Studying pollinator distribution on the Purbeck heaths

By James Appleby

Introduction:

The UK is home to over 250 species of bee, 24 of which are bumble bees, and one is the honey bee. Bees are important pollinators, and their varied tongue lengths allow them to pollinate a variety of different flower species. Heathlands are home to such flowers, with dry heaths dominated by bell heathers in early summer and wet heaths hosting cross-leaved heath, as well as a few less abundant flowering plants such as sundews, sedges and asphodels. This study looked at the numbers of flowers in areas of both wet and dry heath and compared them to the number of different larger bee species found at these sites, to look for correlations between certain flower species and certain bee species.

Method:

The surveys were carried out in the central plateau compartment of Godlingston Heath on the morning of 5th of July, and in Hartland on the afternoon of 12th July 2017. Sample sites were selected haphazardly. The windspeed, temperature and weather were recorded, as these factors could affect the number of bees active during the survey, and should be considered when drawing conclusions. Time of day was also recorded, as well as coordinates, so the sites could be plotted on a map (Figures 1 and 2). The quadrat was measured as 7 by 7 metres using paces. Once marked out, the plants were surveyed. Only flowers were counted; the Ling heather (*Calluna vulgaris*) was not in flower at the time so was not counted. This was because the flowers were what attracted the bees and were proposed to affect their distribution. The numbering system was qualitative rather than quantitative; a 0 was given for no floral units, a 1 for 1-50, a 2 for 51-500 and a 3 for more than 500. Once this was completed the two surveyors would look for bees in the quadrat for ten minutes each, totalling twenty minutes surveying time. The number of *Bombus terrestris* and *B.lucorum* were tallied together as their similarity made it difficult for amateurs to tell them apart, and so it was better to keep the data broad and accurate than specific and inaccurate.

Risk assessment:

An obvious hazard when working with honey bees and bumblebees is their ability to sting. Bees even have the potential to kill people if they happen to be allergic to their stings. Because of this, caution was taken when working alongside the bees to avoid getting to close to them or disturbing them. A member of the team also carried a first aid kit and everyone was provided with their phone number in the event that someone was stung and needed medical attention. The other hazards were those that are typically associated with working outside in the field, such as sunburn and heat stroke. The surveyors were advised to wear sun cream and carry bottles of water, and to stop work if they started to feel ill.

Figure 1 – Map of survey sites at Godlingston Heath

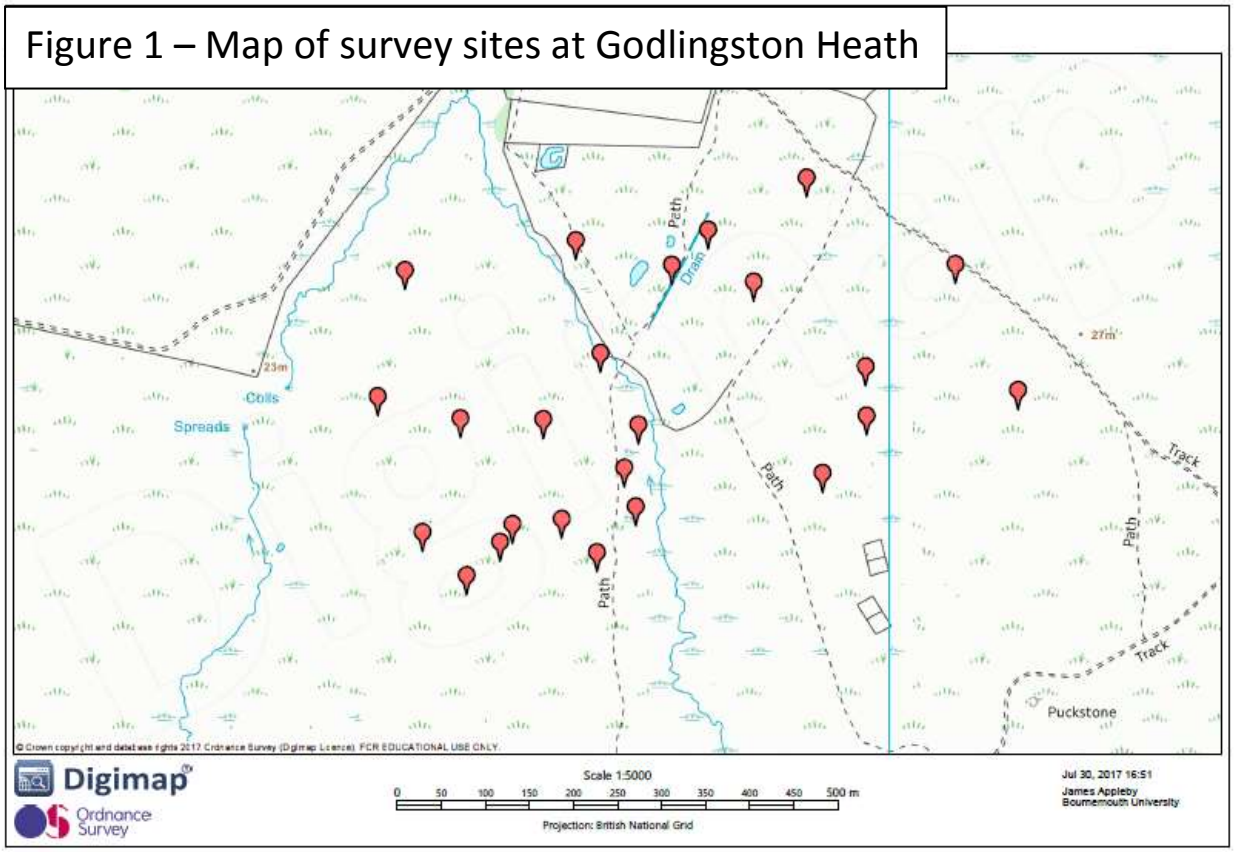
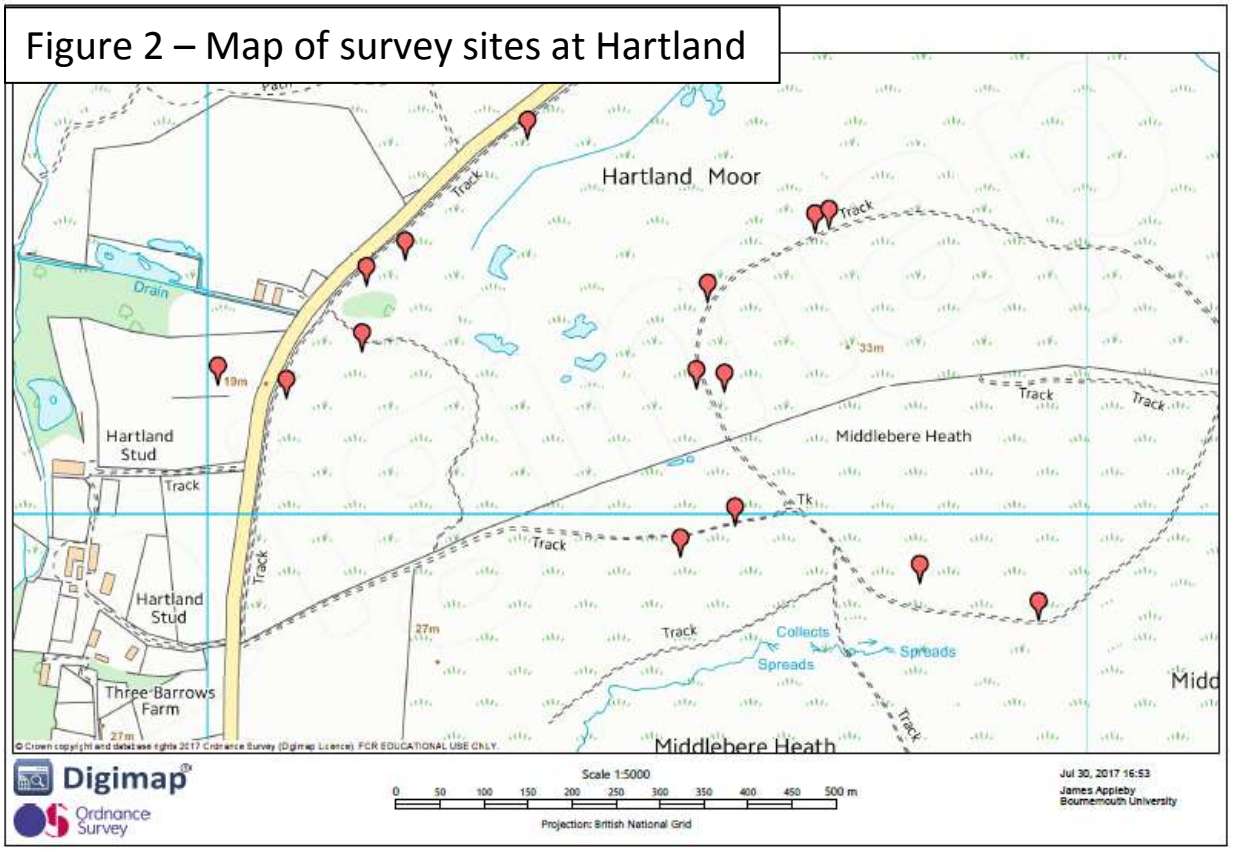


Figure 2 – Map of survey sites at Hartland



Results:

The results from the survey were first entered into Excel and then SPSS. In SPSS correlation tables were produced (Figures 12-14). These were used to find the data deemed statistically significant, which were used to produce the following graphs in Excel. Each circle or square on the graph represents the data for one 7x7 metre quadrat.

Figure 3: Occurrence of *B.terrestris* in areas with *E.tetralix*

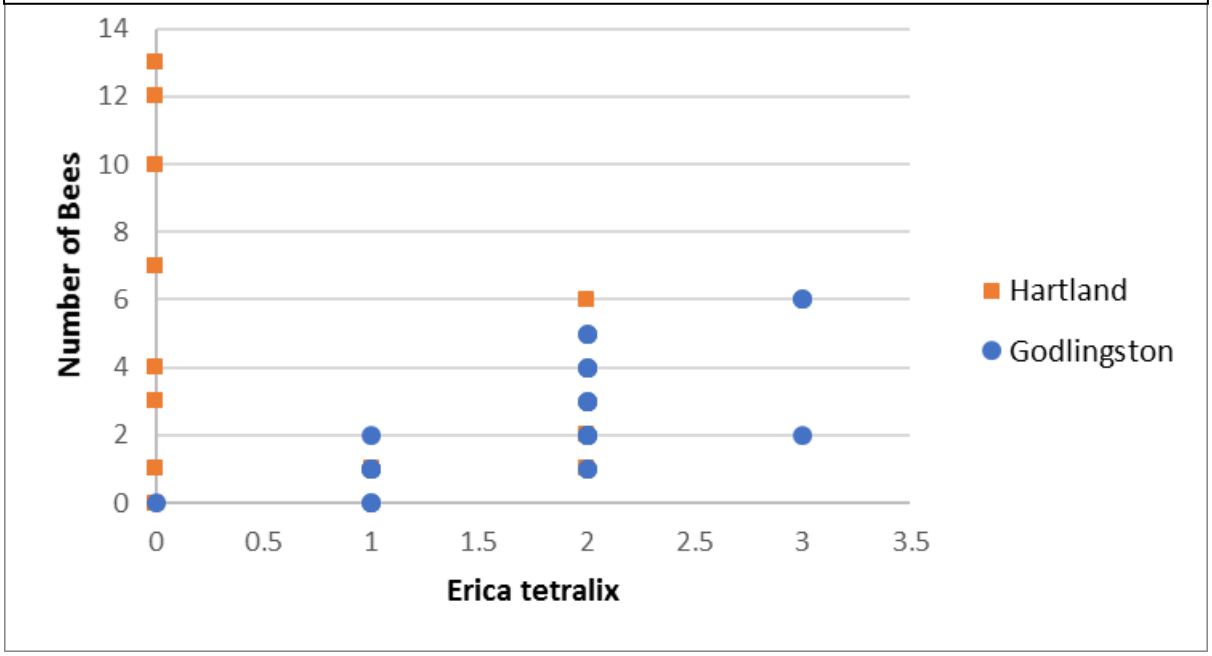


Figure 5: Occurrence of *Apis mellifera* in areas with *E.tetralix*

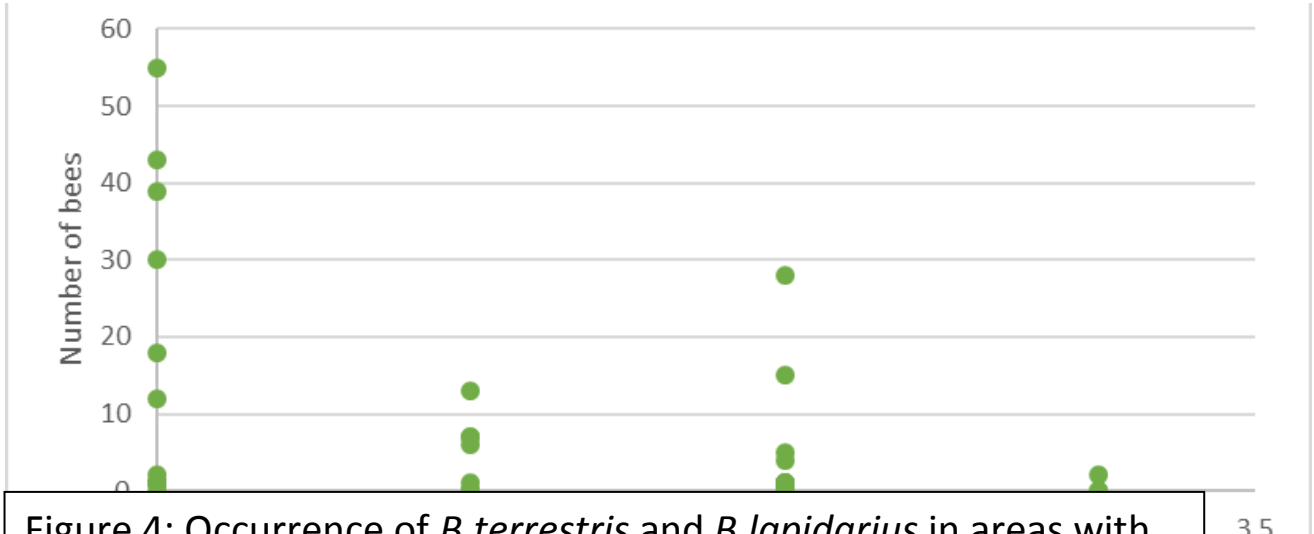
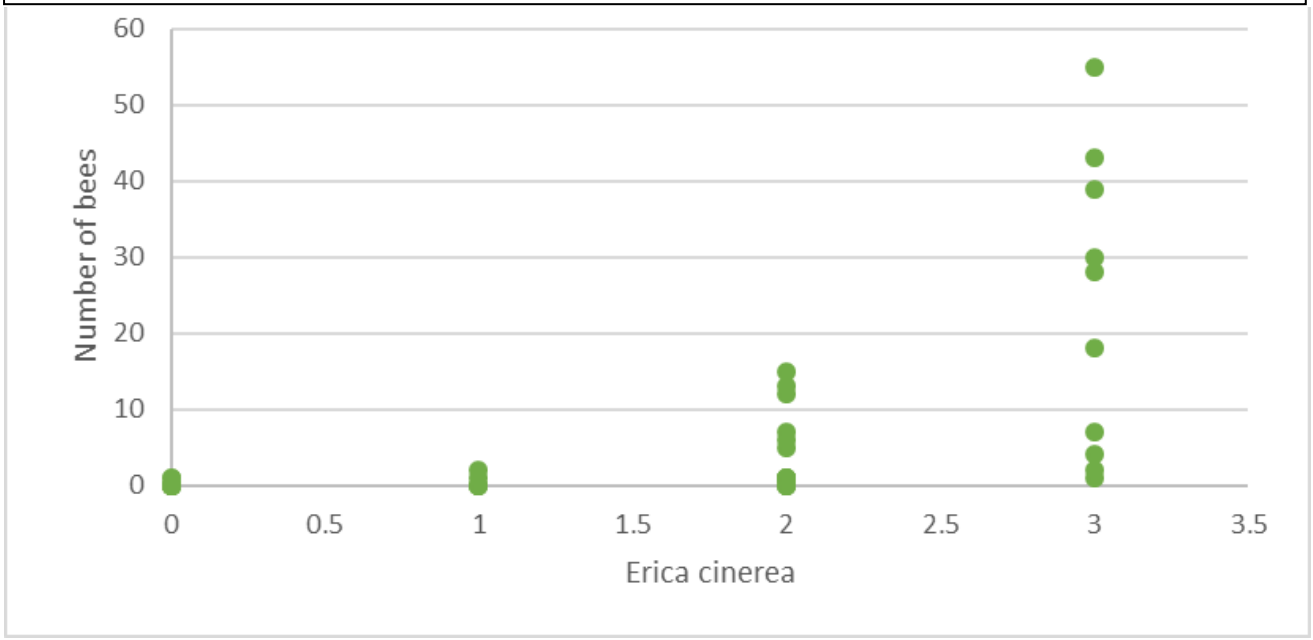
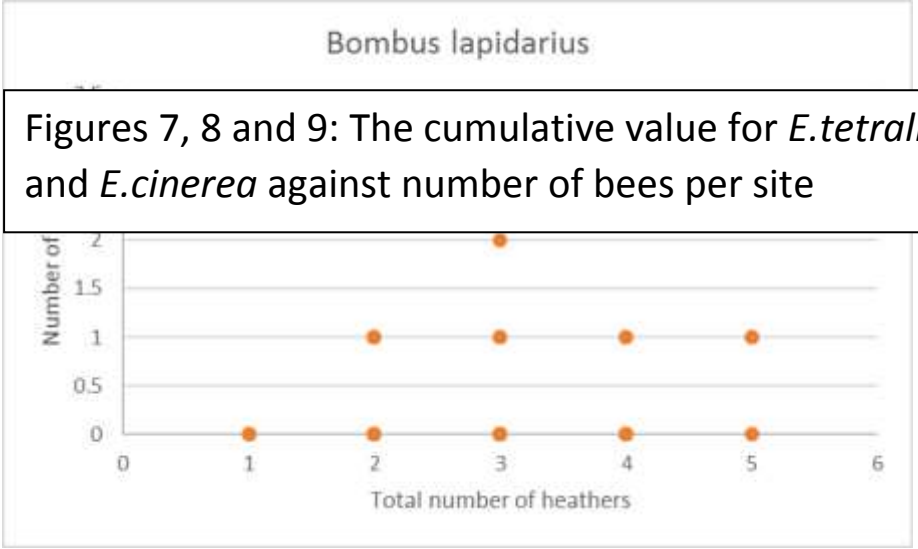


Figure 4: Occurrence of *B.terrestris* and *B.lapidarius* in areas with *E.cinerea*

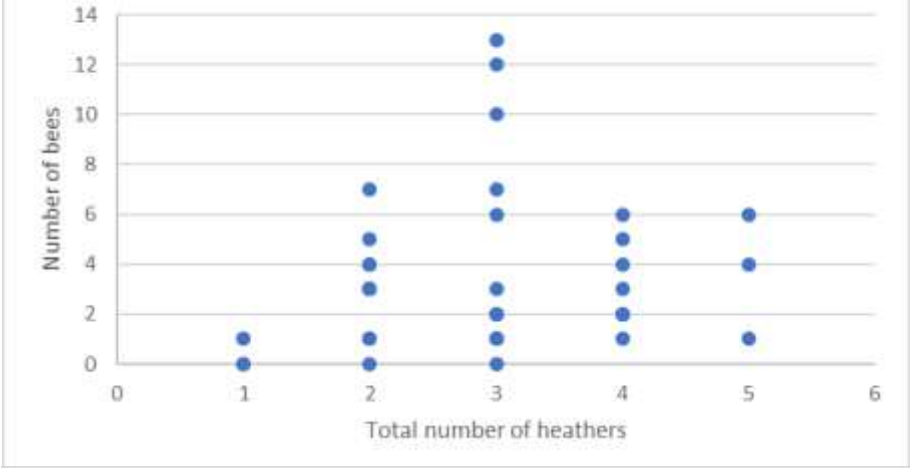
Figure 6: Occurrence of *Apis mellifera* in areas with *E.cinerea*



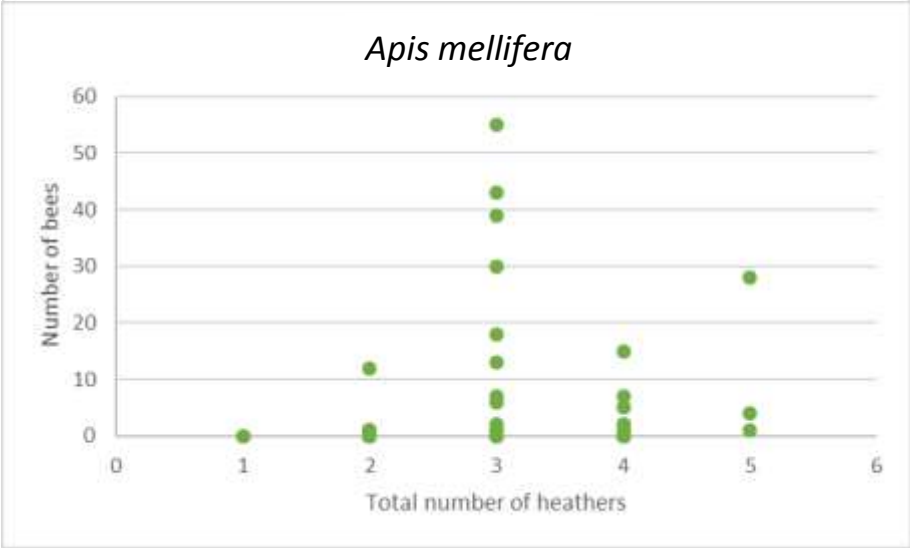


Figures 7, 8 and 9: The cumulative value for *E.tetralix* and *E.cinerea* against number of bees per site

Bombus terrestris



Apis mellifera



Bombus lapidarius

Figure 10: Amount of *Erica* heathers against total number of bees

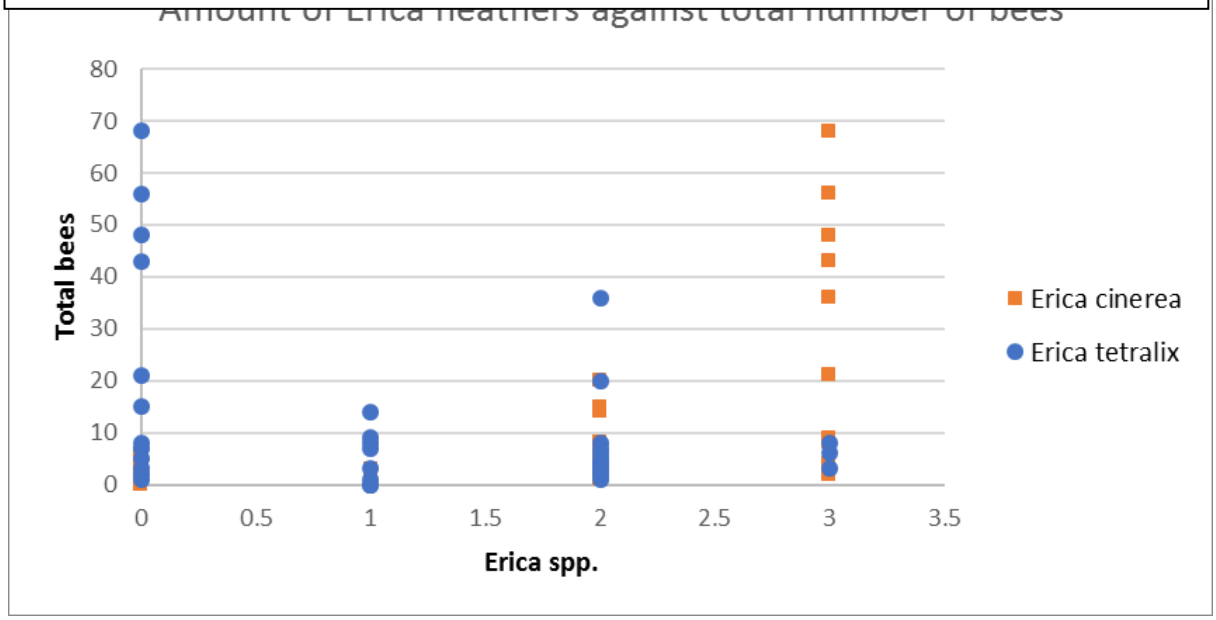
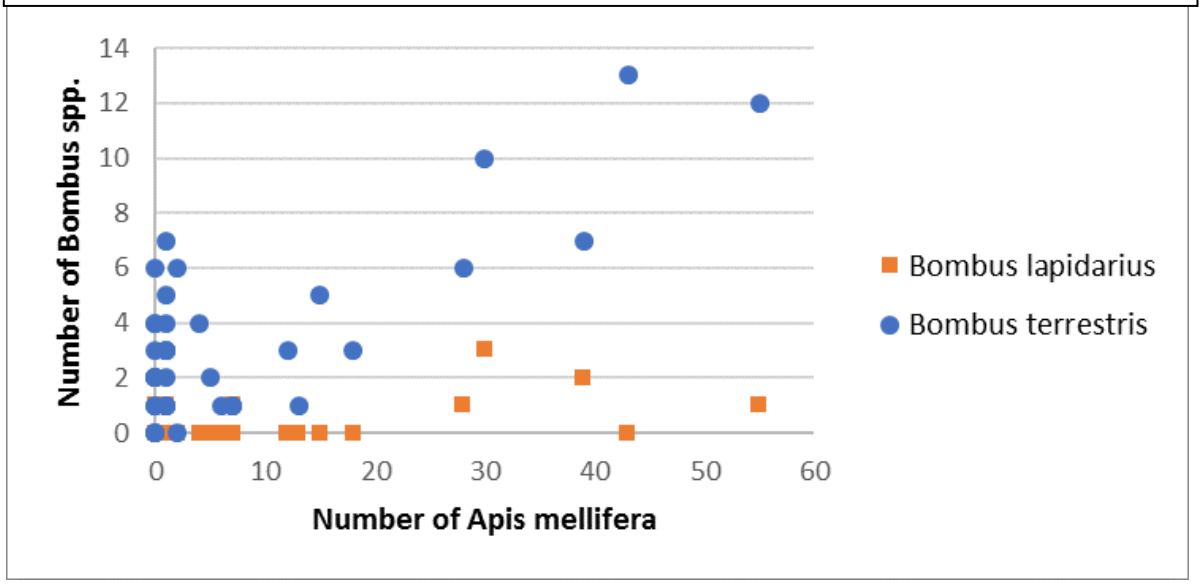


Figure 11: The occurrence of *Bombus* speies in areas with *Apis mellifera*



Correlation tables in Appendix document

Discussion:

The buff-tailed bumblebees (*Bombus terrestris*) at Godlingston showed a strong, positive correlation in numbers with the cross-leaved heath (*Erica tetralix*) (Figures 3, 12). However, at Hartland there was no correlation (Figures 3, 13), and thus no overall correlation (Figure 14). This could be attributed to the fact that in general there was very little *E.tetralix* at Hartland, so any bumblebees found in areas without it were going to play against the correlation. In addition, one site was on top of a *B.terrestris* nest, which would have also skewed the results by giving a large number of bees. It certainly indicates that the bumblebees did not rely on the *E.tetralix*, but there may still be a correlation in areas where it is the dominant flowering plant species.

The two most common species of bumblebee in the survey, *B.terrestris* and *B.lapidarius* both showed no statistically significant correlation with bell heather (*E.cinerea*) in either site (Figures 12, 13). However, when the results for both sites were combined, both species showed a positive correlation at the 0.05 level (Figure 14). Then again, figure 4 shows that while the trend appeared to increase, there was still a great range in the numbers of bees for each quantity of flowers.

Honeybees (*Apis mellifera*) appeared to show much clearer correlations. On Godlingston heath there was a statistically significant correlation between the bees and both bell heather and European gorse (*Ulex europaeus*) (Figure 12). The same correlation with bell heather was seen on Hartland (Figure 13) albeit less strong, while that with gorse was not repeated. The results for both sites showed both a positive correlation with *E.cinerea* and a negative correlation with *E.tetralix* (Figures 5, 6, 14).

When comparing the three most common bee species surveyed with the total quantity of heathers (Figures 7, 8, 9) a bell curve is created in all cases. In no cases are there more than 500 flowers of both species. The increase from 1 to 3 is easily understandable – more flowers attract more bees, but without further research it is hard to understand why the numbers of bees dropped from 3 to 5.

Figure 10 depicts the same set of data (total number of bees) twice, plotted against the quantities of flowers for each Erica heather species. A notable pattern is that the highest numbers of bees are found in the areas with no *E.tetralix* and more than 500 *E.cinerea*. However, it must be understood that the sites with the highest numbers of bees primarily contained Honey bees, which as previously established appear to favour *E.cenerea*, thus biasing the result.

Finally, Figure 11 compares the numbers of the two common bumblebee species with those of the honeybees, to look for evidence of coexistence or competition. The correlation is a statistically significant positive one, thus indicating that these bees coexist and that areas which are good for one species are good for the other. Nevertheless, there is still a large cluster of data which shows a high number of *B.terrestris* in sites with few honeybees, which probably represent the areas of Godlingston with *E.tetralix* and no *E.cinerea*.

Evaluating the method

A 7x7 metre square was used to give a wider area to survey than that typically used for plants. This gave a more representative sample and allowed the bees a chance to be counted – had a smaller one been used no bees may have entered the area at all. However, a disadvantage of this was that 7 metres was hard to measure, and paces were used, reducing the accuracy of the sample method. The plant survey was very quick, much quicker than counting the flowers individually or taking a percentage cover. However, as the data was qualitative rather than quantitative, it was much harder

to use for data analysis. The 3 categories may have been too broad, and by increasing the number of categories the ranges of data for each quantity may have reduced. The 20 minutes survey time was split into 10 minutes to make surveying a quicker process. Then again, this meant that two people were surveying the same area at the same time, greatly increasing the likelihood of recounting bees. This could have been rectified by separating the 7x7 metre square into two and having the two surveyors look at their section only. It would still have to be considered however that the bees could move from one section to the other and be recounted that way.

All the Godlingston data was collected on the 5th July and all the Hartland data on the 12th July 2017. The windspeed and temperature were similar for both, though the Hartland data was taken later in the day. The similar time of year makes the data very comparable, as very little had changed with regards to what was flowering. The dataset may have been improved by taking surveys at different times of the year, particularly later in summer when the Ling heather (*Calluna vulgaris*) starts to flower. This would provide a useful comparison with the early July data where almost all the flowering plants were *Erica* heathers. The early July data could be improved by more samples, to avoid biases such as that created by the large number of *A.mellifera/E.cinerea* assemblage sites, and to increase the records of the less common plant and bee species. 30 sample sites at each area would be recommended to gain a representative sample.

Conclusion:

On heathland, honeybees are found in areas with bell heather (where they can be very numerate) and tend to avoid areas with Cross-leaved heather. Buff tailed bumblebees can be found in areas of both bell and cross-leaved heather, and usually occur in much lower numbers than honeybees. Red-tailed bumblebees (*B.lapidarius*) follow a similar trend to buff-tailed bumblebees, but are even less numerate. The common carder bee (*B.pascuorum*) and Brown-banded carder bee (*B. humilis*) were so innumerable that no conclusions could be drawn from their data, as was the case for most plants aside from the two *Erica* heathers. The survey method was effective but could be improved by dividing the survey area and using more possible values for number of flower heads.