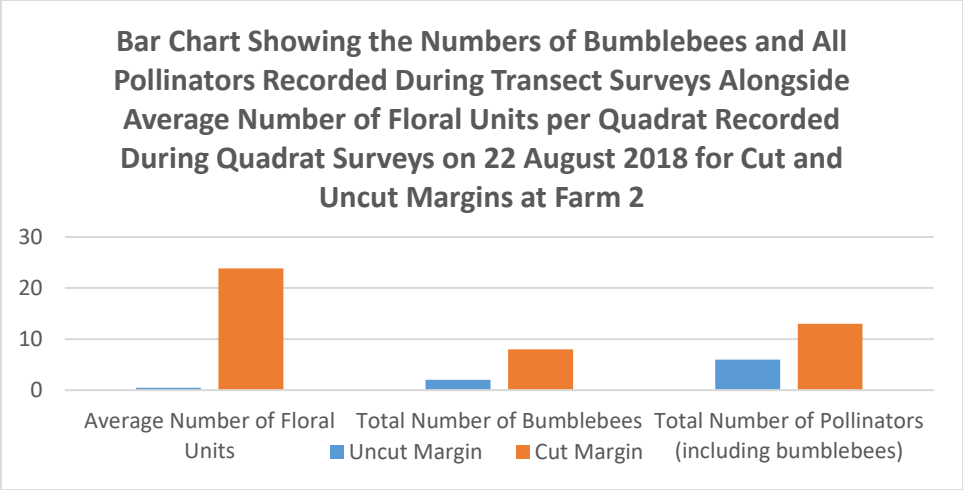
## Monitoring Data Results

**Map Showing the Location of the Field Margins that were Surveyed at Farm 2 on 22 August 2018 and Pie Charts of the Pollinator Species Recorded in the Margins Alongside the Corresponding Margin Location (the figure given next to each pie chart is the total number of individual pollinators recorded for the margin, and the size of each pie chart is proportional to that figure)**




- The pie charts show that more pollinators were recorded on 22 August 2018 in the margin that was cut in the first week of July 2018, compared to the margin that was left uncut at the same time.

- The bar chart below shows the total numbers of bumblebees and pollinators next to the average number of floral units per quadrat for the margins surveyed. This shows that there are more bumblebees/ pollinators and more floral units in the cut margins, compared to the uncut margins.




**Discussion of Monitoring Data Results**

- The results indicate a positive correlation between the number of floral units and the number of bumblebees/ pollinators recorded in a field margin.
- A greater number of floral units and bumblebees/ pollinators were seen in the cut margin, compared to the uncut margin. This is thought to be due to the length of time between the silage cut, when the uncut margin was left, and the survey date, which was approximately 4 weeks. 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.
- These results illustrate that the uncut margins will be useful to pollinators for a relatively short period of time following the silage cut, to tide them over while the cut area of the field grows up again and starts producing productive flowers. It also shows the importance within this Project, of surveying the margins within a couple of weeks after the silage is taken.

- It was noted, across the Project farms, that the hot summer of 2018 was speeding up the reproductive phase of flowering plants, and that plants were flowering and going over earlier than would 'normally' be expected. Thus, the length of time between areas being cut or grazed and the plants growing up to flower again may vary.

**Whole Farm Habitats Identified and Discussed**

- Potential habitat for bumblebees and other pollinators was noted during the site visit of the land near Rake Lane. This included flower and nectar sources along a wooded block; generous margins alongside hedgerows; flowers such as black knapweed (an important later flowering plant) present on tracks; and an area of willow scrub, which may provide forage for bumblebees/ pollinators during the spring. There may be suitable nesting habitat in rougher, more tussocky south and south-east facing grassland edges; similar north-facing areas may be suitable for bumblebee hibernation sites.
- It is hoped that there will be sufficient time to survey the 16 acres of SSSI saltmarsh field earlier in the season in 2019 or 2020, before it has been grazed down, to investigate the floral resources present in that parcel. Management of this area will not be discussed as there is already a management agreement in place for the SSSI.
- The relevant areas will be mapped in future years, and the management of these areas will be discussed further, in order to try to maintain and increase the floral resources and other habitat available to bumblebees and pollinators generally on the farm.

# *Report for Farm 3*

Early bumblebee male on bramble at Farm 3

## Summary of Work

- A total of 5.5 survey days were undertaken at Farm3 during the summer months of 2018.
- The majority of the farm was walked by the Pasture for Pollinators surveyors, and habitat beneficial to bumblebees, and pollinators generally, was noted and pollinators seen were recorded.
- Further botanical surveys were carried out in the less improved parcels; 'Big Smoke Field', 'Marsh Field' and 'Nick's Field'.
- Additionally, grazed/cut and ungrazed/uncut 100m x 4m margins left by Famer 3 were surveyed during the visits on 7 August and 3 October 2018.
- A desktop study was also undertaken to examine bumblebee records within a 5km radius of the farm.

## Practicalities & Compromises

- The seed obtained from Cotswold Seeds Ltd was sown during 2018 and not ready to survey during this season, so margins left in fields containing the farm 'standard' ley, a diverse herbal ley comprising 15 species, were surveyed.
- Leaving margins has not proved to be straightforward for all of the farms. At Farm 3, contractors cut the silage and there is not necessarily good communication from them as to when they will be undertaking the work. For the first planned survey date, the contractors had taken silage cuts earlier than expected and unfortunately an uncut margin was not left. The cows also escaped prior to the survey on the 7 August 2018 and grazed the margin that had been left to be surveyed (although another suitable margin was subsequently left in another field and surveyed instead).
- The margin left on the 28 September 2018, that was surveyed on 3 October 2018, was approximately 50mx4m instead of 100mx4m, meaning that the standard methods of data collection were altered slightly but still of use.
- For the remaining two years of the Project, 100mx4m ungrazed/uncut and grazed/cut margins (excluding the hedgerow margin) will be left in the field containing the Project Seed mix and in an additional parcel containing the farm 'standard' herbal ley.
- Whilst the Project looks to investigate the benefit to pollinators of leaving uncut margins in herbal ley fields as well as other management options across the whole of a holding, there will be some farms where the pragmatic approach after the Project would be to focus efforts on enhancing other areas across the farm for pollinators. This will prove a valuable case study if this is the direction Farm 3 looks to takes.

## Monitoring Data Methods

- Transect surveys and quadrat surveys were undertaken in each grazed/cut and ungrazed/uncut margin that was surveyed (as shown on the maps in this report).
- Transect surveys were used to record bumblebees and other pollinators present in a margin. Plant surveys were undertaken by placing fifteen 1mx1m quadrats in each margin and listing plants used as a nectar/ pollen source by pollinators; and estimating percentage cover and counting the number of floral units for each plant species. N.B. 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.
- Additionally, plant 'DAFOR' surveys were undertaken in 'Nick's', 'Marsh' and 'Big Smoke' fields (shown on the maps within this report). Twenty 1mx1m quadrats were placed evenly spaced along a 'W' route across 'Marsh' field (the least improved field), and floral resources measured by counting the number of floral units for each species within each quadrat. These fields have subsequently been mole ploughed, so the data collected during 2018 will be used as a baseline with which to compare results from subsequent years.

## Results

- Across the farm, a total of five (possibly 6) species of bumblebee were recorded, in addition to numerous other pollinator species given in the table below.

**Bumblebee and Other Pollinator Species Recorded Across the Whole Farm During the 2018 Surveys (not exhaustive)**

| **Common Name** | **Scientific Name** |
|---|---|
| **Common carder bee** | ***Bombus pascuorum*** |
| **Red-tailed bumblebee** | ***Bombus lapidarius*** |
| **Buff-tailed bumblebee** | ***Bombus terrestris*** |
| **White-tailed/ buff-tailed bumblebee** | ***Bombus lucorum/ terrestris* worker** |
| **Early bumblebee** | ***Bombus pratorum*** |
| **Tree bumblebee** | ***Bombus hypnorum*** |
| Hoverfly species | - |
| Wasp species | - |
| Crane fly species | - |
| Large skipper butterfly | *Ochlodes venata* |
| Cinnabar moth | *Tyria jacobaeae* |
| Fly species | - |
| Meadow brown butterfly | *Maniola jurtina* |
| Small white butterfly | *Pieris rapae* |
| Ringlet butterfly | *Aphantopus hyperantus* |
| micromoth species | - |
| Large marsh horsefly | *Tabanus autumnalis* |

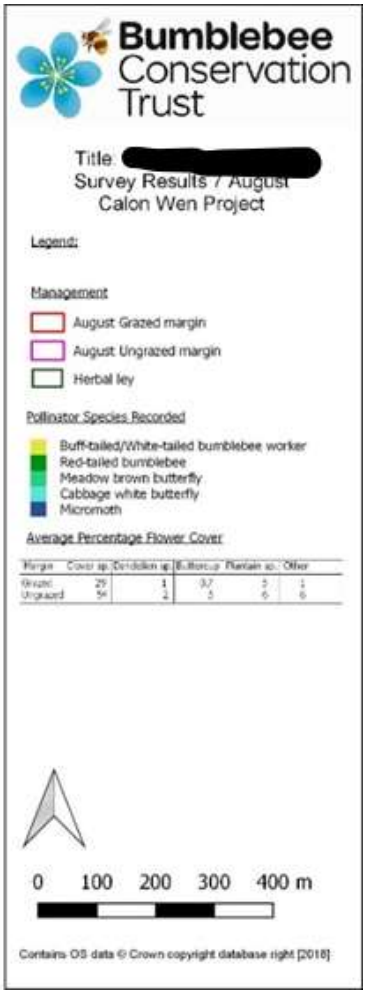
## List of Bumblebee Species Recorded Within 5km of Farm 3 Farm Since 2000 Under BWARS and BeeWalk from the desktop study:

| | |
|---|---|
| Common carder bee | *Bombus pascuorum* |
| Early bumblebee | *Bombus pratorum* |
| Buff-tailed bumblebee | *Bombus terrestris* |
| Red-tailed bumblebee | *Bombus lapidarius* |
| White-tailed bumblebee | *Bombus lucorum* |
| Tree bumblebee | *Bombus hypnorum* |
| Garden bumblebee | *Bombus hortorum* |
| Gypsy cuckoo bee | *Bombus bohemicus* |
| Field cuckoo bee | *Bombus campestris* |

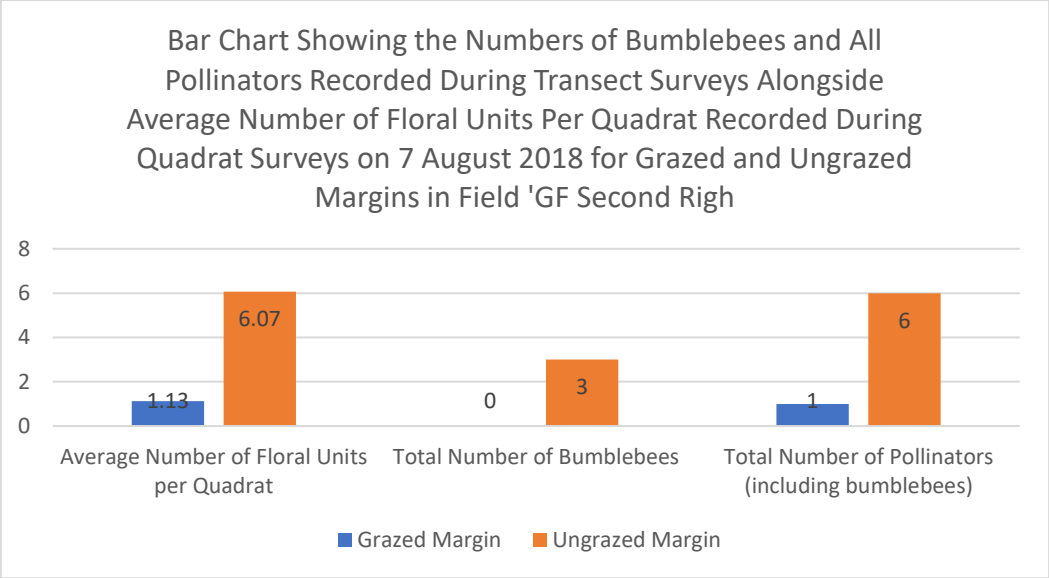
Bumblebee records from the desktop study show that there is a potential for additional bumblebee species to be recorded on the farm.

## Monitoring Data Results

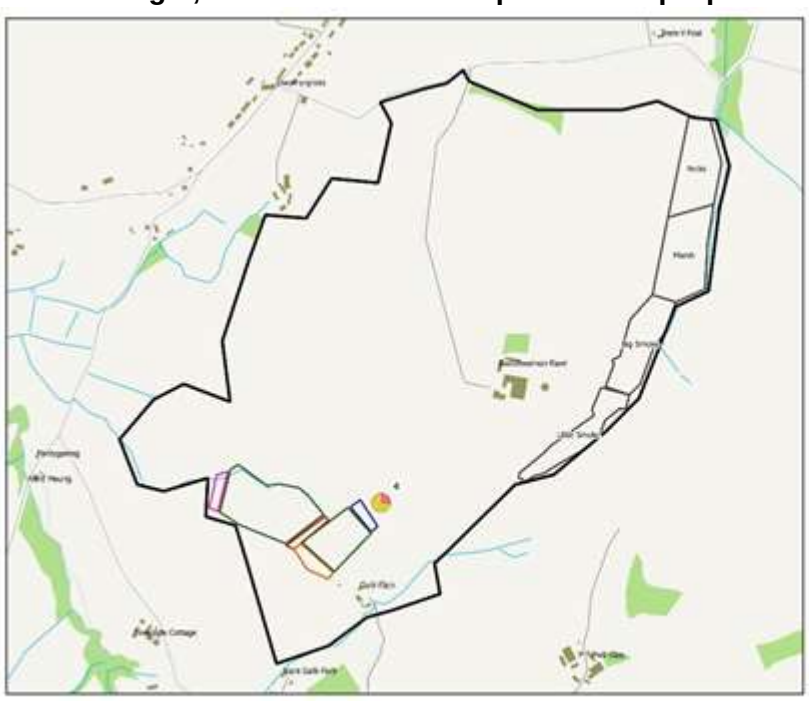
**Map Showing the Location of the Field Margins that were Surveyed at Farm 3 on 7 August 2018 and Pie Charts of the Pollinator Species Recorded in the Margins Alongside the Corresponding Margin Location (the figure given next to each pie chart is the total number of individual pollinators recorded for the margin, and the size of each pie chart is proportional to that figure)**

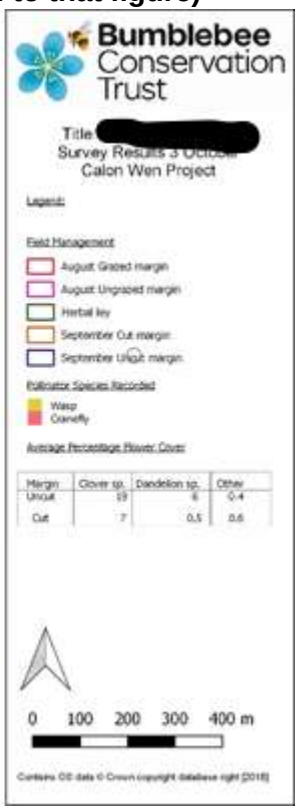




- The pie charts above show that more pollinators were recorded on 7 August 2018 in the ungrazed margin of the field compared to the grazed margin.
- The weather probably had an impact on results recorded on 7 August 2018; it was sunny/ cloudy whilst the grazed margin was surveyed, but it started to rain half way through the ungrazed margin survey, meaning that potentially fewer pollinators were recorded for the ungrazed margin than if the weather had remained fine.
- The bar chart below shows the total numbers of bumblebees and pollinators next to the average number of floral units per quadrat for the margins surveyed. This shows that there are more bumblebees/ pollinators and more floral units in the ungrazed margin, compared to the grazed margin.

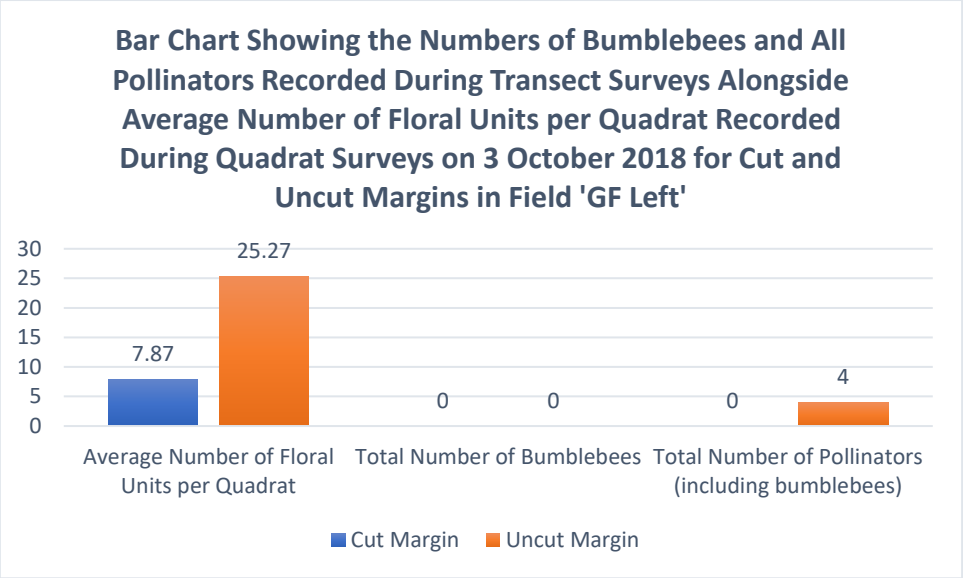



**Map Showing the Location of the Field Margins that were Surveyed at Farm 3 on 3 October 2018 and Pie Charts of the Pollinator Species Recorded in the Margins Alongside the Corresponding Margin Location (the figure given next to each pie chart is the total number of individual pollinators recorded for the margin, and the size of each pie chart is proportional to that figure)**






- The pie chart above shows that more pollinators were recorded on 3 October 2018 in the uncut margin of the field compared to the cut margin, in which no pollinators were recorded.
- The difference in pollinator numbers between the uncut and cut margins is not that pronounced. This may be due to a number of factors; the fact that this survey was undertaken late in the season; the margin included the hedgerow margin and did not comprise fully of the herbal ley; and the margin being 50m long instead of 100m, meaning that the transect surveys were shorter in duration.
- The bar chart over shows the total numbers of bumblebees and pollinators next to the average number of floral units per quadrat for each of the margins surveyed. This shows that no bumblebees were seen in either margin, and that there are more pollinators and more floral units in the uncut margins, compared to the cut margin.




## Discussion of Monitoring Data Results

- The results indicate a positive correlation between the number of floral units and the number of bumblebees/ pollinators recorded in a field margin.
- Higher numbers of floral units and bumblebees/ pollinators were seen in the ungrazed/uncut margins, compared to the grazed/cut margins.

It was noted, across the Project farms, that the hot summer of 2018 was speeding up the reproductive phase of flowering plants, and that plants were flowering and going over earlier than would 'normally' be expected. Thus, the length of time between areas being cut or grazed and the plants growing up to flower again may vary.

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.

These results provide an encouraging indication that leaving uncut/ ungrazed margins when ley fields are grazed, or silage is taken, could supply the bumblebees/ pollinators with a food source during the period when the cut 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 pollinators. Similarly, if other areas on the farm are sympathetically managed for pollinator/bumblebees, this could be an alternative way to support pollinators in a farm situation.

## Whole Farm Habitats Identified and Discussed

- Areas identified on the farm, which have the potential to provide forage or suitable nesting and hibernation sites for bumblebees/ and other pollinators are outlined below:

    - The farming system works on a 21-day grazing rotation of the herbal leys and permanent grassland. If possible, within the remit of this Project, it is hoped that we can gain an understanding of whether or not there are always flowers available to pollinators across this grazing platform from February/ March through to October. As far as possible, this will be investigated further during subsequent years and prove valuable as a case study.
    - 'Nick's', 'Marsh' and 'Big Smoke' fields were identified as being the least improved permanent grassland parcels at Farm 3 and having the potential to provide forage for pollinators. 'Marsh' was the least improved field and most valuable in terms of its wildflowers. More concentrated

plant surveys will be carried out in 2019 to investigate further the floral resources available within these parcels and compare data with the baseline data gathered in 2018.

- The old, large hedgebanks across the farm have the potential to provide habitat for bumblebees/pollinators. Those with bare earth, especially the south-facing banks, have the potential to provide nesting habitat for solitary bees and beetles, in addition to basking sites for invertebrates generally. Gorse present on these banks can provide forage across the year for pollinators, and bramble and rose seen can provide an important source of pollen and nectar during summer months.
- The grassy hedgebanks and other areas with rougher, more tussocky grass, may provide suitable locations for bumblebee nests, particularly the south- and south-east facing areas. Similar areas that are north-facing may be used for hibernation sites.
- Within some of the field parcels, are margins that contain plant species, such as greater bird's-foot trefoil, that are valuable to bumblebees and other pollinators for forage. The management of these areas could be enhanced by appropriate cutting regimes. Allowing plants to flower and set seed before cutting the areas in mid to late summer, and the cutting again in late spring, would knock back grass growth and allow for the wildflowers to persist and potentially increase in number. Arisings should always be removed after cutting to prevent enrichment, which makes soils less suitable for the wildflowers.
- The edges of the wooded areas on the farm could also provide important resources for pollinators, both in terms of forage and nesting habitat. These areas may be enhanced by appropriate management. Tree species, such as some of the willows, can also be an important source of pollen and nectar in Spring for bumblebees when the new queens are feeding up following hibernation and establishing their new colonies.
- If areas across the whole farm are to be the focus for enhancement for pollinators (rather than leaving ley margins as well), 'a useful rule of thumb is to create five roughly even patches of wildflowers of 0.25Ha, or 0.5Ha in landscapes lacking in flowers' (Nowakowski, M. and Pywell, R., Habitat Creation and Management for Pollinators, 2016).
- The relevant areas of Farm 3 will be mapped in future years, and the management of these areas will be discussed further, in order to try to maintain and increase the floral resources and other habitat available to bumblebees and pollinators generally on the farm.
- Farmer 3 also manages Hafod SSSI near to Farm 3. This is an important site that is particularly valuable for pollinators, with old hay meadows and damper areas with marshy grassland plant assemblages and willow scrub. The management of these areas is being discussed with Natural Resources Wales. Enhancing Hafod by bringing the areas of grassland that have become more 'rank' back into favourable condition would undoubtedly be of benefit to pollinators across the site.

# *Report for Farm 4*

Small Copper Butterfly at Farm 4

## Summary of Work

- A total of two survey days were undertaken at Farm 4 during the summer months of 2018.
- The majority of the farm was walked by the Pasture for Pollinators surveyors, and habitat beneficial to bumblebees, and pollinators generally, was noted and pollinators seen were recorded.
- More intensive bumblebee surveys were carried out in Fields 1, 2, 3 and 4, as labelled on the map within this report (numbers assigned to fields are shown in the centre of each field on the map).
- Cut and uncut 100m x 4m margins were not available to survey during 2018.
- A desktop study was also undertaken to examine bumblebee records within a 5km radius of the farm.

## Practicalities & Compromises

- The seed obtained from Cotswold Seeds Ltd was sown during 2018 and not ready to survey during this season.
- In subsequent years, ungrazed and grazed margins will be left in the field containing the Project Seed mix and in an additional parcel containing the farm ‘standard’ herbal ley.
- Additionally, Farmer 4 was concerned regarding loss of grazing as the land is farmed to capacity. For 2019, it has been agreed that margins will be left temporarily, until they have been surveyed, which will occur within 2 weeks of the margins being left. Following the surveys, the margins will be grazed down or cut. As the farming system works on a 21-day grazing rotation of the herbal leys (which occupy the majority of the farm land), it is possible that there will be insufficient flowers available to pollinators once the temporary ungrazed margins are removed. However, as far as it is possible, this will be investigated further during subsequent years and prove valuable as a case study.
- Additionally, a community project has been developed by Farmer 4, involving local community groups such as the Cubs and Scouts and the Local Council. Additional Project seed will be sown along a 5m wide roadside verge on a quiet road that is bordered by the farm on both sides. Part of the length will be cut and part uncut for surveys. It is hoped that this ‘sub-project’ will help to raise awareness and educate people about pollinators and the Pasture for Pollinators Project.

## Monitoring Data Methods

- Fields 1, 2, 3 and 4, were walked and pollinators seen were recorded. Additionally, plant species seen in each field were recorded and observations on abundance of floral units noted. N.B. 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.

## Results

- Across the farm, a total of four (possibly five) species of bumblebee were recorded, in addition to other pollinator species given in the table below.

**Bumblebee and Other Pollinator Species Recorded Across the Whole Farm During the 2018 Surveys (not exhaustive)**

| **Common Name** | **Scientific Name** |
|---|---|
| **Common carder bee** | ***Bombus pascuorum*** |
| **Red-tailed bumblebee** | ***Bombus lapidarius*** |
| **Buff-tailed bumblebee** | ***Bombus terrestris*** |
| **White-tailed/ buff-tailed bumblebee** | ***Bombus lucorum/ terrestris worker*** |
| **Garden bumblebee** | ***Bombus hortorum*** |
| Common blue butterfly | *Polyommatus icarus* |
| Wasp sp | - |
| Meadow brown butterfly | *Maniola jurtina* |
| Small tortoiseshell butterfly | *Aglais urticae* |
| Green-veined white butterfly | *Pieris napi* |
| Silver Y moth | *Autographa gamma* |
| Hoverfly species | - |
| Small white butterfly | *Pieris rapae* |
| Large white butterfly | *Pieris brassicae* |
| Painted lady butterfly | *Vanessa cardui* |
| Small copper | *Lycaena phlaeas* |
| Honey bee | *Apis mellifera* |

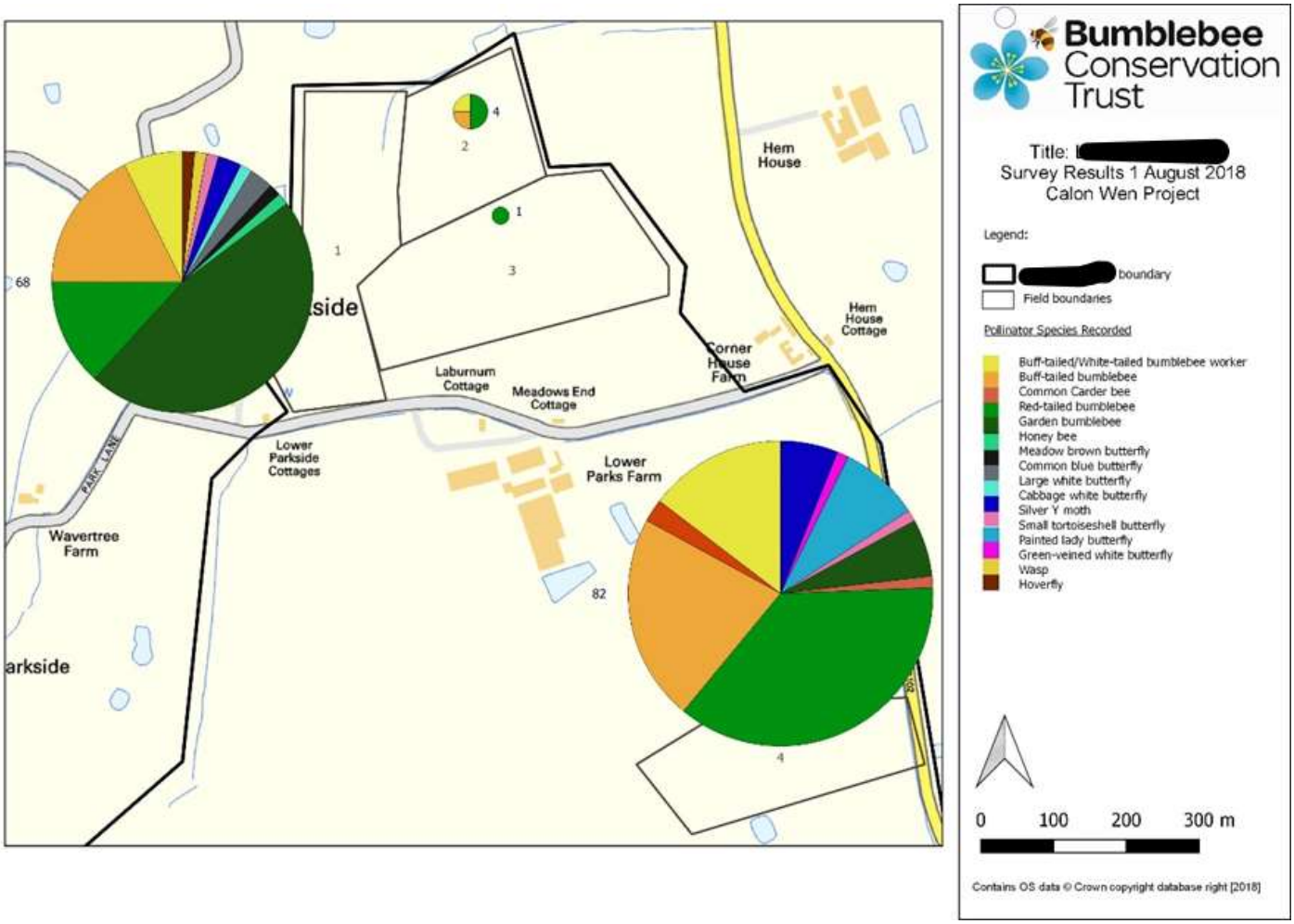
## List of Bumblebee Species Recorded Within 5km of Farm 4 Since 2000 Under BWARS and BeeWalk from the desktop study:

| | |
|---|---|
| Common carder bee | *Bombus pascuorum* |
| Early bumblebee | *Bombus pratorum* |
| Buff-tailed bumblebee | *Bombus terrestris* |
| Red-tailed bumblebee | *Bombus lapidarius* |
| Tree bumblebee | *Bombus hypnorum* |
| White-tailed bumblebee aggregate | *Bombus lucorum sensu lato* |
| Southern cuckoo bee | *Bombus vestalis* |
| Forest cuckoo bee | *Bombus sylvestris* |
| Field cuckoo bee | *Bombus campestris* |

Bumblebee records from the desktop study show that there is a potential for additional bumblebee species to be recorded on the farm.

## Monitoring Data Results

**Map Showing the Location of the Fields that were Surveyed for Pollinators at Farm 4 on 1 August 2018 and Pie Charts of the Pollinator Species Recorded in Each Field (the figure given next to each pie chart is the total number of individual pollinators recorded, and the size of each pie chart is proportional to that figure)**




- The pie charts show that more bumblebee and pollinator species were recorded in Fields 1 and 4 (with 12 and 10 species respectively), compared to Fields 2 and 3 (with 3 and 1 species respectively).
- Larger numbers of bumblebees and pollinators were recorded in Fields 1 and 4 (with 68 and 82 individuals respectively), compared to Fields 2 and 3 (with 4 and 1 individuals respectively).
- Fields 1, 2, and 4 contained herbal leys, comprising a number of species; at least 14 plant species were present in Field 1 and more than 6 species of herb were recorded in Fields 2 and 4. Field 3, contained perennial rye grass and white clover.
- It was observed that Field 3 had the lowest floral unit abundance of all the fields; Field 2 had the second lowest abundance of floral units; and Fields 1 and 4 had the highest abundance of floral units.
- It was noted that there was more red clover in Field 4 compared to Field 1; very little red clover in Field 2; and no red clover was seen in Field 3.

## Discussion of Monitoring Data Results

- Whilst floral resources weren't measured quantitatively, it would appear that there was a greater abundance of floral units in Fields 1 and 4 and higher numbers of pollinator individuals and species. Whilst Field 2 contained a similar number of species of flowering plant to Field 4, Field 2 had a much lower abundance of floral units and fewer pollinator numbers and species were seen. Field 1 contained the lowest plant diversity and abundance of floral units, and the lowest number of pollinators was recorded in Field 1. Interestingly, it was noted that Field 4 contained the most red clover and the highest numbers of pollinators of all the Fields.

- The results indicate a positive correlation between the number of floral units and the number of bumblebees/ pollinators recorded in a field.
- 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.
- It was noted, across the Project farms, that the hot summer of 2018 was speeding up the reproductive phase of flowering plants, and that plants were flowering and going over earlier than would 'normally' be expected. Thus, the length of time between areas being cut or grazed and the plants growing up to flower again may vary.

## Whole Farm Habitats Identified and Discussed

- The rough grassland within an area that is fenced off in Field 2, and within fenced out areas in at least 3 other parcels, has the potential to provide nesting habitat for bumblebees. The grass along some lengths of the tracks has become tussocky and could also provide suitable nesting sites.
- There are substantial amounts of trackside verges and ditch sides across the farm (where rough grassland suitable for nesting is not present) that could be enhanced for bumblebees and pollinators, by cutting and removing arisings in April/ May to knock back courser grasses to allow wildflowers to thrive; and cutting and/or grazing after the flowering season to allow wildflower seed to set before reducing grass growth. Wildflowers or native red clover could be introduced to areas where there are not currently flowering plants and managed similarly.
- Hedgerows are cut into an A-shape on the farm, which is valuable for native species. If different lengths are allowed to flower in different years, this would help to provide Spring forage for bumblebees, that is much needed when the new queens emerge from hibernation, in order to feed up and establish the new colonies. This would also provide for many other pollinator species.
- There is a block of woodland, the edge of which could provide important spring forage, in addition to forage later on in the year when the bramble comes into flower.
- The relevant areas will be mapped in future years, and the management of these areas will be discussed further, in order to try to maintain and increase the floral resources and other habitat available to bumblebees and pollinators generally on the farm.

# *Report for Farm 5*

Buff-tailed bumblebee *Bombus terrestris* queen on a bluebell at Farm 5

## Introduction

Farm 5 is an organic dairy farm located on the Pembrokeshire coast. Much of the permanent grassland is extensively grazed, and not intensively farmed, meaning that there is still valuable, less improved grassland present. This includes areas of marshy grassland which contain important flowering plants which provide nectar and pollen food sources for bumblebees and other pollinators. There are also wooded areas, scrub, hedgerows and coastal grassland; all containing a variety of food sources for pollinators. In addition to these areas, many of the relatively more improved permanent grassland parcels retain pockets that contain wildflowers and the arable leys contain valuable red and white clover. There are a variety of different habitats which may provide suitable bumblebee nesting sites.

Farm 5 lies within both an Important Plant Area and an Important Invertebrate Area. In addition, part of the coastal land of Farm 5 forms part of the Strumble Head and Llechdafad Cliffs Site of Special Scientific Interest (SSSI). The SSSI designation includes numerous species of flora and fauna; notably, twenty species of butterfly, including a small colony of the small blue *Cupido minimus* and abundant grayling *Hipparchia semele*. Other scarce invertebrates found on the SSSI include the tortoise beetle *Pilemostoma fastuosa* and two flies *Paragus haemorrhou* and *Epitriptus cingulatus*.

## Summary of Work

A total of four survey days were undertaken at Farm 5 during the summer months of 2018. The majority of the farm was walked by the Pasture for Pollinators surveyors, and habitat beneficial to bumblebees, and pollinators generally, was noted and pollinators seen were recorded. Additionally, the cut and uncut 100m x 4m margins left by Farmer 5 in the two clover and rye ley fields were surveyed during the visits in June and August.

A desktop study was also undertaken to examine bumblebee records within a 5km radius of the farm.

## Practicalities & Compromises

The seed obtained from Cotswold Seeds Ltd and sown during 2018 was a standard rye, white and red clover ley and not the herbal ley intended for the Project. Thus, the Project ley type that will be surveyed on this holding for the duration of the Project is different to that on the other Calon Wen Project farms. This ley is the same or similar to the ‘standard ley’ used at Farm 5 that will also be surveyed under the Project. It will be interesting to be able to compare the data collected to see whether there is much of a difference between the two fields surveyed and thus the data will still be valuable.

## Monitoring Data Methods

Transect surveys and quadrat surveys were undertaken in each cut and uncut margin that was surveyed. At Farm 5, margins were surveyed in two fields, a northern parcel and a southern parcel (as shown on the maps in this report). Transect surveys were used to record bumblebees and other pollinators present in a margin. Plant surveys were undertaken by placing fifteen 1mx1m quadrats in each margin and listing plants used as a nectar/ pollen source by pollinators; and estimating percentage cover and counting the number of floral units for each plant species. N.B. 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.

## Results

Across the farm, a total of four (possibly five) species of bumblebee were recorded, in addition to numerous other pollinator species given in the table below.

**Bumblebee and Other Pollinator Species Recorded Across the Whole Farm During the 2018 Surveys (not exhaustive)**

| **Common Name** | **Scientific Name** |
|---|---|
| **Common carder bee** | ***Bombus pascuorum*** |
| **Red-tailed bumblebee** | ***Bombus lapidarius*** |
| **Buff-tailed bumblebee** | ***Bombus terrestris*** |
| **White-tailed/ buff-tailed bumblebee** | ***Bombus lucorum/ terrestris* worker** |
| **Garden bumblebee** | ***Bombus hortorum*** |
| Hoverfly species | *Rhingia campestris* |
| **Dark green fritillary butterfly*** | ***Argynnis aglaja*** |
| Hoverfly sp | *Syrphidae* |
| Thick-legged flower/ swollen-thighed beetle | *Oedemera nobilis* |
| Sawfly spp | n/a |
| Silver Y moth | *Autographa gamma* |
| Meadow brown butterfly | *Maniola jurtina* |
| Skipper sp butterfly | n/a |
| Small white butterfly | *Pieris rapae* |
| micro moth sp | n/a |
| fly sp | n/a |
| Small tortoiseshell butterfly | *Aglais urticae* |
| Painted lady butterfly | *Vanessa cardui* |
| Small copper butterfly | *Lycaena phlaeas* |
| Common blue butterfly | *Polyommatus Icarus* |

***It is worth noting that the dark green fritillary butterfly is listed as medium conservation concern by Butterfly Conservation.**

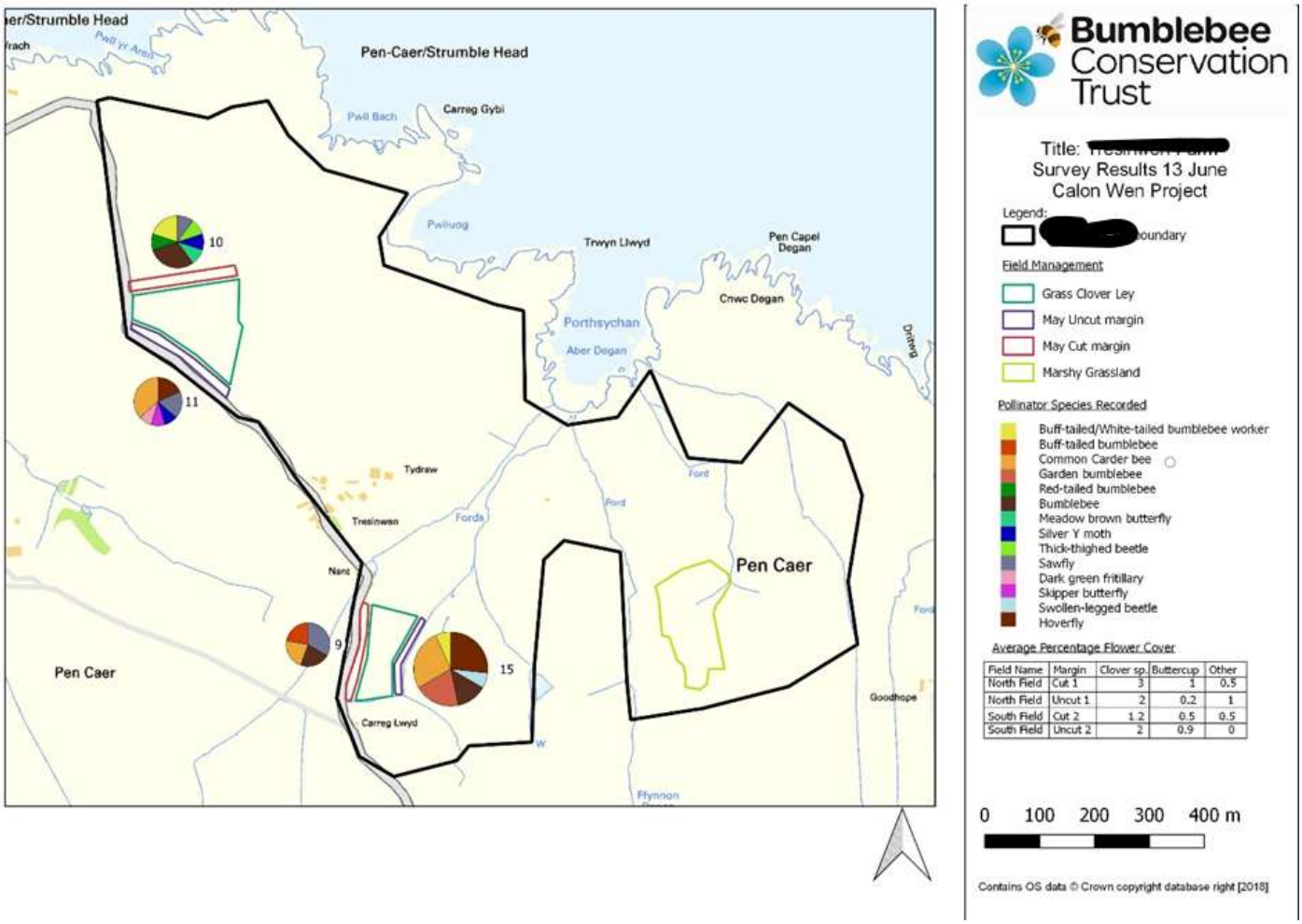
## List of Bumblebee Species Recorded Within 5km of Farm 5 Since 2000 Under BWARS and BeeWalk from the desktop study:

| | |
|---|---|
| Common carder bee | *Bombus pascuorum* |
| Early bumblebee | *Bombus pratorum* |
| Heath bumblebee | *Bombus jonellus* |
| Buff-tailed bumblebee | *Bombus terrestris* |
| Garden bumblebee | *Bombus hortorum* |
| Red-tailed bumblebee | *Bombus lapidarius* |
| Southern cuckoo bee | *Bombus vestalis* |
| Red-tailed cuckoo bee | *Bombus rupestris* |
| **Brown-banded carder bee** | ***Bombus humilis*** |
| Tree bumblebee | *Bombus hypnorum* |
| White-tailed bumblebee aggregate | *Bombus lucorum* sensu lato |
| Gypsy cuckoo bee | *Bombus bohemicus* |

Bumblebee records from the desktop study show that there is a potential for additional bumblebee species to be recorded on the farm. Of particular note, is the record of the Brown-banded carder bee (*Bombus humilis*). This is a rare species that has declined significantly in the UK and is now one of the rarest UK bumblebee species. It favours flower-rich meadows, thus there is a possibility that this species may be helped by managing flower-rich permanent pasture on Farm 5.

## Monitoring Data Results

**Map Showing the Location of the Field Margins that were Surveyed at Farm 5 on 13 June 2018 and Pie Charts of the Pollinator Species Recorded in the Margins Alongside the Corresponding Margin Location (the figure given next to each pie chart is the total number of individual pollinators recorded for the margin, and the size of each pie chart is proportional to that figure)**

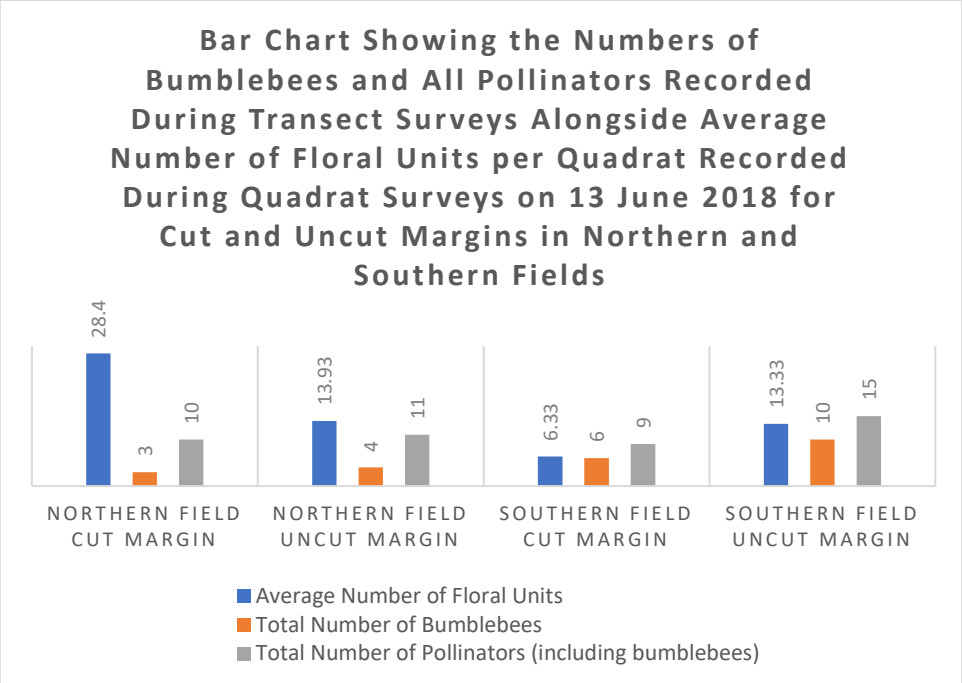



| Field Name | Margin | Clover sp. | Buttercup | Other |
|---|---|---|---|---|
| North Field | Cut 1 | 3 | 1 | 0.5 |
| North Field | Uncut 1 | 2 | 0.2 | 1 |
| South Field | Cut 2 | 1.2 | 0.5 | 0.5 |
| South Field | Uncut 2 | 2 | 0.9 | 0 |

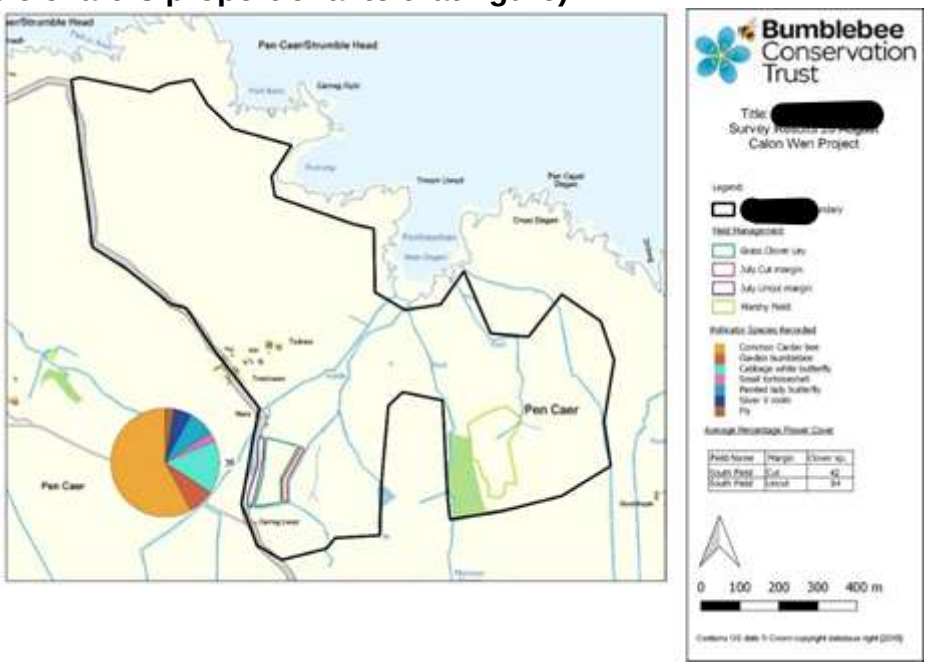
- The pie charts above show that more pollinators were recorded on 13 June 2018 in the uncut margin of the southern field compared to the cut margin. There is little difference between numbers of pollinators recorded in cut and uncut margins of the northern parcel.

- The bar chart below shows the total numbers of bumblebees and pollinators next to the average number of floral units per quadrat for each of the four margins surveyed. This shows that there are more bumblebees/ pollinators and more floral units in the uncut margin of the southern field, compared to the cut margin.

- The situation is slightly different for the northern field, where there are more floral units in the cut margin compared to the uncut margin and similar numbers of pollinators/ bumblebees in both.

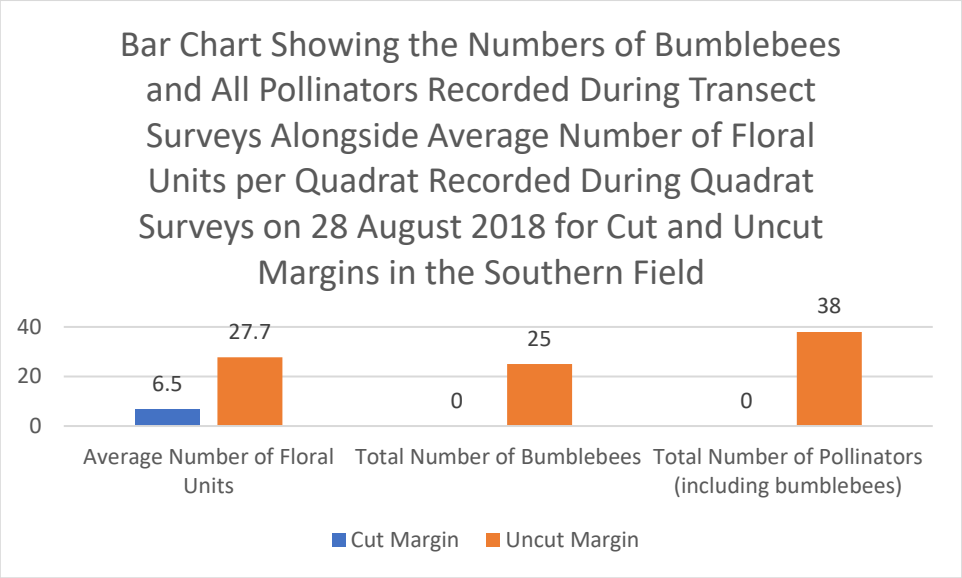



**Map Showing the Location of the Field Margins that were Surveyed at Farm 5 on 28 August 2018 and a Pie Chart of the Species Recorded in the Uncut Margin in the Southern field that was Surveyed (no records were recorded from surveys of the cut margin) (the figure given next to the pie chart is the total number of individual pollinators recorded for the margin, and the size of the pie chart is proportional to that figure)**




- The map previously shows that a number of bumblebees/ pollinators were recorded in the uncut margin; compared to the cut margin, in which no bumblebees/ pollinators were recorded.

- The bar chart below shows that there were few floral units present in the cut margin and many more in the uncut margin. All the bumblebees/ pollinators recorded were found in the uncut margin.




## Whole Farm Habitats Identified

### Marshy Grassland

This includes areas of marshy grassland which contain important flowering plants that provide a food source for bumblebees and other pollinators from around May through into October. The main area spans part of two field parcels and is outlined on the maps within this report.

Typical marshy grassland species that were found at Farm 5 in these areas include the plants: ragged robin, lesser spearwort, water mint, marsh bedstraw, fleabane, greater bird's-foot trefoil and at least one species of orchid.

There are additional 'pockets' of marshy grassland across the farm.

### Woodland, Scrub and Hedgerows

There are wooded areas containing willow, an important spring nectar and pollen food source for bumblebees and other pollinators. Additionally, scrub and hedgerows present contain bramble and other species, which can provide a food source from May to September. Other habitat includes the coastal grassland that is outside the grazing land for the holding, but provides a variety of nectar and pollen sources, such as bluebell, foxgloves and campions.

### Wildflowers Within the More Agriculturally Improved Fields

Many of the relatively more improved permanent grassland parcels retain 'pockets' that contain wildflowers, such as trefoils, important pollinator plants that have long flowering seasons.

There are many areas between field parcels and along field edges where wildflowers are present. Such flowers, for example, tufted vetch, hedge woundwort and bramble, are used by bumblebees and other pollinators as forage plants.

Black knapweed, a later-flowering plant which bumblebees feed from is also present in some of the fields.

### Arable Leys

The fields nearer to the farmstead are mostly arable leys, containing valuable red and white clover, food sources for many pollinators including bumblebees.

### Bumblebee Nesting and Hibernation Habitat

There are old stone-faced hedgebanks, and grassy hedgebanks and other areas with rougher, more tussocky grass, which may provide suitable locations for bumblebee nests, particularly the south- and south-east facing areas. Similar areas that are north-facing may be used for hibernation sites.

## Discussion of Results

### Monitoring Data

- The results indicate a positive correlation between the number of floral units and the number of bumblebees/ pollinators recorded in a field margin.
- Higher numbers of floral units and bumblebees/ pollinators were seen in the uncut margins, for a certain time period after the silage cut is taken.
- The anomalous results from the 13 June survey of the margins in the northern field are thought to be due to the timing of the surveys in relation to when the last silage cut was taken. It was observed during the surveys that flowers in the uncut margin were coming to an end and the plants in the cut margin had started to flower.
- The results indicate that the uncut margins were providing nectar and pollen sources from floral units when the cut margins have none or very few.
- After a certain period, the flowers in the uncut margins die off, but plants in the cut margin will have grown and started flowering again by that time.
- It was noted, across the Project farms, that the hot summer of 2018 was speeding up the reproductive phase of flowering plants, and that plants were flowering and going over earlier than would 'normally' be expected. Thus, the length of time between areas being cut or grazed and the plants growing up to flower again may vary.

These results provide an encouraging indication that leaving uncut margins when silage is taken could supply the bumblebees/ pollinators with a food source during the period when the cut 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 as silage is cut. 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 pollinators.

### Whole Farm Habitats - Management Recommendations

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 native plant species present at Farm 5 include species that flower right the way through this season. The reason the native wildflowers and their semi-natural habitats are present on the holding are thought to be due to the extensive (low stocking) cattle grazing. In addition, it is thought that there is suitable bumblebee nesting and hibernation site on the farm.

The relevant areas will be mapped in future years, and the management of these areas will be discussed further, in order to try to maintain and increase the floral resources and other habitat available to bumblebees and pollinators generally on the farm. Within this report, the management of the largest area of marshy grassland will be discussed (see below).

#### Marshy Grassland

Marshy grassland in Wales has become much reduced, being lost or degraded, for example, by drainage and agricultural improvement. It is, therefore, a valuable resource worthy of conservation both in its own right and for the variety of species it supports.

The possibility of fencing the main area of marshy grassland was discussed with Farmer 5 , in order that management of the parcel could be adjusted to enhance this habitat. By early 2019, Farmer 5 hard had fenced the parcel and installed a gate in order to manage it appropriately.

The aim of the grazing is to maintain species richness by grazing seasonally to levels which will create an uneven and 'tussocky' sward within the range of 5cms to 25cms height by October each year. 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. During grazing, monitor the progress and sward height regularly and adjust the number of stock and length of time they are in the field accordingly. The sward should be no shorter than 5cm by October, allowing a long sward during the summer months.

It is recommended that the field is grazed during the following months:

- 15 March to 15 April;
- 15 July to 15 August;
- If the vegetation at the end of September is greater than the desired mosaic sward of 5-25cm, then autumn grazing can be carried out in drier conditions from 1st October to 14th October.
- Cattle to be taken off if the ground starts to become poached. While a little poaching is beneficial for plants to set seed, too much can damage this habitat.

In addition, it would be advisable to reduce the scrub that has encroached into the field and prevent further scrub encroachment into this marshy grassland area. A small area of scrub could be cut each year between October and February (outside the breeding bird season). The ideal would be to reduce the amount of scrub around the field edges and aim for around 5% of scrub within the parcel. Scrub is valuable for other species, such as birds, and any willow and bramble within the scrub areas can provide forage for bumblebees; however, there are significant amounts of scrub near to this parcel and elsewhere on the holding to allow for scrub removal within the marshy grassland area.

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).

# *Report for Farm 6*

Common carder bee *Bombus pascuorum* on clover at Farm 6

## Summary of Work

- A total of two survey days were undertaken at Farm 6 during the summer of 2018.
- The majority of the farm was walked by the Pasture for Pollinators surveyors, and habitat beneficial to bumblebees, and pollinators generally, was noted and pollinators seen were recorded.
- Additionally, 100m x 4m margins were surveyed both on the ungrazed Project ley and the remainder of the field which had been grazed down.

- A desktop study was also undertaken to examine bumblebee records within a 5km radius of the farm.

## Practicalities & Compromises

- The fields at Farm 6 may be grazed or cut for silage, depending on the situation at the time. This farm will differ slightly from the other Project farms, with comparison between ungrazed and grazed margins being made instead of/ as well as cut and uncut margins. This will be valuable as a case study, to show how margins can be managed for pollinators within a grazing regime.
- The seed obtained from Cotswold Seeds Ltd was sown during 2018 in a central band across a field where a power line had been installed and the ground already disturbed (as shown on the map within this report). It had not been cut or grazed, and was ready to survey during the site visit on 21 August 2018. The rest of the field contained a standard farm ley and had been grazed down, so a 'control' margin was surveyed along one of the field boundaries (as shown on the map).
- In subsequent years, ungrazed/ uncut and grazed/ ungrazed margins will be left in the field containing the Project Seed mix; and in an additional parcel containing the farm 'standard' ley of rye and clover, or on semi-permanent grassland.
- The ungrazed/ uncut margins that will be left within the Project seed ley will be linear 4m by 100m margins.
- An additional margin was left by Farmer 6 in the hay field. However, the hot, dry weather conditions meant that it had gone over by the time the surveys were carried out and the plants in the remainder

of the field had not grown up sufficiently to survey. Thus, no surveys were undertaken in the hay field during 2018.

## Monitoring Data Methods

- Transect surveys and quadrat surveys were undertaken in the grazed and ungrazed margins that were surveyed (as shown on the maps in this report).
- Transect surveys were used to record bumblebees and other pollinators present in a margin. Plant surveys were undertaken by placing fifteen 1mx1m quadrats in each margin and listing plants used as a nectar/ pollen source by pollinators; and estimating percentage cover and counting the number of floral units for each plant species. N.B. 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.

## Results

- Across the farm, a total of three (possibly four) species of bumblebee were recorded, in addition to other pollinator species given in the table below.

**Bumblebee and Other Pollinator Species Recorded Across the Whole Farm During the 2018 Surveys (not exhaustive)**

| **Common Name** | **Scientific Name** |
|---|---|
| **Common carder bee** | ***Bombus pascuorum*** |
| **White-tailed/ buff-tailed bumblebee** | ***Bombus lucorum/ terrestris* worker** |
| **Buff-tailed bumblebee** | ***Bombus terrestris*** |
| **Red-tailed bumblebee** | ***Bombus lapidarius*** |
| Hoverfly species | - |
| Fly species | - |
| Hairy/ sloe shieldbug | *Dolycoris baccarum* |
| Small white butterfly | *Pieris rapae* |
| Wasp species | - |
| Tiny insect species | - |

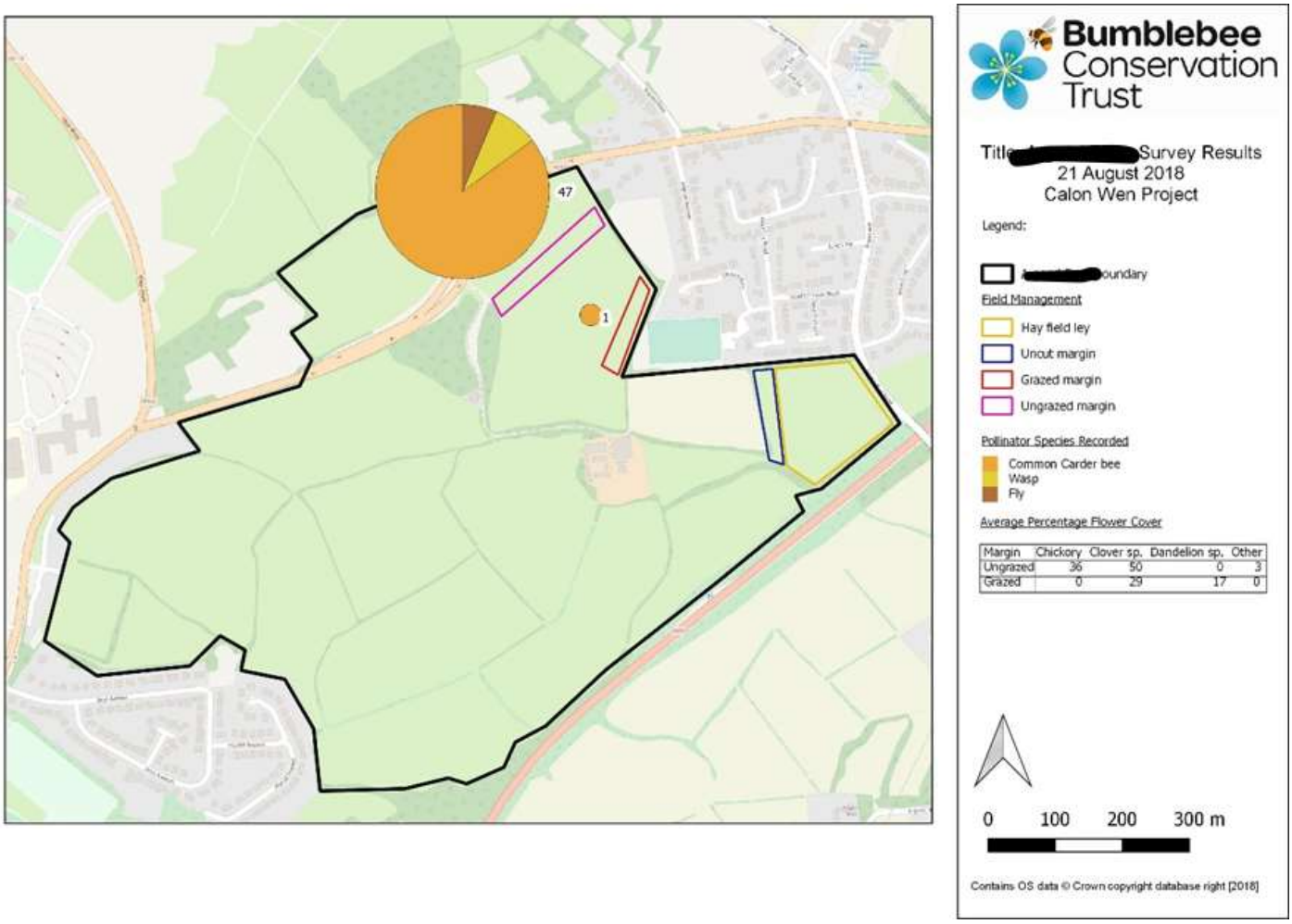
## List of Bumblebee Species Recorded Within 5km of Farm 6 Since 2000 Under BWARS and BeeWalk from the desktop study:

| | |
|---|---|
| Common carder bee | *Bombus pascuorum* |
| Early bumblebee | *Bombus pratorum* |
| Red-tailed bumblebee | *Bombus lapidarius* |

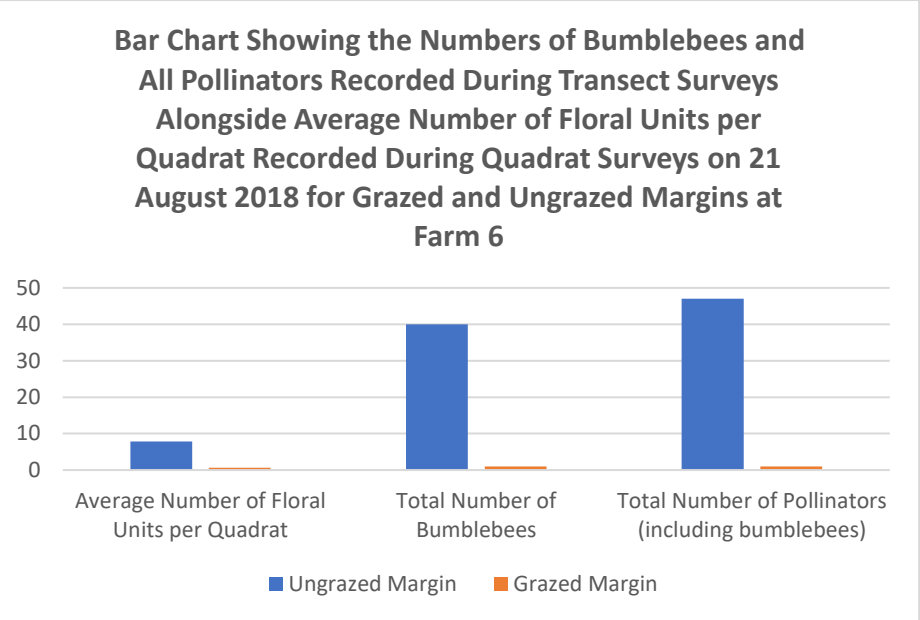
Bumblebee records from the desktop study show that there is a potential for additional bumblebee species to be recorded on the farm.

**Monitoring Data Results**

**Map Showing the Location of the Field Margins that were Left at Farm 6 in 2018, including the Grazed and Ungrazed Margins that were Surveyed on 21 August 2018 and Pie Charts of the Pollinator Species Recorded in the Margins Alongside the Corresponding Margin Location (the figure given next to each pie chart is the total number of individual pollinators recorded for the margin, and the size of each pie chart is proportional to that figure)**




- The pie charts above show that more pollinators were recorded on 21 August 2018 in the ungrazed margin of the field compared to the grazed margin.
- The bar chart below shows the total numbers of bumblebees and pollinators next to the average number of floral units per quadrat for both of the margins surveyed. This shows that there are more bumblebees/ pollinators and more floral units in the ungrazed margin compared to the grazed margin.




## Whole Farm Habitats Identified

### Hay Field

- The hay field has not been ploughed or re-seeded for around 100 years. It is the oldest field parcel on the holding and is more species rich in comparison to the other fields, which are all relatively agriculturally improved.
- The uncut margin left in the hay field in 2018 could not be surveyed due to the fact that the flowering plants had gone over. If this margin was left uncut, it would provide suitable bumblebee nesting habitat within a couple of years, but the floristic diversity would decrease, meaning it would be less suitable as a forage site for invertebrates.
- The South-facing boundary edge has longer, more tussocky grass that would provide good nesting habitat for some bumblebee species and other invertebrates. Also present along that field edge, was black knapweed, a long and late-flowering plant which bumblebees and other pollinators feed from.

### Ley Fields

- The majority of the fields on the holding contain older, modern leys of white clover and rye. White clover provides forage for bumblebees with short tongues. It was noted that creeping thistle is present, which is a valuable source of nectar and pollen for bumblebees and other invertebrates.
- Field parcel SJ25641894 contained black knapweed. It was also noted that there is some local enrichment within that field.
- Bramble and rose were recorded in the hedgerows, both of which are valuable nectar and pollen sources.

### Fenced Out, Damp Area in field SJ26416485

- Flowering plants were recorded in this area, including black nightshade, creeping thistle and rosebay willowherb; all plants that provide food sources for pollinators.

### Bare Earth

- In a couple of areas on the farm, bare earth is present, which can provide nesting sites for solitary bees and some beetle species. However, it becomes less useful if the soil becomes compacted by livestock, which was also seen. South-facing, warmer areas of bare earth are most valuable. As well as nesting sites, these areas can also provide important basking sites for invertebrates.

### Tracksides

- Banks and rough, tussocky grass present on Farm 6 tracksides may provide suitable nesting sites for bumblebees, especially the south-facing sides.

### Farm Garden

- Whilst the farm garden is outside the farmed area, it is worth noting due to the number and diversity of flowering plants being grown. Many of the plants are valuable for invertebrate species, including comfrey and the other herbs being grown.

## Discussion of Results

### Monitoring Data

- The results indicate a positive correlation between the number of floral units and the number of bumblebees/ pollinators recorded in a field margin.
- Higher numbers of floral units and bumblebees/ pollinators were seen in the ungrazed margin.
- The results indicate that the ungrazed margin was providing nectar and pollen sources from floral units when the grazed margin had none or very few.
- It was noted, across the Project farms, that the hot summer of 2018 was speeding up the reproductive phase of flowering plants, and that plants were flowering and going over earlier than would 'normally' be expected. Thus, the length of time between areas being cut or grazed and the plants growing up to flower again may vary.

These results provide an encouraging indication that leaving ungrazed margins when a field is grazed could supply the bumblebees/ pollinators with a food source during the period when the grazed plants are re-growing, and before they start flowering again. Thus, if margins can be incorporated into the farming system, it will be of benefit to the bumblebees and pollinators.

### Whole Farm Habitats - Management Recommendations

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.

Whilst some flowers may have gone over by the time of the surveys, and the farm will be surveyed earlier in 2019, there appeared to be few native plant species present in the majority of the fields at Farm 6. Most field parcels contained white clover, which is suitable for bumblebees with short tongues, such as the Buff-tailed bumblebee and the White-tailed bumblebee; but few flowering plants suitable for bumblebees with longer tongues, such as red clover. Black knapweed, which is present in some fields across the farm is suitable for bumblebees of any tongue length.

One possible management option, would be to introduce wildflowers or native red clover across the holding. This could be undertaken in ungrazed areas such as tracksides, or in hedgerow margins. Such areas would need to be ungrazed during the summer months to allow plants to flower; and cut and the arisings removed after the flowering season to ensure that grasses do not start to dominate, thus, ensuring the persistence of the flowering plants. It would be ideal if such areas could be grazed as well as being cut.

The relevant areas will be mapped in future years, and the management of these areas will be discussed further, in order to try to maintain and increase the floral resources and other habitat available to bumblebees and pollinators generally on the farm.

# Appendix II: 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