Heathland report from sites at Arne, Heartland, Studland and Godlingston

By Emily Ford, George Cartwright, Alexander Harvey, Laura Hewett, Samuel Leak, Archibald Neale, David Stanley, David Taylor Alice Todd and, Miriam Treadway

Edited: Emily Ford

Introduction: George Cartwright

Methods: Archibald Neale

Whole site results and discussion: David Stanley and David Taylor

Random quadrats results and discussion: Alexander Harvey and Laura Hewett

Pollinator results and discussion: Emily Ford and Samuel Leak

Participants: Alice Todd and Miriam Treadway

Introduction

Lowland heathlands are an important habitat type and are becoming increasingly rare across the UK. These heathlands occur on dry sandy or wet peaty soils and are characterised by the abundance of varying species of dwarf shrubs. These species include ling, bell and cross leaved heath heathers and European and dwarf gorse. Lowland heathland is a priority for nature conservation in the UK due to its status as a rare and threatened habitat. As well as the shrub types to be found in this habitat type, there are also often many species of grass. Grass species include Bristle bent, common bent, purple moor grass and deer grass. Occasionally forbs and trees can also be found in lowland heathland. There can be two main types of lowland heathland that are recognisable, wet and dry heathland with different species adapted to live in one or the other type. Some species can thrive in both habitat types.

The habitat is home to many highly specialised plants and animals. It is particularly important for many species of reptiles including the rare smooth snake and sand lizard which exist in many lowland heathland areas particularly in southern UK. They're also important for the Dartford warbler and the nightjar which both rely heavily on this habitat type with Dartford warblers living and nesting primarily on European and Western gorse.

One of the primary reasons for the varying heathland surveys conducted between the 1st and 12th August 2016 as to measure the impacts on the heathland caused by the heather beetle. The heather beetle feed on the leaves of heather plants and can strip the plants bare. In the past heather beetles' populations have exploded into massive outbreaks which have been very detrimental to heathland and causing mass decimation of heather. It has been widely recognised that heather beetles are instrumental in changing areas of heathland to grass dominated moorland with the purple more grass often being the dominant takeover species. Therefore, measuring percentage cover of dead heathers and of purple moor grass would be helpful in coming to conclusions on the impacts that heather beetles are having in certain areas.

Method

Site surveys

Between the 2nd and 11th of August, 2016, ten students and course coordinator carried out heathland surveys across 101 sites in the Purbeck District. Students were split into five groups to survey each site, this was comprised of five surveys; quadrats, whole site, pollinators, hoverflies, and pan traps. The tasks were divided between the groups so everything could be covered quicker and once all the information had been collected, which was later transferred onto an excel format and external hard drive.

Whole Site

For every site surveyed the whole of site was surveyed to provide broader information of the site. We used factors such as vehicle tracks and footpaths which is less specific than small covers of heather, and because this was more generalized of the transect we used DAFORN scale instead of % cover.

Random quadrats

As well as a whole site survey 10 quadrats had been placed on the ground. Meter rulers and bamboo sticks measured out the 2m quadrat. Each unit of space in was made randomly by throwing

one of the bamboo sticks in the air and using its landing point as a marker while making sure the quadrats remained in the site area. The information observed was written down on a printed spreadsheet and involved the percentage cover of each quadrat. The percentage cover had been used as it is more accurate than DAFORN. The recordings involved factors such as bare ground, cover of Ling Heather, and cover of dead heath.

Pollinators

In each transect one out of the two groups surveying the site would carry out a pollinators survey. This procedure involves walking up and down the transect counting all visible pollinators, this includes anything flying over the area or resting on heather. The pollinators were tallied on a printed spreadsheet that provides columns for the site number, pollinators seen and where they were at the time within the quadrat (e.g. resting on Ling Heather).

Hover Fly's and Sweep Netting

Throughout all of the sites sweep netting was used to collect hoverfly species which would later be identified. For this we used a sweep net, plastic collection pots, tweezers, labels, and propylene glycol. To catch the hoverflies, the sweep nets were brushed back and forth over the heather for 5-10 minutes within the transect. Caution was taken to avoid sweeping near Gorse so the nets wouldn't tear. If any hoverflies were identified in the sweep net they would be transferred into a collection tube and then have propylene glycol added to drown them.

Pan Traps

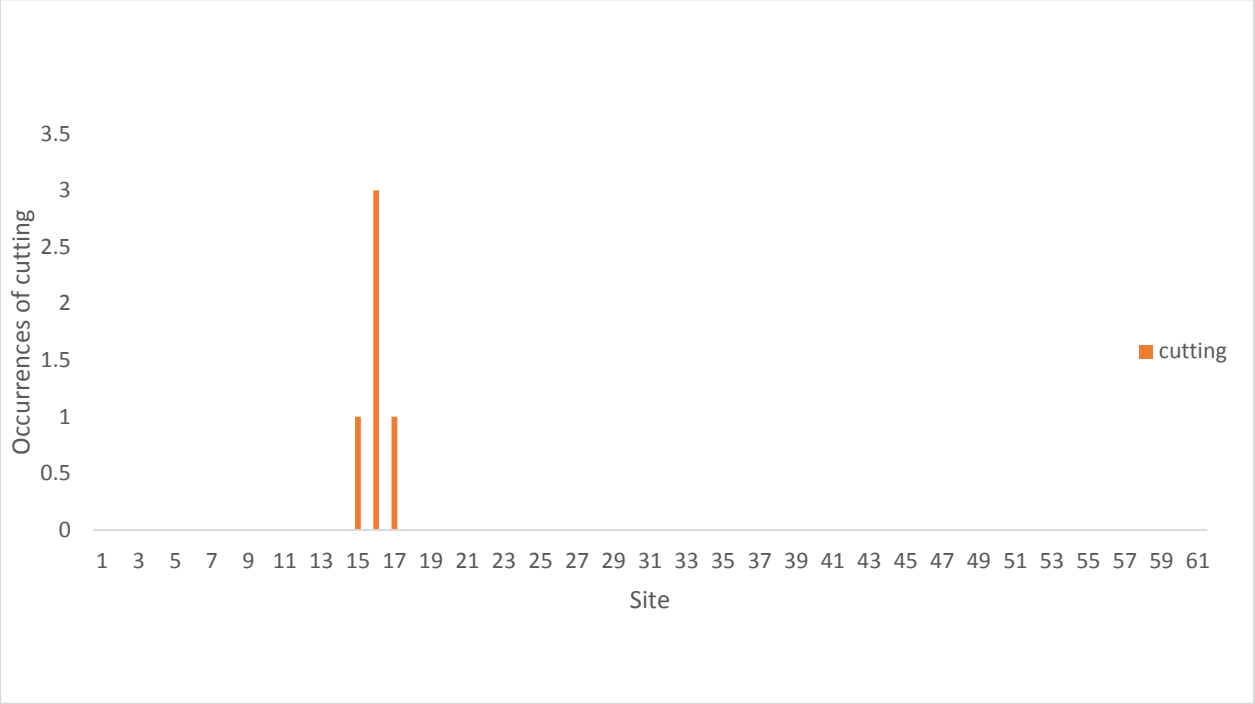
Between sites 1-42 in Studland and Godlingston Heath, each group that carried out a pollinator survey would place down four pan traps. Each of these pan traps were coloured either red, yellow, white or blue and had a thin layer of propylene glycol poured onto the trap. Due to the heavy wind conditions it was advised we lay the traps deep enough into the heath that they wouldn't blow over and compromise the study.

Results

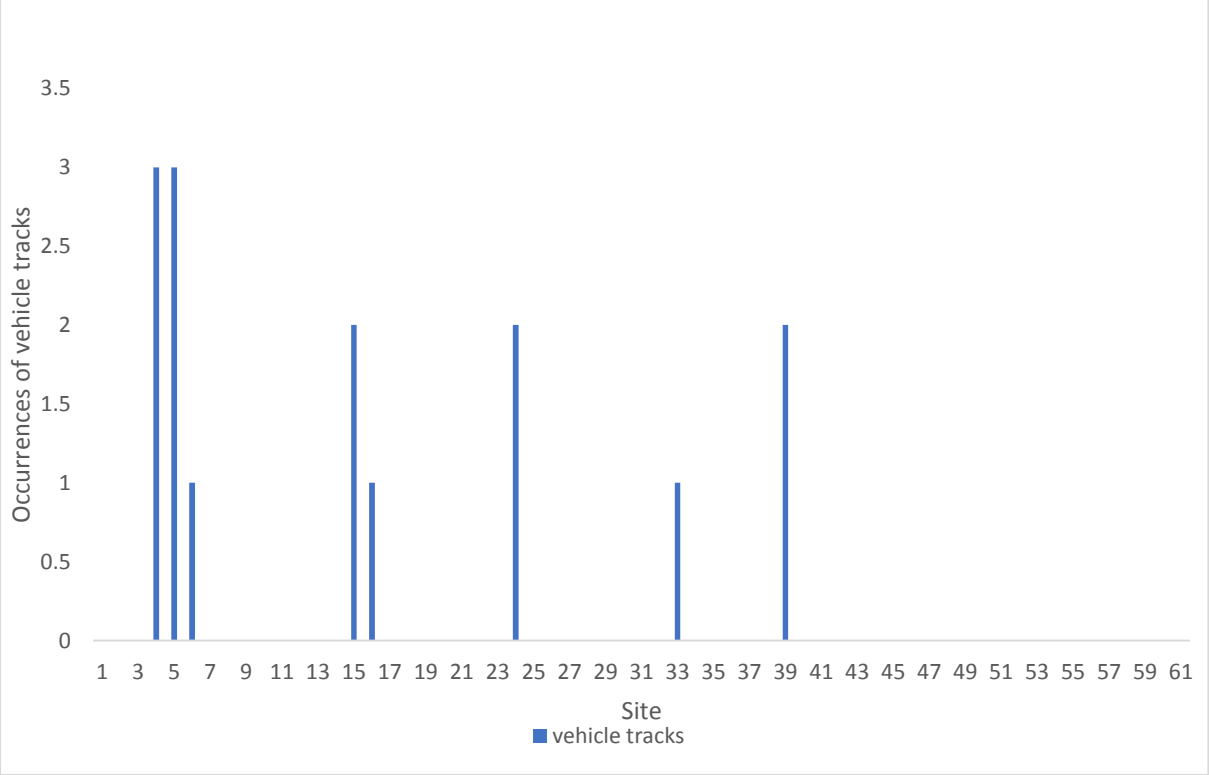
Whole site

The aim of this is to show any relationships between the overall state of the sites surveyed and disturbance by humans and animals. The first graph was supposed to show the signs of fire present at each site but as each site had a DAFORN score of 0/none, there is no graph present.

Cutting was the next factor taken into consideration. Cutting was only present at three dry sites 15, 16, 17. Sites 15 and 17 were only rarely cut. Although there were frequent signs of cutting at site 16, this can be explained as the cattle were present on the site with an electric fence. Thus explaining the high levels of cutting. Next, vehicle tracks were surveyed. Few sites had the presence of vehicle tracks with yet again site 16 being one of these. The other sites had some vehicle tracks on the edge however no site was dominated by them



Footpaths were commonly found at most sites, with them even being abundant at site 17. There was no clear pattern to show there were more footpaths on the dry sites or the wet sites. This shows that the majority of sites experience some disturbance at some point – whether it's human or



animal. Rabbit pellets were found predominantly in dry sites, although some signs were found at site one which is a wet site. The pellets were found in a third of all sites surveyed.

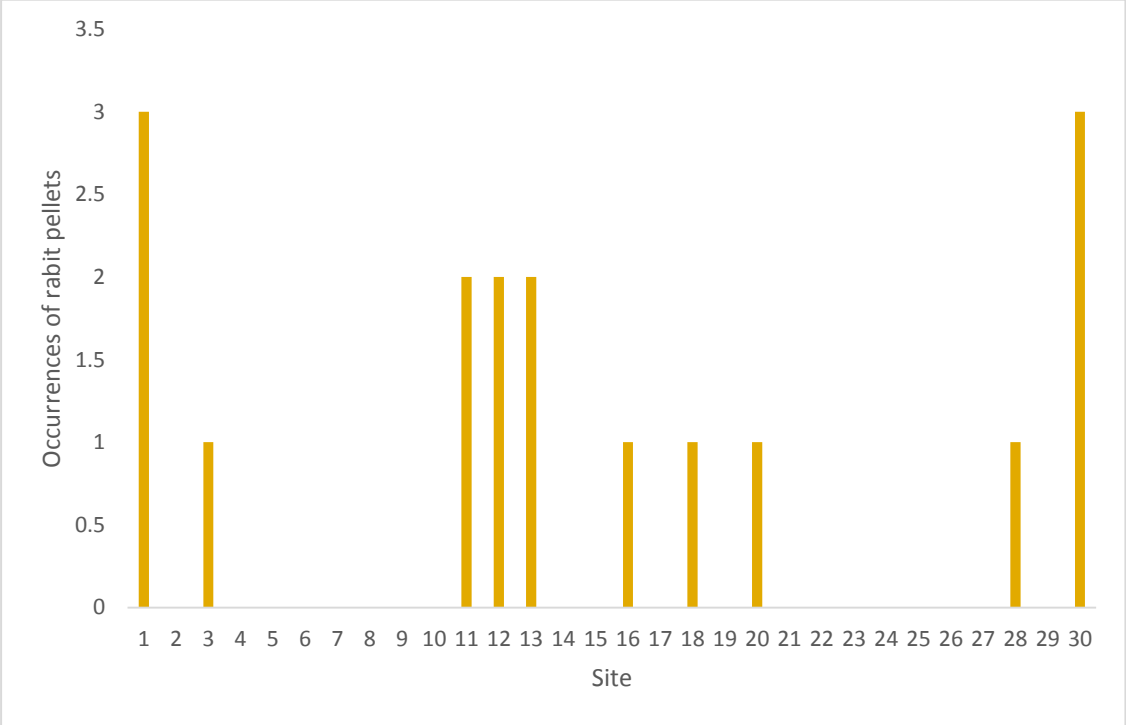


Figure 4: the occurrences of rabbit pellets at each site.

The signs for deer and cattle were generally not found in the same sites, other than site 1 and site 20. Apart from that, the signs were generally found in separate sites with the deer favouring the dry heaths with heather and the cattle favouring wetter sites with purple moor grass. One of the sites that was an exception was the site on which the cattle were enclosed which forced them to graze wetland.

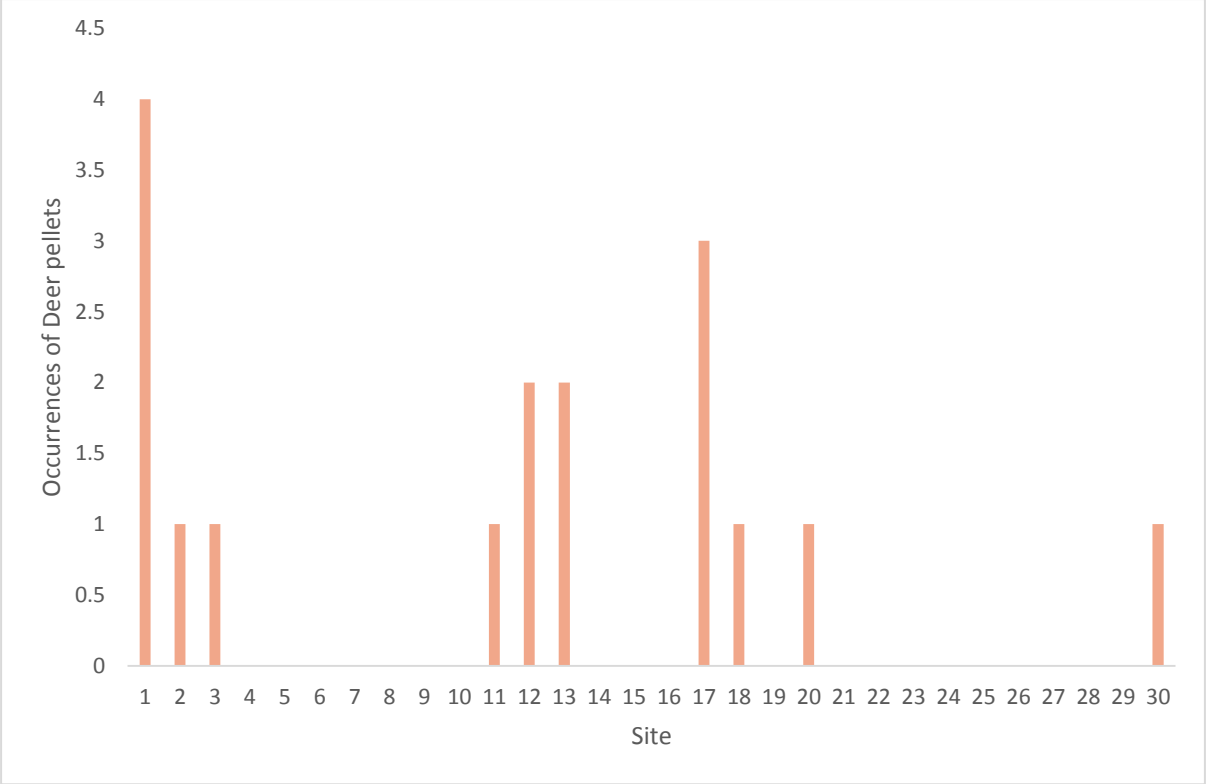


Figure 5: occurrences of deer pellets at each of the surveyed sites.

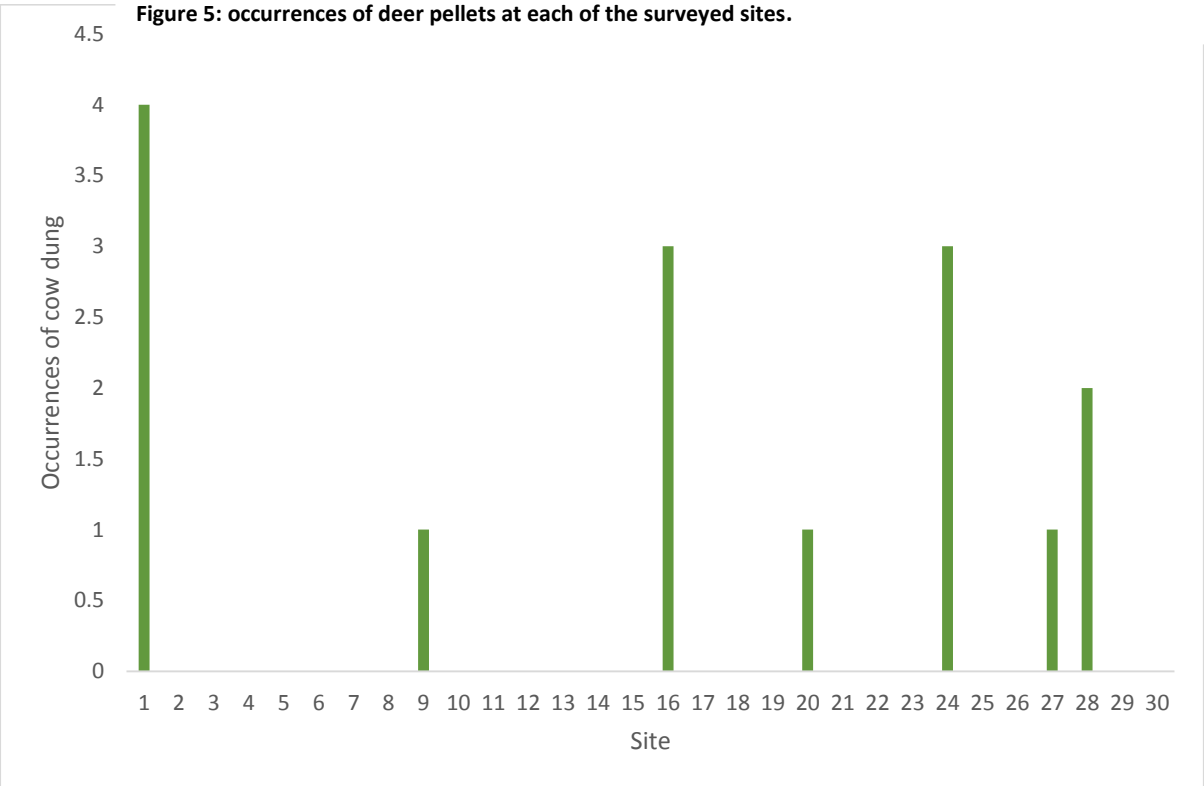


Figure 6: occurrences of cow dung at each of the surveyed sites

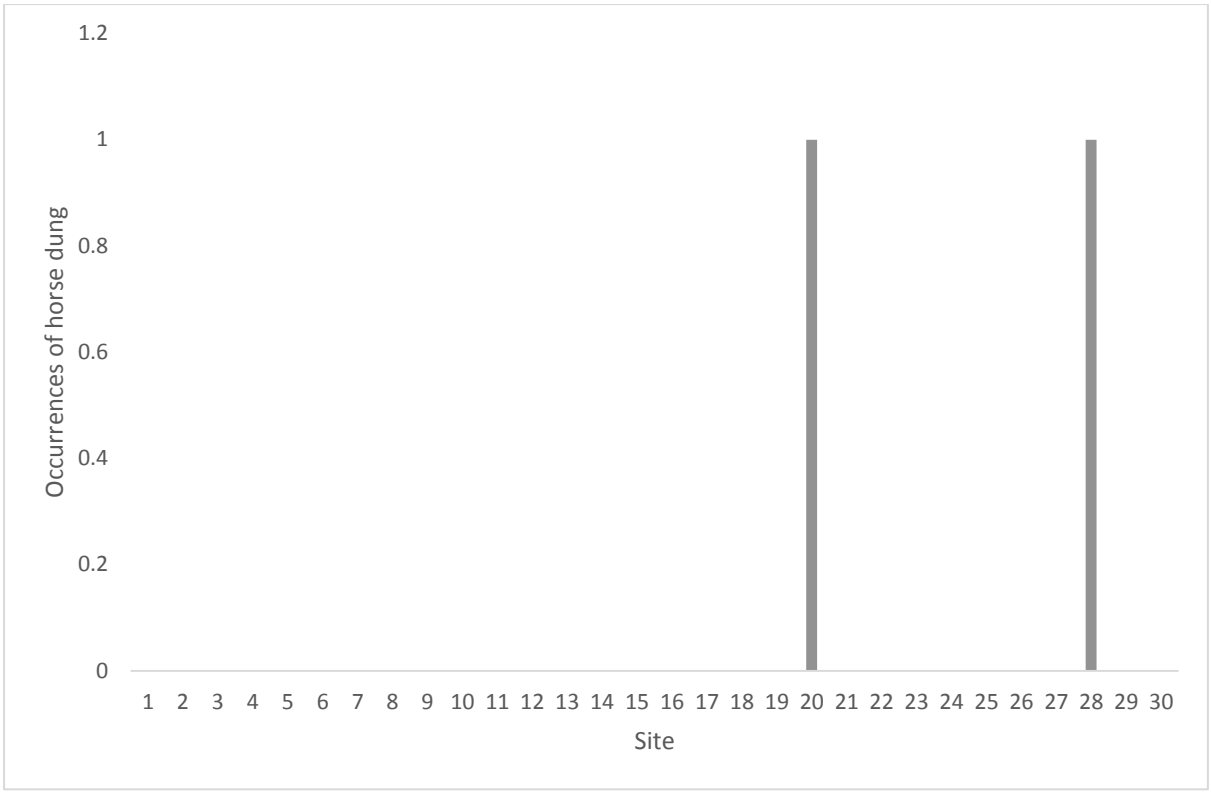


Figure 7: occurrences of horse dung at each of the surveyed sites

Random quadrats

In figure 8 the percentage of dead heather total in 2016 is compared against the dead heather total in 2015 against four different site locations (total of 64 sites). At Arne the % of dead heather in 2015 was the highest at site 58 with a total of 80%, whereas the highest % of dead heather in 2016 was at site 18 in Studland with a total of 38.6 % dead heather. Overall the average amount of dead heather is most abundant at Studland. Whereas Godlingston had the lowest of dead heather total in 2015 and 2016, compared to the other three site locations.

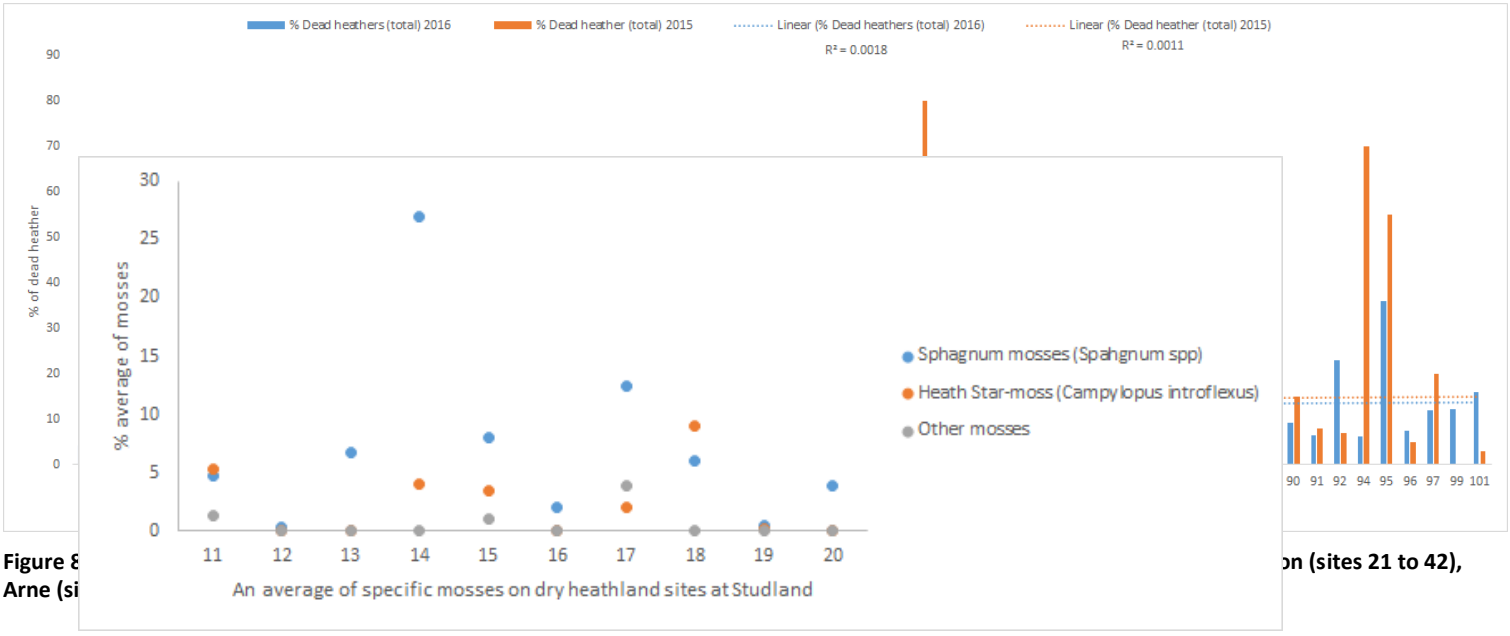


Figure 8 ... on (sites 21 to 42), Arne (si

Figure 9: The average percentage cover of the two most abundant species of mosses and the total average of other mosses found at Studland's survey sites (Personal collection 2016)

Looking more specifically in detail, figure 9 highlights that if two different types of mosses are compared to dry sites at one location, in this case Studland, then a relationship can be seen. Figure 2 indicates that sphagnum moss is the most abundant and dominant species of moss compared to the other mosses across the dry sites. Site 14 has a total of 27% sphagnum moss and this causes a reduction in heath star moss/ other mosses to below 5%. Figure 2 shows dry site locations only as moss in the understory of heather is a major issue.

When looking at all of the dry (d) and wet (w) heathland sites combined with the type of heather stage (Pioneer (p), building (b) and mature (m))the results conclude that on average the % of total moss is greater on the dry heathland sites, than on the wet heathland sites (Figure 10 and 11). Also figure 3 and 4 show when living heather total increases the moss % increase as well. This tends to happen when the heather stage is at mature (m) resulting in the mature heather having the most amount of moss in the understory.

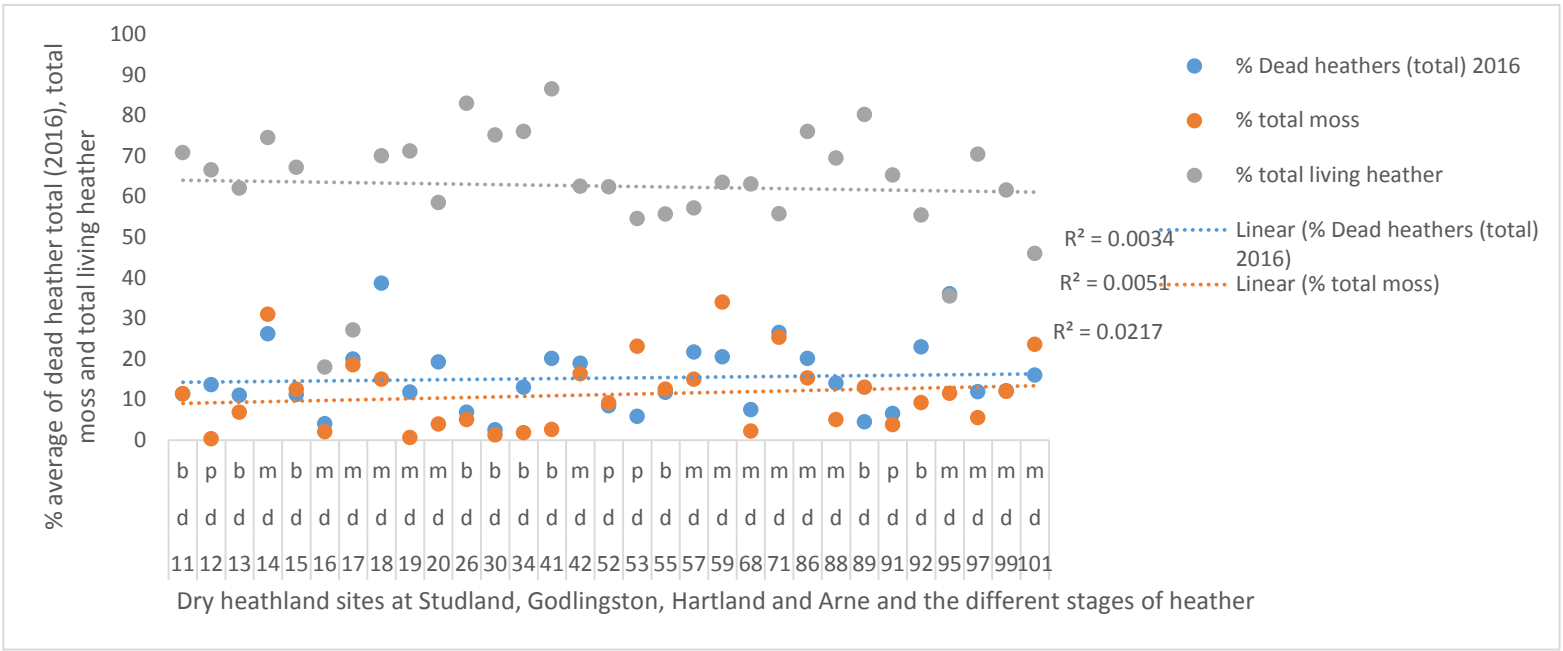


Figure 10: An average of the dead heather total, moss and living heather on all of the dry heathland sites studied and comparing it to the different stages of heather (Personal collection 2016)

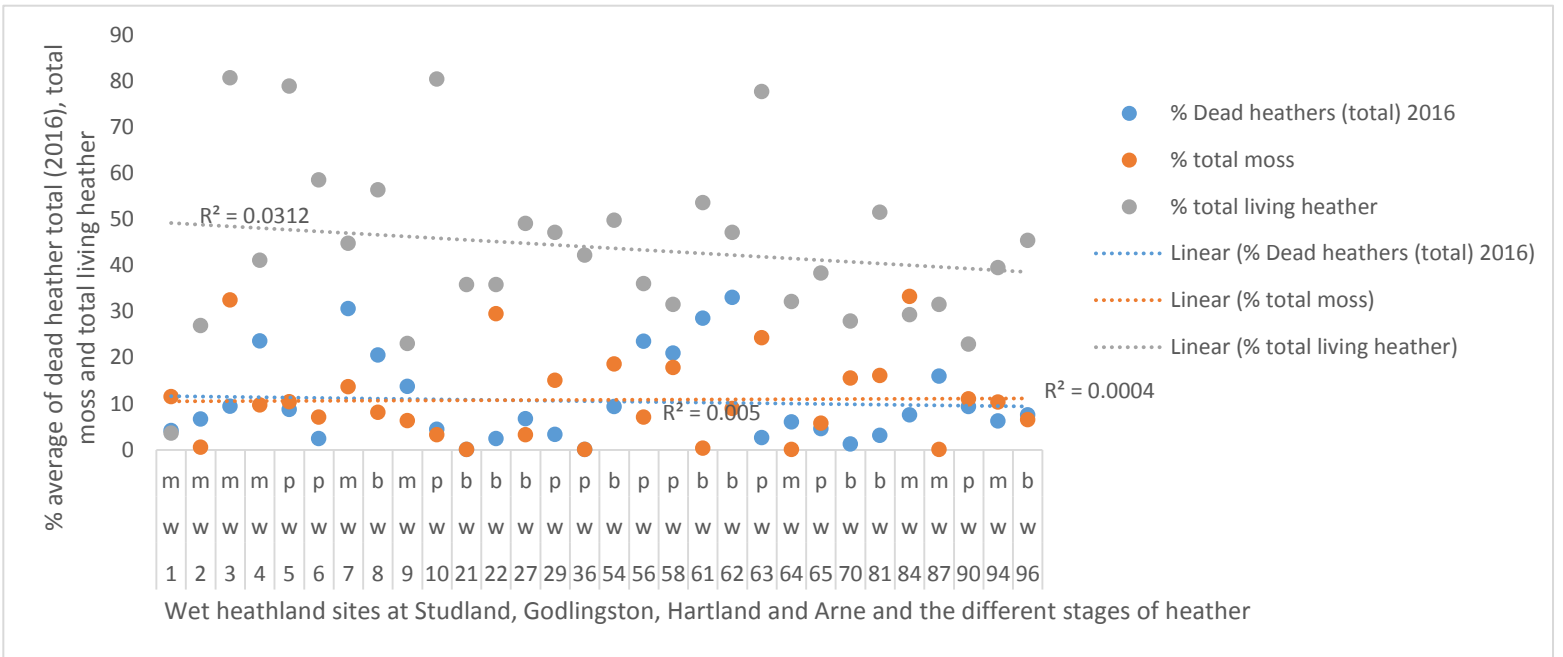


Figure 11: An average of the dead heather total, moss and living heather on all of the wet heathland sites studied and comparing it to the different stages of heather (Personal collection 2016)

Figure 12 demonstrates when total live vegetation increases, the total % of bare ground/dead vegetation decreases such as when live vegetation is 127% (two stories) then bare ground is only at 23% as the live vegetation exceeds more surface area. Figure 12 also indicates the dry sites tend to have more live vegetation and more bare ground then the wet sites.

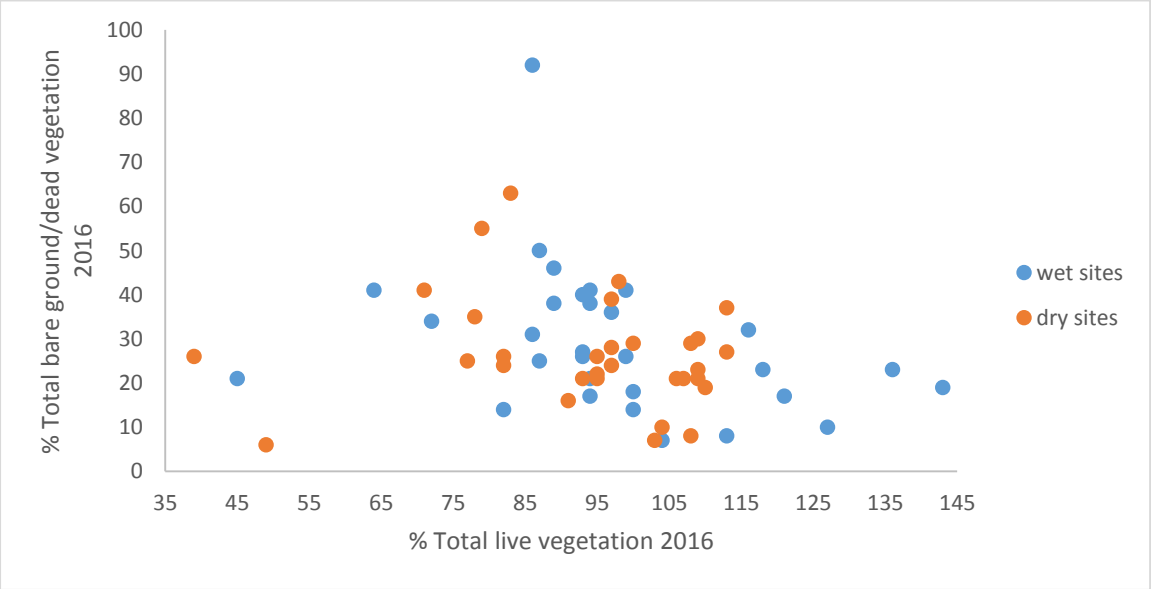


Figure 12: Total % of living vegetation and total % of bare ground/ dead vegetation across all 64 sites (wet and dry) and the 4 locations (Personal collection 2016).

Pollinators

There were a few clear trends that can be seen when you look at the data, firstly there seemed to be a flower preference among the hoverflies (Family Syrphidae). Out of the 74 hoverflies seen whilst carrying out the survey, 18 where on Ling heather (C. vulgaris) flowers compared to 5 on bell heather (E. cinerea) flowers and 4 on crossed leaved heather (E. tetralix) flowers, this can be seen in figure 13. Of the hoverflies seen on flowers 66% were on Ling flowers.

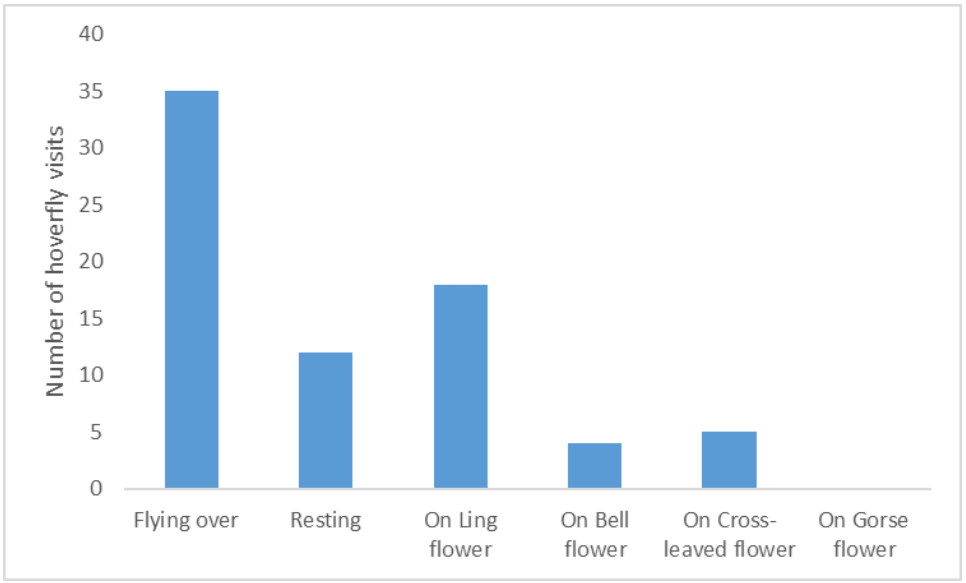


Figure 13: number of hoverfly seen: Flying over, Resting, on ling flowers, on bell flowers, on cross leaved flowers and on gorse flowers.

However, this trend of Ling flower preference was not seen in the bee's (family Apidae). Of the 166 bees recorded 50 where found on Ling heather flowers, 34 were found on bell heather flowers and 14 were found on crossed-leaved heather flowers, this can be seen on figure 14. Of the 98 flower visits by bee's 51% were to ling flowers which is significantly lower that the hoverflies.

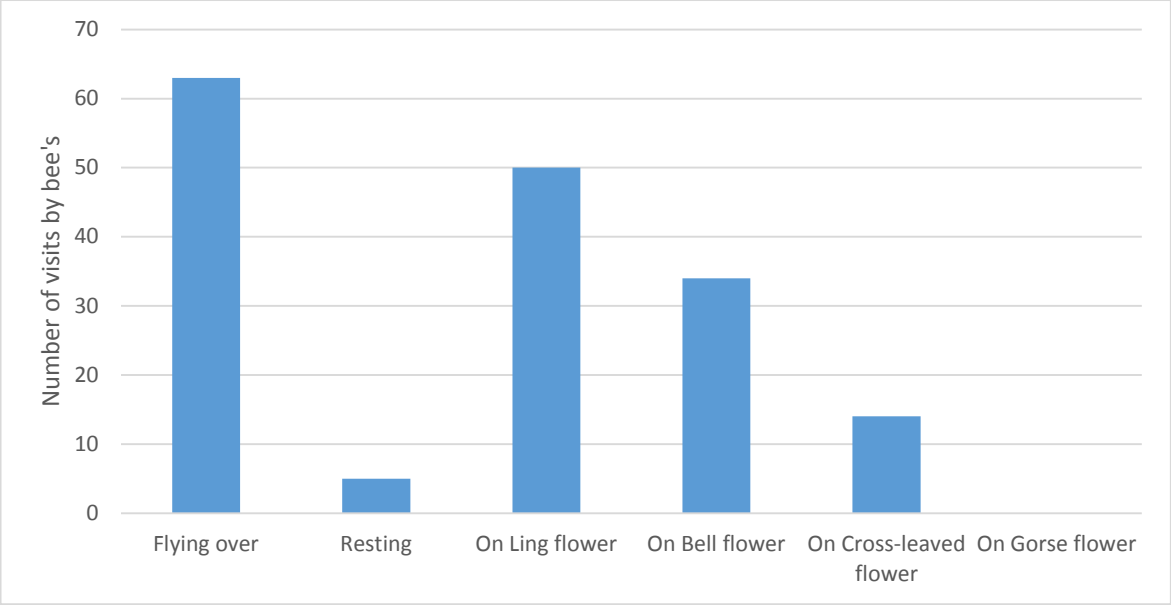


Figure 14: number of bee's seen Flying over, Resting, On Ling flowers, On Bell flowers, On Cross-leaved flowers and On Gorse flowers.

The final trend is the overall most visited flowers on the heathland. The expected trend was that the higher the average percentage cover of each flower the more pollinator visits it would receive. Figure 15 shows the average percentage cover. Whilst Figure 16 shows the total number of pollinator visits.

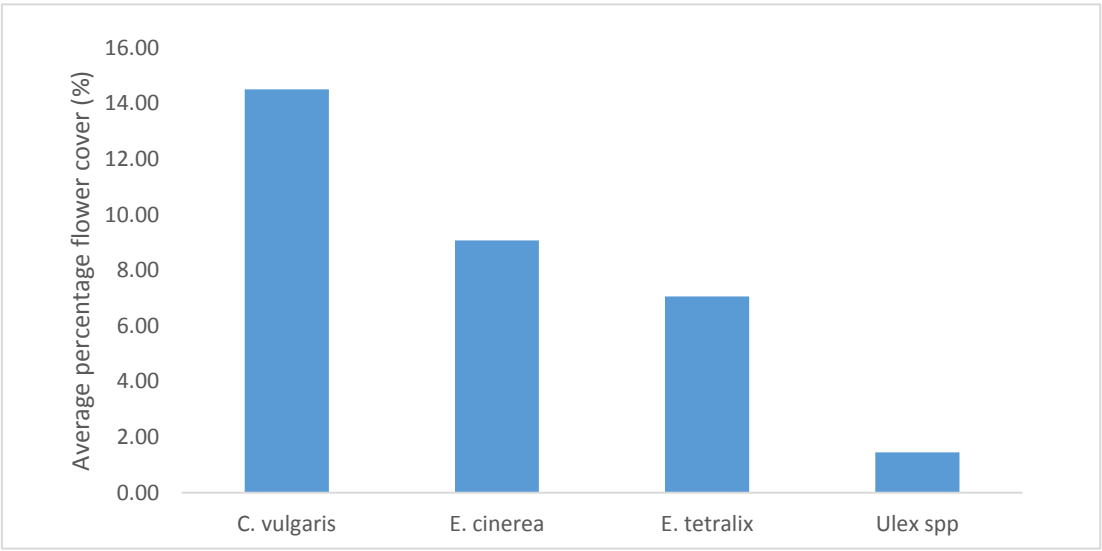
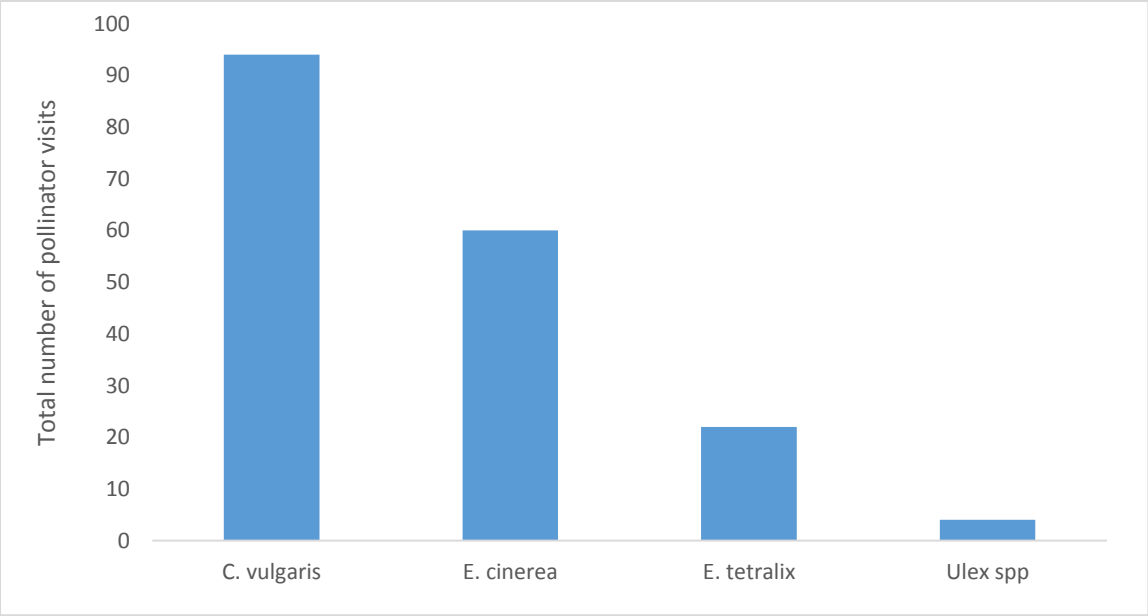


Figure 15: the average percentage coverage of flowers from different flowering plant species in a 2x2 meter quadrat at 61 sites across Purbeck heathlands

Figure 16: the total number of pollinators seen on different flowering plant species across the 51 site in the Purbeck heathland.



As the graphs show there is a clear potential link between the average flower coverage and the number of visits by pollinators with C.vulgaris having the highest average percentage flower coverage and the highest number of pollinator visits.

Conclusions

Whole site

There were only two sites that had any sign of horse dung and even they were rare which suggests horse have a low impact on the heath. Also, rabbit pellets were found predominantly within dry sites – suggesting that this is their preference, perhaps due to presence of plant species that they feed on. Deer also showed a preference to dryer sites with more heather species present. On the

other hand, signs of cow were seen more in wetter sites – although the validity of this find may be affected as they are not truly wild as may have been led there by farmers.

Interestingly, immediate disturbance through footpaths and vehicle tracks are good for certain species, as they are dependent on the bare ground as habitat. Therefore, the level of disturbance is actually beneficial to the general ecological health of the overall sites.

You could argue on the overall reliability of this technique of whole site surveys, as due to human error, dung signs may have been under represented as hidden by vegetation or things may have been mistaken for another category – allowing for a small margin of error.

The whole site surveys were carried out on multiple sites within a 20 metre by 20 metre quadrat with a DAFORN scale. The results collected led us to conclude that sites with an optimum level of disturbance had higher biodiversity as bare ground left by footpaths/tracks were beneficial to some heathland species. We also found which sites larger mammals preferred by looking for recent dung droppings (for example, deer preferred dry sites whereas cows were the opposite).

Random quadrats

Figure 1 shows the total percentage of dead heather at all of the survey locations for 2016 (blue), alongside 2015's data (Orange). 2016 Linear regression line is a fraction below 2015's showing a reduction in the percentage of dead heather present at each site. However 2016 has a correlation coefficient of R^2=0.0018 while 2015 is R^2=0.0011, the closer to 1 an R^2 value the better the fit. These R^2 values show the different percentages of dead heather recordings are highly variable between each site. Never the less a reduction in the percentage of dead heather present is strikingly obvious at such sites as 7, 9, 17, 58, 94 and 95 all of which apart from 17 and 95 are wet sites. Figure 1 also indicates that Godlingston has the lowest amount of dead heather total both in 2015 and 2016. This may be due to Godlingston only having 10 survey points unlike Studland that has 20 survey points. The points are disproportionate as each location had a different amount of number of the surveys that were done.

One major cause of damage to heathlands can come in the form of Heath beetles *(Lochmaea suturalis)*, which consumes and damage the leaves of Bell *(Erica cinerea)*, Ling *(Calluna Vulgaris)* and Cross Leaved Heather *(Erica tetralix)* (Laurie 2013 and Gillingham et al 2016), all of which are found at Arne, Hartland, Godlingston and Studland. To monitor the impacts of the damage to the heather caused by *Lochmaea suturalis*, several surveys were carried out. The results concluded that the area that was damaged by *Lochmaea suturalis* in 2015, has now recovered in 2016 (therefore have less damage) whereas areas in 2015 that were low on dead heather are now high in 2016. This is because heather beetles jump from one heather to another. Therefore when one area is damaged a new area that was once untouched becomes damaged (figure 1).

Furthermore, on average Studland had the highest amount of dead heather total in 2015 and 2016 (figure 1) and this is because, for example Studland (figure 2) had a high abundance of sphagnum moss which allows for *Lochmaea suturalis* to lay their eggs in the moss. This evidence is backed up by Waloff who states that the beetles thrive best where there is an understory of sphagnum moss or in wet places (1987). This evidence can further be seen in figure 4.

There is no real significant difference between the dry heathland and wet heathland sites (figure 3 and 4) in the total dead heather 2016 compared to in 2015 where there was less heather damage on the dry sites. However, the dry sites have had a significant amount of damage and this could be to the heather beetles as figure 3 indicates that the % of moss on the understory of the

heather increases when living vegetation increases. This means that the two are linked together, as when the heather grows it provides the ideal habitat for the moss like sphagnum to grow. Analyzing the results further, on the dry sites at mature heather stage is when the moss is the most abundant along with living heather (figure 3). This could be due to the grazing that happens on the four heathland locations. For example at Arne the area is constantly being grazed by deer and cattle which will favor for the shorter stages of heather such as pioneer and building. Also on the dry sites the heathland is heavily dominated by mature heath and understory moss (Natural England 2016). Unlike the wet sites where, for instance, cattle will go for the wet sites more than the dry sites. This could also explain why figure 4 indicates that moss and total living vegetation is lower in the wet sites than in the dry sites.

Finally looking at figure 5 in more depth, the dry sites have more bare ground and fewer living vegetation in total then the wet sites. This is an important concept to consider as bare ground in heathland habitats provides natural shade and opening for a variety of species to thrive. For example Sand lizards (*Lacerta agilis*) require bare ground in order to bask in the sunlight, due to them being ectotherms. Also the bare ground heats up quicker and is an idyllic place for reptiles to lay their eggs and germinate (English Nature 2005)

However, the reason why bare ground is greater in presence on dry heathland sites than on wet heathland sites could be down to the formidable *Lochmaea suturalis* that will destroy the heather and thus creating more dead vegetation, resulting in a decrease in live vegetation and more bare ground. The damage the *Lochmaea suturalis* are causing is detrimental to species such as pollinators as they consume the flower heads, but it can also be a positive in creating new areas of bare ground.

To conclude, there is more information that can be extracted from the data that was collected to give more in depth analysis on factors such as *Lochmaea suturalisI* damage on heather. However, overall the 2016 sites on average have had less damage than in 2015. Sphagnum moss is dominant in the understory of mature heath on dry sites and bare ground increase when live vegetation is decreased.

Pollinators

There were two main groups of pollinators that where commonly recorded, flies (mainly hoverflies) and bees (bumble bees and honey bees). There were many difficulties with the pollinator survey, the biggest being the weather, as pollinators are very weather dependant with weather characteristics playing an important role in the visitation rates to different sites high visitation happening in warm and light conditions (McCall and Primack, 1992) the data was collected over a few days in which the weather changed so these different temperatures and light levels would have affected the results and which insects were caught. These levels also differed throughout the day however the weather was mostly consistent throughout the surveying so any effects should be limited

A study by Krenn et al (2005) states that “Diptera with small proboscises tend to go more to open easily accessible flowers.” Of the flowers on the heathland ling flowers are the most open and so easier to get nectar from. This data would therefore suggest that due to hoverflies preference for the more open Ling flowers that many of them have a small proboscis. However, this trend of Ling flower preference was not seen in the bee’s (family Apidae).

The reduced flower preference among the bee’s is likely due to honey bee’s having a long proboscis “of 5.3-7.2 mm long” (Winston, 1991) which enables them to easily feed on the more

closed bell and cross-leaved heather flowers. Furthermore, even the shorter proboscis of the bumble bee is not an issue as they are "able to bite holes in the corolla's" (Williams, 2012) of flowers to access the nectar within. This therefore means that they are not confined to feeding on the open easily accessible flowers such as ling heather flowers.

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