Nature in Harmony 2020

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A report on the Nature in Harmony project wildlife surveys undertaken throughout 2020 in the Diamond Wood and Harmony Woods, Andover, Hampshire.

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ABSTRACT

Until now, there has been little available wildlife data for Harmony Woods and the wider Diamond Wood in Andover, Hampshire. Since 2016, some data has been collected from a registered Butterfly Conservation transect in Harmony Woods, but little historic data has been available.

Having a baseline dataset is key in monitoring wildlife, as it allows you to identify trends in species populations and ecological communities over time. Monitoring wildlife will also allow the identification of any invasive or competitive species, as well as any priority and at-risk species - both of which may require special attention.

This report provides the first baseline dataset and species list of the plants and animals observed in the 44-acre site from April - October 2020.

Bird, pollinator and plant data is grouped into the west and east sides of the wood to reflect the difference in land management style between each end. It is asked whether this difference in management style has lead to any significant differences in biodiversity in birds, pollinators and plants between each end. The number of human and dog visitors to the site is also recorded.

Birds and pollinators were more diverse in the west. Plant diversity was not significantly different across both ends, however, species composition was notably different between each end.

Butterfly numbers increased in 2020 compared to previous recordings. The number of dogs off-leads were higher in the west, numbers of dogs on-leads and human walkers had no significant difference between the east and west. Reasons for these findings and wider implications are discussed.

ACKNOWLEDGEMENTS

I would like to thank:

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Liz for keeping track of the expenditure and monitoring our wildlife cameras.

Wendy for your continued support.

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INTRODUCTION

Until now, there has been little available wildlife data for Harmony Woods and the wider Diamond Wood in Andover, Hampshire. Since 2016, some data has been collected from a registered Butterfly Conservation transect in Harmony Woods, but little historic data has been available.

Having a baseline dataset is key in monitoring wildlife, as it allows you to identify trends in species populations and ecological communities over time. Monitoring wildlife will also allow the identification of any invasive or competitive species, as well as any priority and at-risk species - both of which may require special attention.
The Nature in Harmony project will provide the first baseline dataset of the site, set up methods for ongoing monitoring, and allow the land managers (Andover Trees United) to make more informed decisions to better conserve their habitats and species.

The Nature in Harmony project also provides ongoing opportunities for citizen science and community engagement in environmental education. This meets Andover Trees United's constituted aims.

Before 2012, the 44-acre site was agricultural, growing kale and rape, although no historic data exists, it is assumed that the biodiversity of plants and animals would have been lower than it is today due to crop homogeneity.

The site was set aside by the Trinley Estate for the Andover Trees United (ATU) community planting project 'Harmony Woods' and for a Queen Elizabeth Diamond Jubilee woodland in 2012, supported by Hampshire County Council. Since 2012, the site has been owned and part-managed by Hampshire County Council. Harmony Woods, a 12-acre section of the site, has been managed by ATU. In 2020, Andover Trees United agreed to take on the management rights to the entire 44 acre site.

The Diamond Wood, and Harmony Woods, offer a unique opportunity to survey separate pockets of land that vary in their land management and land use.

The eastern end of the woods was planted with trees and sown with fescue grass in 2012/13, since then it has been left with very little land management input. It contains an area of mixed deciduous woodland, a hazel stand and chalk grassland. The east also contains a public right of way and is used frequently by walkers and local residents from an adjacent housing development who walk their dogs.

The western end contains Harmony Woods, which is surrounded by 2 main pathways . The 2 pathways are similarly managed and used as the pathways in the eastern end. However, the Harmony Woods section has been carefully managed since 2012 by Andover Trees United volunteers and the community of Andover.

It has been used by ATU for environmental education and nature connection. The wooded area has grown in succession with 1000 new native British trees planted every year since 2012, rather than all being planted at once as was done in the east. A conscious decision was made by ATU to involve all young people and all educational establishments within the Andover catchment area (Andover and surrounding villages) in this woodland creation.
A chalk wildflower meadow has also been created, which is cut and raked on a yearly basis to mimic grazing. A chalk scrape has been dug as well as a wildlife pond, and very recently some new pinch points to help reduce the size of the surrounding pathways and encourage more animals to migrate into the space.
Harmony Woods is a space where a team of volunteers come together to care for nature with environmental conservation in mind.

In 2020, with an agreement for ATU to take on the management rights to the entire 44 acre site, it will be interesting to see how the land management, land usage and, as a result, biodiversity and species composition of the west and the east changes over time.

The Diamond Wood site consists of priority habitats including lowland deciduous woodland, hedgerow and lowland calcareous grassland.

Chalk meadows are incredibly rare and important habitats. They are among the most species rich in the UK. However, they have declined immensely over the second half of the 20th century due to a variety of causes, including agricultural improvement, urban development and abandonment where management cannot be continued or is no longer economically viable (Natural England). Lowland calcareous grassland is still under threat and rare, covering around 3% of England's land area, with an estimated total area of lowland calcareous grassland in England of 38,687 ha. The greatest risk to lowland calcareous grasslands are fragmentation, under or over-grazing and nutrient enrichment from atmospheric nitrogen deposition (Natural England, 2020).

Priority species (UK Post-2010 Biodiversity Framework, 2012) identified from the Nature in Harmony wildlife surveys include: Skylark, Common Linnet, Corn Bunting, Yellowhammer, Grey Partridge, Common Starling, Brown Hare, Small Heath butterfly, Small Blue butterfly, Argent & Sable moth, Speckled Footman moth, Dingy Mocha moth, Garden Dart moth, White-line dart moth, White Ermine moth.

Harmony Woods forms the location for many community outreach activities such as green craft workshops, citizen science and volunteer work days. The site is used as a learning resource, community space and volunteer base and sits within 200m of Augusta Park, a large residential estate on the edge of Andover and just south of the village of Enham Alamein. This provides an interesting opportunity to consider how wild nature spaces may be impacted by being so close to the urban town, for example whether footfall from humans and their dogs may impact ground nesting bird populations.

Overall, it is clear to see how this community-planted woodland, Harmony Woods, is of high ecological value, as well as sentimental and educational value, and why it is important to monitor and carefully manage the wildlife that resides here, and the visitors who pass through.

In this report, we make a start on the continuous wildlife monitoring programme 'Nature in Harmony' and we present our preliminary findings and discussion.

METHODS

Data Collection

The field site - Data was collected from the 44-acre Queen Elizabeth Diamond Wood in Andover, Hampshire UK. Within the Diamond Wood lies the 12-acre, community planted woodland called Harmony Woods. Harmony Woods was included in the surveys.

The Diamond Wood, and Harmony Woods offer a unique opportunity to investigate separate pockets of land that vary in their management and use. To gain an insight into the impact that this has had on the diversity of nature in Harmony, the site was divided into East and West sides. 8 100m transects were placed randomly across the site, however it was ensured that 4 transects remained to the west, and 4 to the right (**Figure.0**) - in order to allow comparison.
Every week, 2 transects (1 west and 1 east - pairs were kept the same throughout) were surveyed for wildflowers and grasses, birds and pollinators. As well as this, butterfly data was collected from the registered Butterfly Conservation transect in Harmony Woods, Moths were surveyed and humans and dogs were recorded.

Figure.0 The locations of each transect across the Diamond Wood. The purple dotted line represents the west/east divide, and the circle encloses roughly the 12 acre Harmony Woods section.

Bird Surveys - A random number was generated between 0 - 100 and this number was used as the point (in metres) along the transect at which the bird survey would take place. At this point, the recorder stood for 20 minutes and noted down every bird they saw within 100m of them. When birds were overhead they were included, regardless of how high in the sky they were spotted. Binoculars were used. Abiotic data such as date, time, weather conditions and proximity of bird was also recorded. Bird species as well as number of individuals was recorded, and care was taken not to record the same individual twice (although this was an assumption).

Humans and dogs - During bird surveys, it was also noted how many walkers, dogs on-leads and dogs off-leads were spotted within 100m.

Pollinators - Transects were walked at a very slow pace, at about 2 metres per minute. During the walk, recorders made a note of any pollinators seen within a 5m belt of the transect. This included Hymenoptera, Diptera, Lepidoptera and the occasional Coleoptera (if seen on a flower head).

Butterflies - Butterflies are recorded in a fixed width band (typically 5m wide) along the registered transect each week. Transect walks are undertaken between 10.45am and 3.45pm and only when weather conditions are suitable for butterfly activity: dry conditions, wind speed less than Beaufort scale 5, and temperature 13°C or greater if there is at least 60% sunshine, or more than 17°C if overcast. Even when there was a count of 0 butterflies this was recorded.

Moths - A battery powered, LED heath moth trap was left in Harmony Woods from sunset and overnight until 8 or 9am the following morning. Moths were then removed, identified and released. Over the spring and summer the moth trap was set 3 times.

Wildflowers and grasses - A random number between 0 and 5 was generated. This number was used as the starting point (in metres) along the transect. Recorders then placed a 1m squared quadrat on the ground at the starting point. A coin was flipped to decide on whether the quadrat was placed to the right or left hand side of the transect. Then, the number of squares containing grass was noted and the dominant grass species present. The number of squares containing wildflowers and other grass species were also recorded, along with their identification.
Any unsure observations were photographed or a sample taken for later analysis.
Then the recorder took 5 big steps (about 5 metres), and the quadrat was placed on the ground again, on the same side of the transect, and the process was repeated.

All other observations - All other observations were collated into a complete list of species spotted in the Diamond Woods. This data comprised of off-transect observations and citizen science observations made during a Bioblitz event in September 2020 and via a Nature in Harmony project page on the application 'iNaturalist'.

Statistical Analysis

Birds, pollinators, wildflowers and grasses - The number of different species recorded on each transect for each day of data collection was summed (diversity). Then an average was calculated from these values, giving the average number of different species recorded on each transect over the duration of the spring and summer.

The diversity values were allocated between 'west' and 'east' group. The 'west' group comprised of data collected from transect 1,2,3 & 4. The 'east 'group comprised of data collected from transects 5,6,7 & 8 .

Data in west and east groups were plotted on a QQPLOT in order to check for a normal distribution. All data was normally distributed, therefore, a two-tailed an independent t.test was carried out using R Core Team (2015) in order to identify any significant difference between the diversity in the west and east.

Humans and dogs - The average number of humans , dogs on-leads and dogs off-leads were allocated to west and east groups. The data from west and east groups were plotted on a QQPLOT in order to check for a a normal distribution. All data was normally distributed, therefore, a two-tailed an independent t.test was carried out using R Core Team (2015) in order to identify any significant difference between the diversity in the west and east.

All data - Microsoft Excel was used to produce all graphs and calculate descriptive statistics such as averages, standard deviation and standard error on all datasets.

RESULTS

Birds

The bird diversity of the western end of the Diamond Woods is significantly higher than the eastern end (**figure.1**) (p=0.0006 (two-tailed), t=3.7087, d.f= 41.937).

The t value is larger than the critical t value of 1.68, therefore, we can reject the null hypothesis and accept the hypothesis.

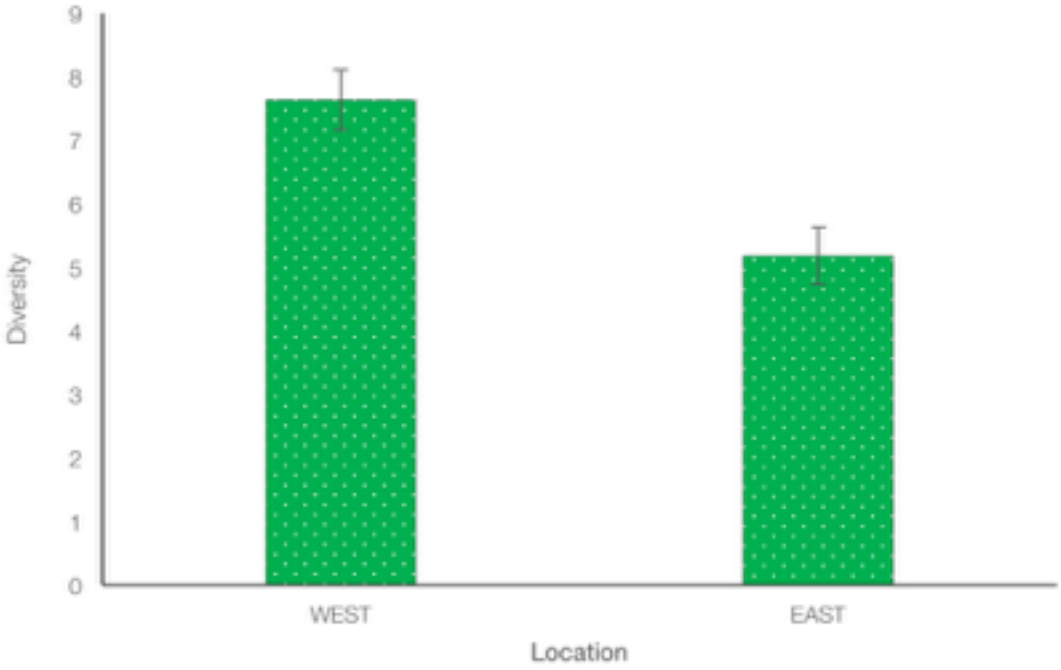


Figure.1. The number of different species recorded on each transect for each day of data collection was summed to give the diversity. The bird diversity values were allocated between 'west' and 'east' groups. Then an average was calculated from these values, giving the average number of different species recorded in each group.

The average bird diversity of the Diamond Wood is significantly higher in the western end (mean = 7.63 sd = 2.237036 se = 0.476938) compared to the eastern end (mean = 5.18 sd = 2.152216 se = 0.458854). (t=3.7087, p=0.0006 (two-tailed), d.f= 41.937).

The 'west' average includes data from transects 1, 2, 3, & 4. The 'east' aveage includes data from transects 5, 6, 7, & 8. The error bars represent the standard error.

Data was recorded from the Western end on 22 days and from the Eastern end on 22 days between May - October 2020.

29 species of bird were recorded in total, this does not include extra species that were spotted off-transect. The western end saw recordings of all 29 species, whereas the eastern end only recorded 23 **(figure.2, table.1)**

Both the west and east ends of the Diamond Wood have large proportions of Skylark and Wood Pigeon, although in the west, Skylark numbers are more than double that of the east. Both groups also had greater numbers of crow compared to most other species, but the east had well over twice as many Jackdaw compared to the west, and the west had only 1 less Linnet than it did crows.

The west had higher numbers of Linnet, Blue Tit, Blackbird, Buzzard, Corn Bunting, Great Tit, Gull spp, House Martin, Kestrel, Starling and Rock Pigeon compared to the east - 3 of these are priority species (UK BAP)
The east had higher numbers of Jackdaw and Yellowhammer than the west - 1 of these are priority species (A difference, however, of only 2 Yellowhammers).
Species which had no change or only a difference of 1 individual between east and west were the Goldfinch, Chaffinch, Collared Dove, Great Spotted Woodpecker, Jay, Pheasant, Red Kite, Robin, Rook, Sparrow, Swallow and Swift - 1 of these is a priority species.

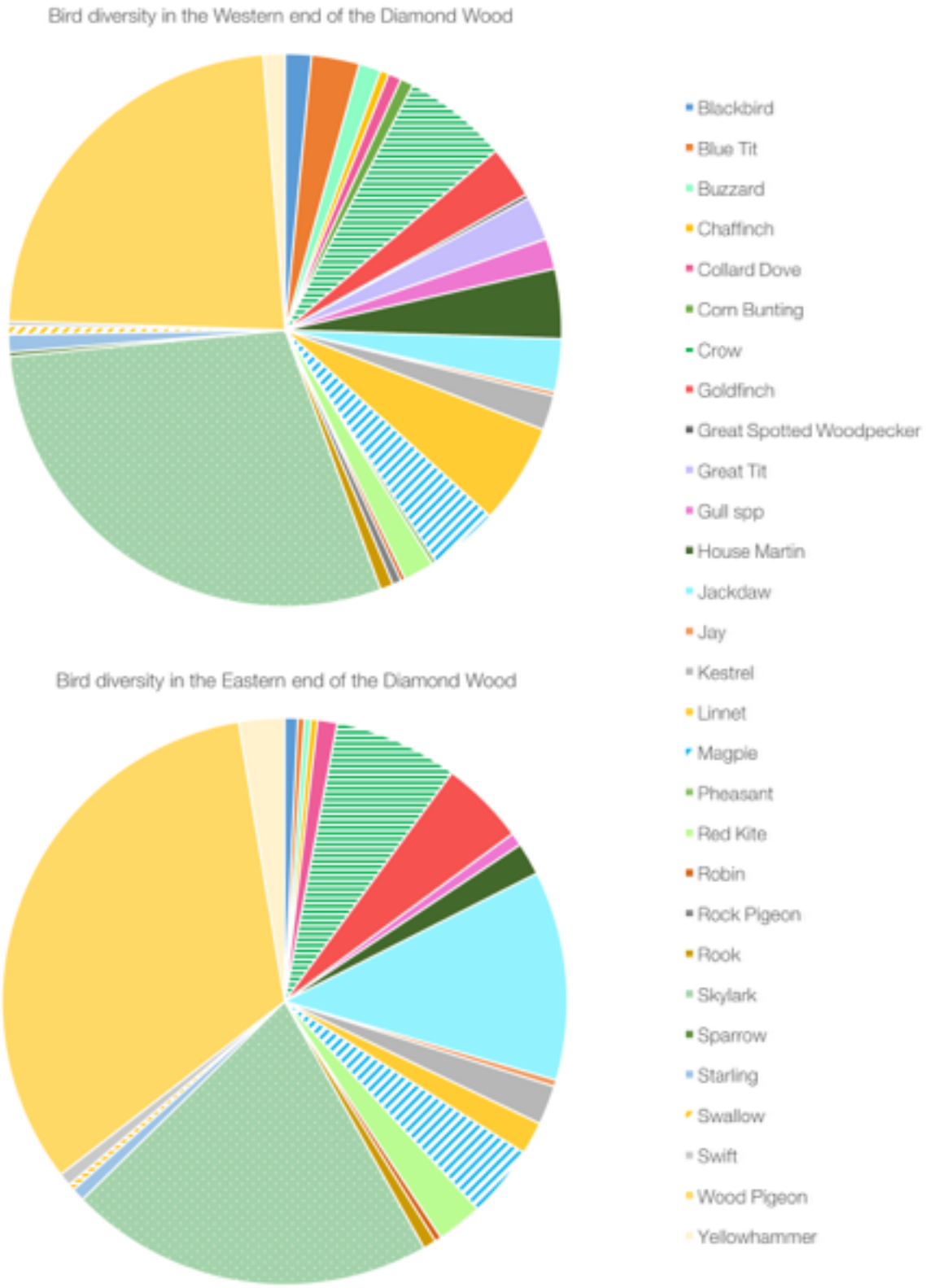


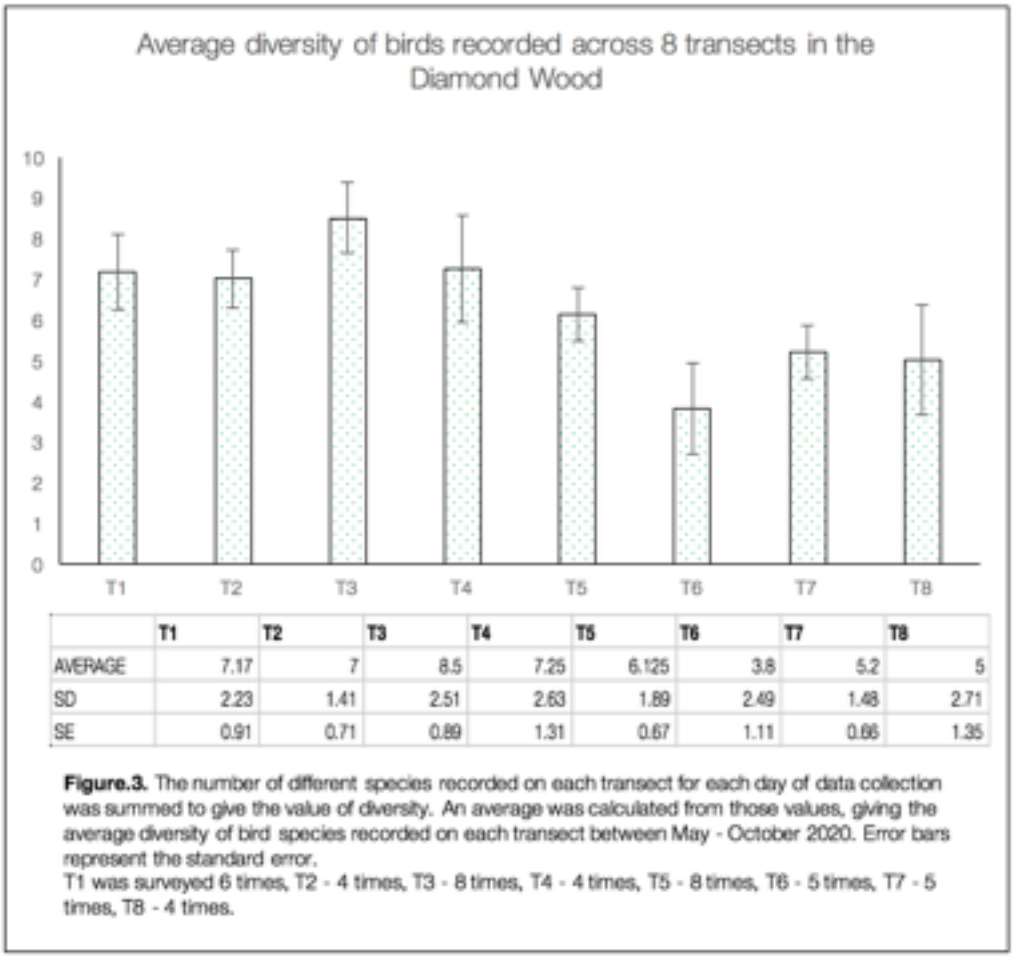
Figure.2. The number of individuals of each species of bird that was recorded on transect 1, 2, 3, and 4 was summed to give an overall frequency value per species in the western end of the Diamond Wood. The same was done for birds recorded on transects 5, 6, 7, and 8, giving the overall frequencies in the eastern end of the Diamond Wood.
29 species, 660 birds were recorded in total between May - October 2020. 392 individuals were recorded in the western end, and 268 individuals were recorded in the eastern end. Other bird species spotted off-transect are not included in this analysis - they are however, included in the complete species list.

	LOCATION	
SPECIES	**WEST**	**EAST**
Blackbird	6	2
Blue Tit	11	1
Buzzard	5	1
Chaffinch	2	1
Collard Dove	3	3
Corn Bunting	3	0
Crow	24	19
Goldfinch	12	13
Great Spotted Woodpecker	1	0
Great Tit	10	0
Gull spp	7	2
House Martin	16	5
Jackdaw	12	32
Jay	1	1
Kestrel	8	6
Linnet	23	5
Magpie	16	11
Pheasant	1	0
Red Kite	7	7
Robin	1	1
Rock Pigeon	2	0
Rook	3	2
Skylark	114	56
Sparrow	1	0
Starling	4	2
Swallow	2	1
Swift	1	2
Wood Pigeon	91	88
Yellowhammer	5	7
Total	**392**	**268**

Table.1. The number of individuals of each species recorded on transects in the western and eastern ends of the Diamond Wood between May - October 2020.

Yellowhammer. Photographed by Kym Welsh

Finally, when comparing the average diversity of birds recorded between each transect (**Figure.3**), the data suggests that transect 1, 2, and 4 have little difference in average. Transect 3 is shown to be the most diverse, whereas transect 6 is suggested to be the least diverse. The diversity of transect 5 falls just below that of 1 ,2 and 4, and transect 7 and 8 fall just below transect 5.



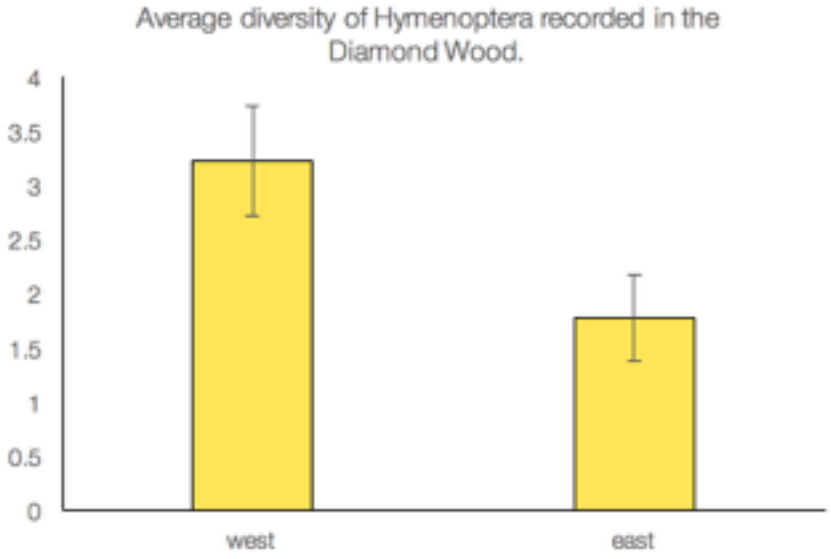
	T1	T2	T3	T4	T5	T6	T7	T8
AVERAGE	7.17	7	8.5	7.25	6.125	3.8	5.2	5
SD	2.23	1.41	2.51	2.63	1.89	2.49	1.48	2.71
SE	0.91	0.71	0.89	1.31	0.67	1.11	0.66	1.35

Figure.3. The number of different species recorded on each transect for each day of data collection was summed to give the value of diversity. An average was calculated from those values, giving the average diversity of bird species recorded on each transect between May - October 2020. Error bars represent the standard error.
T1 was surveyed 6 times, T2 - 4 times, T3 - 8 times, T4 - 4 times, T5 - 8 times, T6 - 5 times, T7 - 5 times, T8 - 4 times.

Pollinators - Hymenoptera and Diptera

The average diversity of Hymenoptera recoded on transects in the western end (mean = 3.23 sd = 1.833 se = 0.508) was significantly higher than in the eastern end (mean = 1.77 sd = 1.423 se = 0.395) (t= 2.2709, p=0.03 (two-tailed), d.f= 22.613). (**figure.4**).

The null hypothesis stated that the two sample means are not significantly different, with the critical t value of -1.715102. The t-test t value was larger than the critical value of 1.72, therefore, we can reject he null hypothesis and accept the hypothesis.



	Location	
	West	**East**
Average	3.231	1.769
SD	1.833	1.423
SE	0.508	0.395
n	13	13

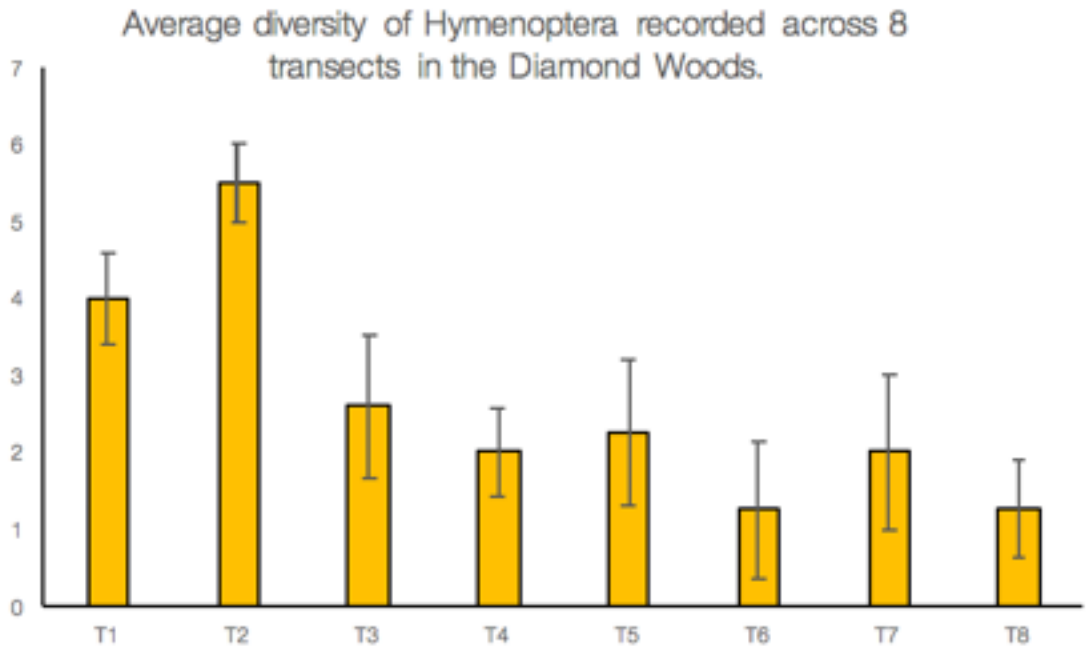
Figure.4 The number of different species recorded on each transect for each day of data collection was summed to give the diversity. The diversity values were allocated between 'west' and 'east' groups. Then an average was calculated from these values, giving the average number of different species of Hymenoptera recorded in each group.

The average Hymenoptera diversity of the Diamond Wood is significantly higher in the western end compared to the eastern end (t= 2.2709, p=0.03 (two-tailed), d.f= 22.613).

The 'west' average includes data from transects 1, 2, 3, & 4. The 'east' average includes data from transects 5, 6, 7, & 8. The error bars represent the standard error.

Data was recorded from the Western end on 12 days and from the Eastern end on 12 days between May - October 2020.

When comparing the average diversity of Hymenoptera recorded between each transect (**Figure. 5**), the data suggests that transect 1 and 2 were the most diverse, whereas transect 6 and 8 were the least. Diversity of transects 3, 4, 5 and 7 are on average very similar.



	T1	T2	T3	T4	T5	T6	T7	T8
Average	4	5.5	2.6	2	2.25	1.25	2	1.25
SD	1.000	0.707	2.074	1.000	1.893	1.528	1.414	1.258
SE	0.577	0.500	0.927	0.577	0.946	0.882	1.000	0.629
n	3	2	5	3	4	3	2	4

Figure.5 The number of different species recorded on each transect for each day of data collection was summed to give the diversity. An average was then taken from those values, giving the average diversity of hymenopteran species recorded on each transect between May - October 2020. The error bars represent the standard error, and n represents the number of times data was recorded on each transect.

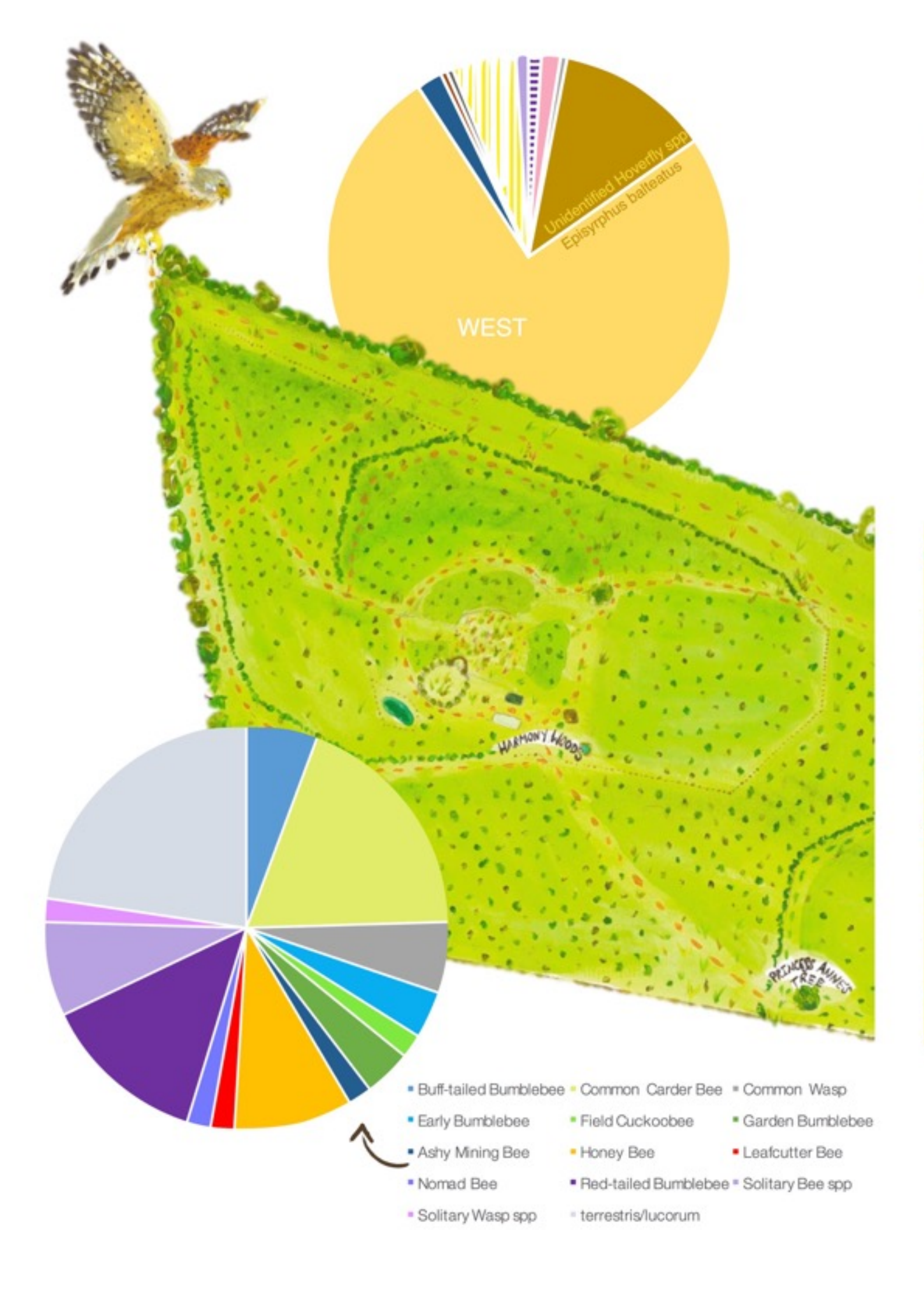
In total, 251 Hymenoptera and 362 Diptera were recorded on transects across the Diamond Wood **(table.2).** 14 species of Hymenoptera were identified in the west and 7 were identified in the east. 10 Diptera species were identified in the west and 5 in the east (**figure.6**) . Greater numbers of individuals of both Hymenoptera and Diptera were recorded in the west compared to the east, except for a couple of Hoverfly species (**table.2**).

		Number of events that each species was recorded at each location	
	Species	**West**	**East**
Hymenoptera	Buff-tailed Bumblebee	3	1
	Common Carder Bee	10	4
	Common Wasp	3	0
	Early Bumblebee	2	0
	Field Cuckoobee	1	0
	Garden Bumblebee	2	0
	Ashy Mining Bee	1	1
	Honey Bee	5	5
	Leafcutter Bee spp	1	0
	Nomad Bee spp	1	0
	Red-tailed Bumblebee	7	4
	Solitary Bee spp	4	4
	Solitary Wasp spp	1	0
	terrestris /lucorum	12	4
	total	**53**	**23**

		Number of individuals counted at each location	
	Species	**West**	**East**
Hymenoptera	Buff-tailed Bumblebee	9	1
	Common Carder Bee	10	3
	Common Wasp	8	0
	Early Bumblebee	3	1
	Field Cuckoobee	1	0
	Garden Bumblebee	50+ (too many to count)	0
	Ashy Mining Bee	1	1
	Honey Bee	50+ (too many to count)	22
	Leafcutter Bee spp	2	0
	Nomad Bee spp	1	0
	Red-tailed Bumblebee	12	5
	Solitary Bee spp	9	7
	Solitary Wasp spp	1	0
	terrestris /lucorum	50+ (too many to count)	4
	Total Hymenoptera	**207+**	**44**

		Number of individuals counted at each location	
Diptera	*Brachypalpoides spp*	3	0
	Merodon equestris	1	0
	unidentified hoverfly spp	24	14
	Eristalis spp	0	1
	Episyrphus balteatus	148	86
	Scaeva pyrastri	4	3
	Chrysotoxum bicinctum	1	0
	Helophilus spp	1	0
	Syrphus spp	10	0
	Eristalis tenax	2	3
	Eupeodes spp	2	6
	Total Diptera	**249**	**113**

Table.2 The number of individuals of each pollinator species counted across the west and east ends of the Diamond Woods between May - October 2020. Where larger swarms of species were present and it became too difficult to accurately count their numbers we have assumed that there were more than 50.


Unidentified Hoverfly spp
Episyrphus balteatus
WEST
HARMONY WOODS
PRINCESS ANNES TREE
Buff-tailed Bumblebee
Common Carder Bee
Common Wasp
Early Bumblebee
Field Cuckoobee
Garden Bumblebee
Ashy Mining Bee
Honey Bee
Leafcutter Bee
Nomad Bee
Red-tailed Bumblebee
Solitary Bee spp
Solitary Wasp spp
terrestris/lucorum

Pollinators

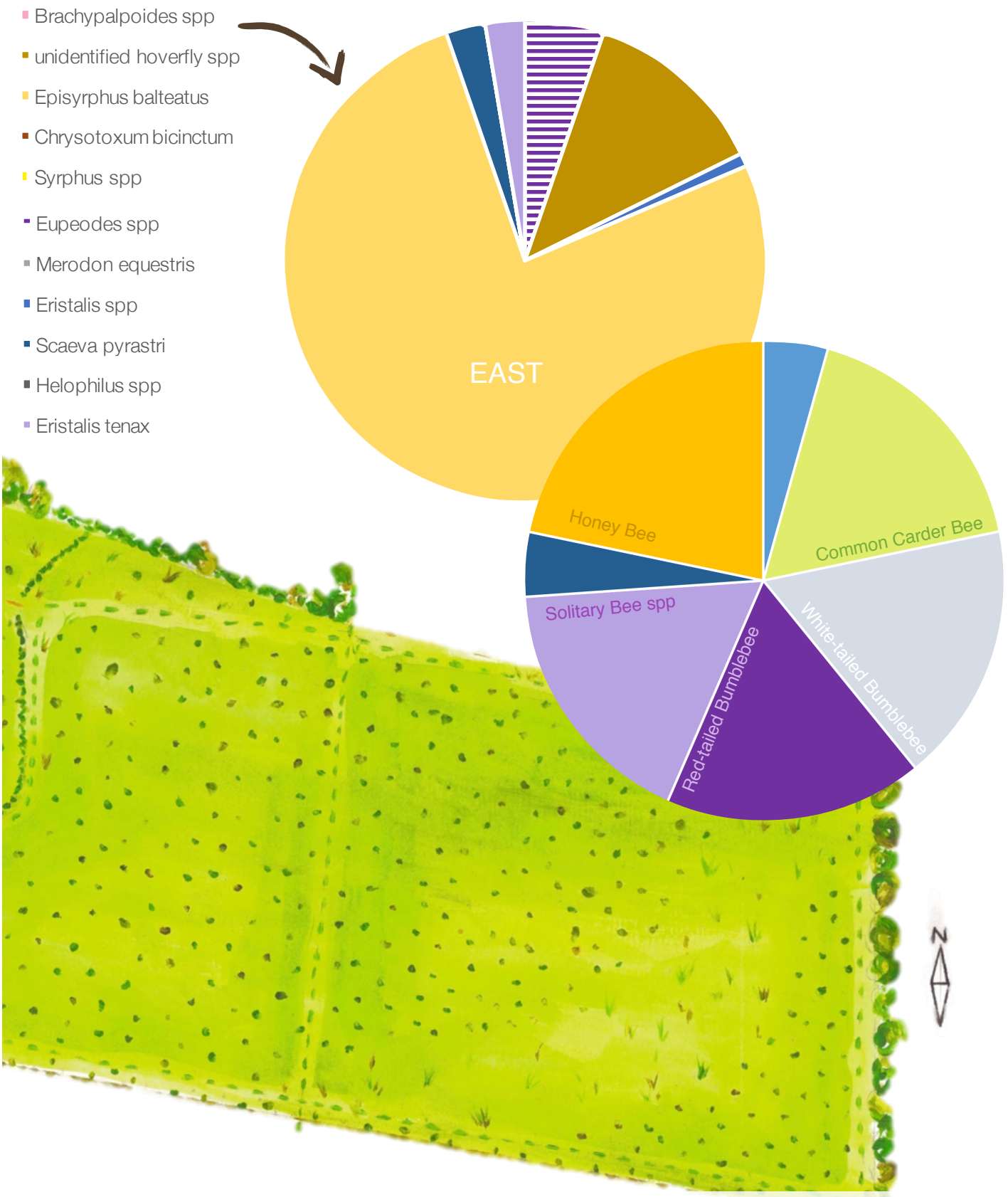


Figure.6 Orange-coloured pies represent the number of individuals of each species of Diptera that was recorded in the eastern and western end of the Diamond Wood between May -October 2020. The purple-coloured pies represent the number of occasions (rather than the number of individuals) that each species of Hymenoptera was recorded in the eastern and western end of the Diamond Wood between May -October 2020.
Number of individuals of Hymenoptera were not used to create pie charts due to the fact that on 3 occasions they were too numerous to count. Please see *table.2* for numbers of individuals of Diptera and Hymenoptera.

Lepidoptera - Butterflies

The overall number of butterflies recorded on the registered Butterfly Conservation transect was shown to have increased in 2020 from previous years **(figure.7).** Similarly to 2019, the butterflies whose populations are doing most well appear to be the Meadow Brown, Marbled White, Small Heath and Gatekeeper. The Small Skipper has made a huge increase from the 2019 data, jumping from 1 individual to 95. **(figure.8).**

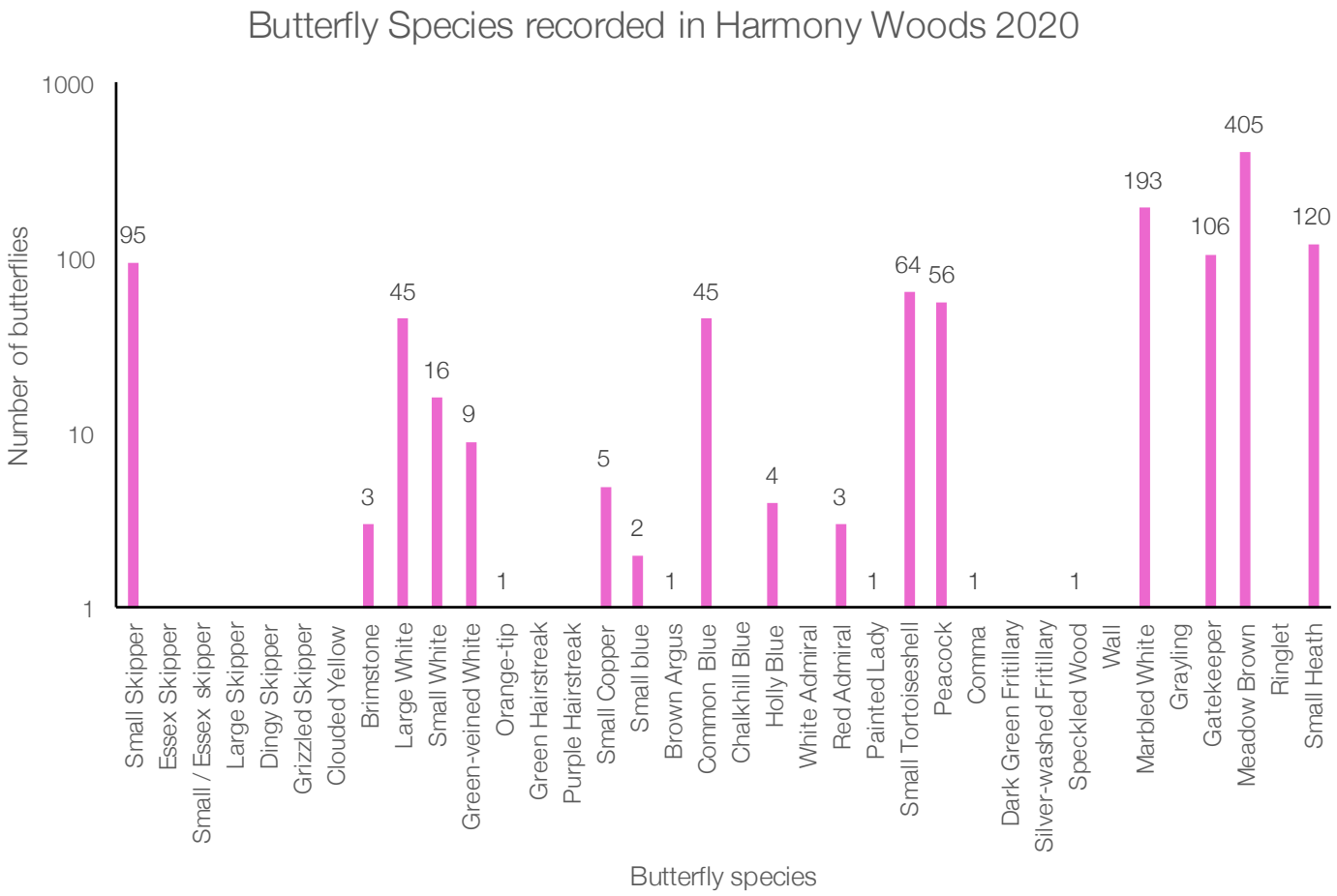
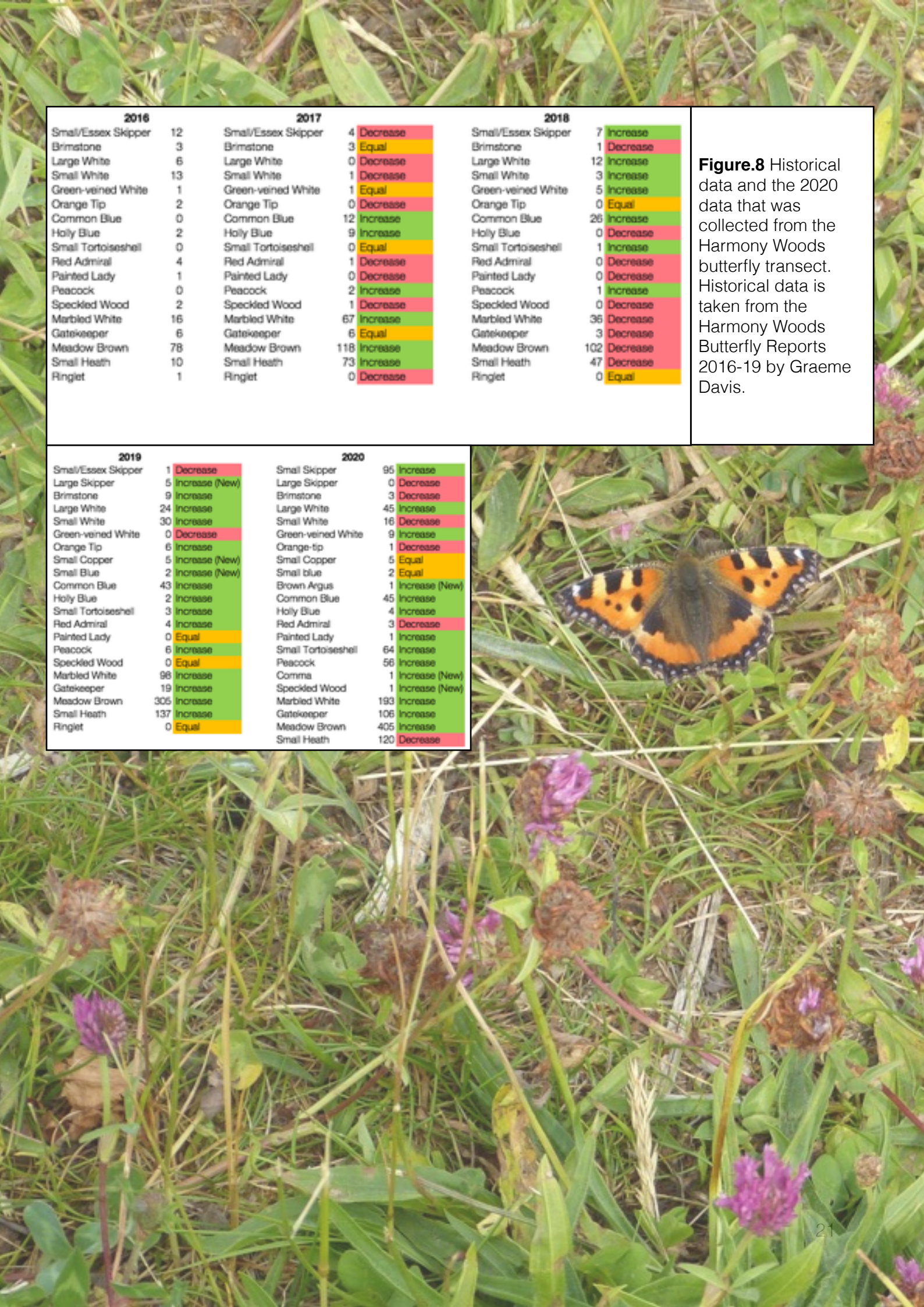


Figure.7 The graph above shows the numbers of each butterfly species that was seen. In total 1176 butterflies were seen, compared to 157 in 2016, and 298 in 2017, 248 in 2018 and 699 in 2019. (Previous butterfly results analysed by Graeme Davis)

21 different species were recorded from the Harmony Woods in 2020, compared to 12 in 2018 and 17 in 2019. Greater detail can be found in the Harmony Woods Butterfly Results report by Graeme Davis. The butterfly transect was walked on 23 days between May - October 2020.



2016	
Small/Essex Skipper	12
Brimstone	3
Large White	6
Small White	13
Green-veined White	1
Orange Tip	2
Common Blue	0
Holly Blue	2
Small Tortoiseshell	0
Red Admiral	4
Painted Lady	1
Peacock	0
Speckled Wood	2
Marbled White	16
Gatekeeper	6
Meadow Brown	78
Small Heath	10
Ringlet	1

2017		
Small/Essex Skipper	4	Decrease
Brimstone	3	Equal
Large White	0	Decrease
Small White	1	Decrease
Green-veined White	1	Equal
Orange Tip	0	Decrease
Common Blue	12	Increase
Holly Blue	9	Increase
Small Tortoiseshell	0	Equal
Red Admiral	1	Decrease
Painted Lady	0	Decrease
Peacock	2	Increase
Speckled Wood	1	Decrease
Marbled White	67	Increase
Gatekeeper	6	Equal
Meadow Brown	118	Increase
Small Heath	73	Increase
Ringlet	0	Decrease

2018		
Small/Essex Skipper	7	Increase
Brimstone	1	Decrease
Large White	12	Increase
Small White	3	Increase
Green-veined White	5	Increase
Orange Tip	0	Equal
Common Blue	26	Increase
Holly Blue	0	Decrease
Small Tortoiseshell	1	Increase
Red Admiral	0	Decrease
Painted Lady	0	Decrease
Peacock	1	Increase
Speckled Wood	0	Decrease
Marbled White	36	Decrease
Gatekeeper	3	Decrease
Meadow Brown	102	Decrease
Small Heath	47	Decrease
Ringlet	0	Equal

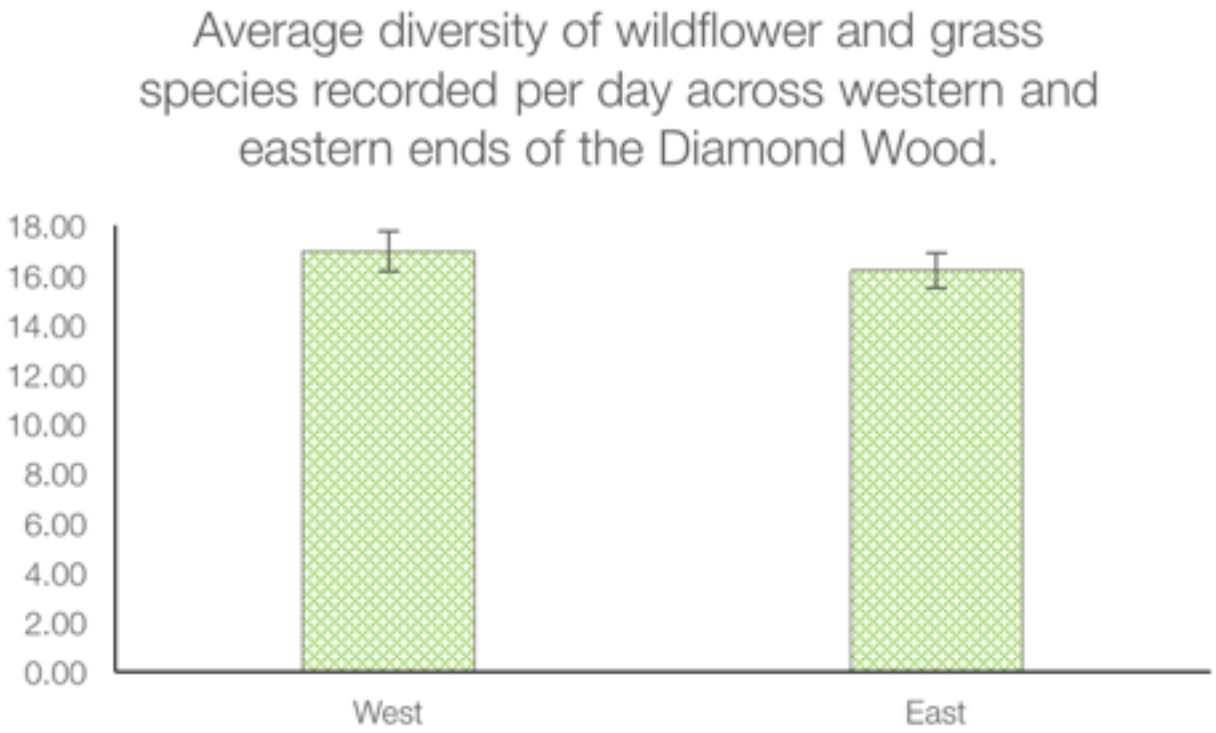
2019		
Small/Essex Skipper	1	Decrease
Large Skipper	5	Increase (New)
Brimstone	9	Increase
Large White	24	Increase
Small White	30	Increase
Green-veined White	0	Decrease
Orange Tip	6	Increase
Small Copper	5	Increase (New)
Small Blue	2	Increase (New)
Common Blue	43	Increase
Holly Blue	2	Increase
Small Tortoiseshell	3	Increase
Red Admiral	4	Increase
Painted Lady	0	Equal
Peacock	6	Increase
Speckled Wood	0	Equal
Marbled White	98	Increase
Gatekeeper	19	Increase
Meadow Brown	305	Increase
Small Heath	137	Increase
Ringlet	0	Equal

2020		
Small Skipper	95	Increase
Large Skipper	0	Decrease
Brimstone	3	Decrease
Large White	45	Increase
Small White	16	Decrease
Green-veined White	9	Increase
Orange-tip	1	Decrease
Small Copper	5	Equal
Small blue	2	Equal
Brown Argus	1	Increase (New)
Common Blue	45	Increase
Holly Blue	4	Increase
Red Admiral	3	Decrease
Painted Lady	1	Increase
Small Tortoiseshell	64	Increase
Peacock	56	Increase
Comma	1	Increase (New)
Speckled Wood	1	Increase (New)
Marbled White	193	Increase
Gatekeeper	106	Increase
Meadow Brown	405	Increase
Small Heath	120	Decrease

Figure.8 Historical data and the 2020 data that was collected from the Harmony Woods butterfly transect. Historical data is taken from the Harmony Woods Butterfly Reports 2016-19 by Graeme Davis.

Wildflowers and grasses

The average diversity of wildflowers and grasses recorded in the western end (mean = 16.955 sd = 3.76 se = 0.8) has no statistical significant difference to that of the eastern end (mean = 16.19 sd = 3.27 se = 0.71) (t= 0.71235, p= 0.4803(two-tailed), d.f= 40.648). **(figure.9).**
The null hypothesis stated that the two sample means are not significantly statistically different, with the critical t value of -1.683215. The t-test t value was smaller than the critical value, so we can accept the null hypothesis and reject the hypothesis.



Location	West	East
Average	16.95	16.19
SD	3.76	3.27
SE	0.80	0.71
n	22	21

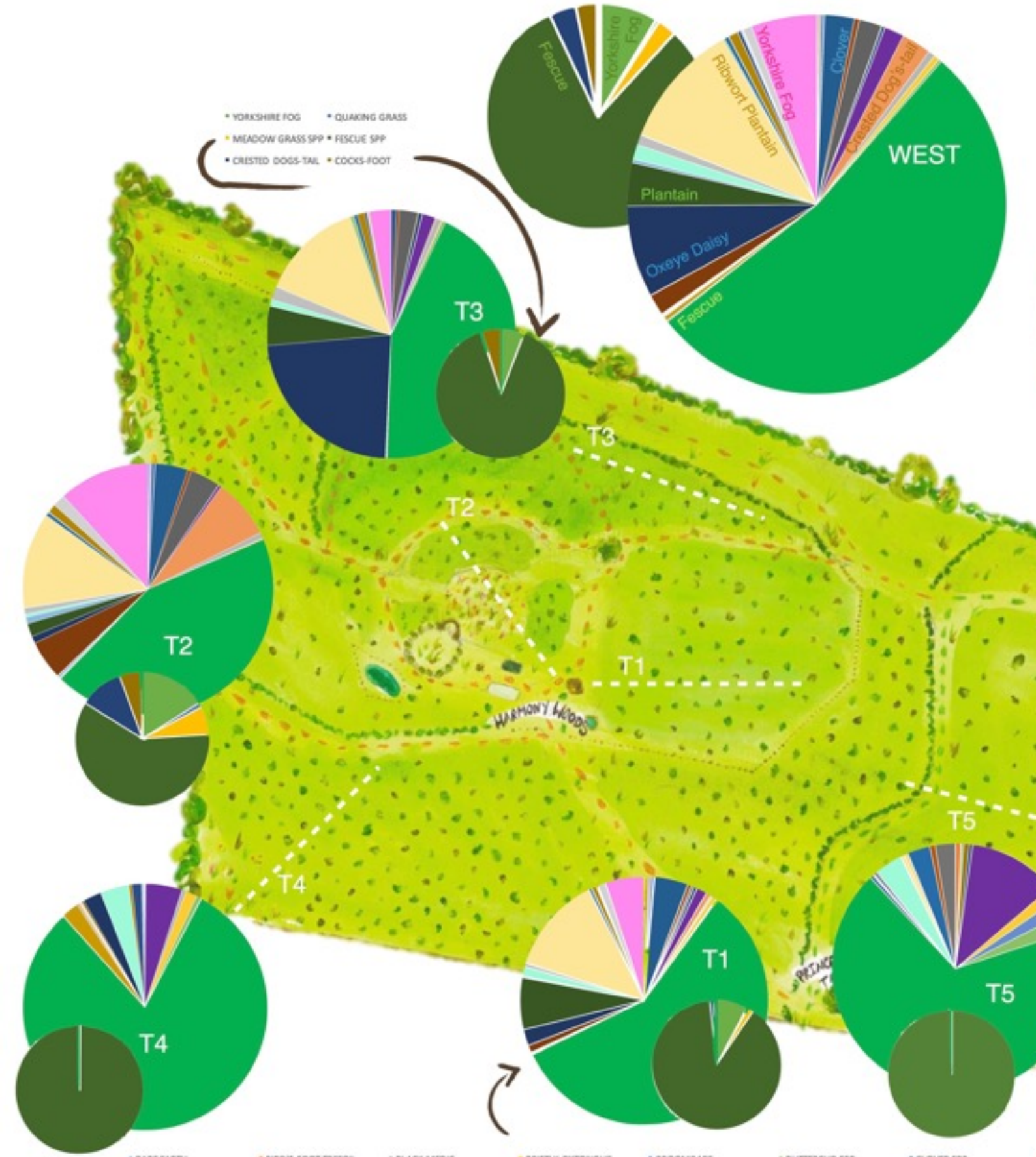
Figure.9 The number of different species was summed per day of data collection to give the diversity. An average was taken from the diversity values from each day of data collection. The 'west' average was taken from data collected from transect 1-4, and the 'east' average was taken from data collected from transect 5-8. Data was collected from western transects on 22 days, and from eastern transects on 21 days between May - November 2020. Transects were rotated so that each one was surveyed at least once per month.

Although diversity is not significantly different, the species present between the east and the west were notably different **(figure.10).** Transect 2 was the most diverse of all **(figure.11).**
Species that were recorded on transects in the western end and not in the eastern end of the woods include: Bird's-foot Trefoil, Broomrape, Common Nettle, Dock spp, Field Scabious, Greater Knapweed, Herb Robbert, Kidney Vetch, Lesser Knapweed, Meadow Crane's-bill, Red Clover, Sainfoin, Selfheal, Teasel spp, Wild Daffodil, Yarrow, Yellow Rattle, Yorkshire Fog and Cock's-foot grass.
Species that were recorded on transects in the eastern end and not in the western end of the woods include: Autumn Hawkbit, Black Bindweed, Blue Fleabane, Bramble, Field Bindweed, Fool's Parsley, Hawkeed spp, Hoary Plantain, Hop Trefoil, Pyramidal Orchid, Smooth Cat's-ear, Speedwell spp and St.Johns Wort.

West			East		
Species	Number	Present in west only or both sides?	Species	Number	Present in east only or both sides?
BARE EARTH	13	Both	AUTUMN HAWKBIT	7	East
BIRD'S-FOOT TREFOIL	18	West	BARE EARTH	173	Both
BLACK MEDIC	19	Both	BLACK BINDWEED	1	East
BRISTLY OXTONGUE	1	Both	BLACK MEDIC	56	Both
BROOMRAPE	29	West	BLUE FLEABANE	2	East
BUTTERCUP SPP	7	Both	SOW-THISTLE SPP	26	Both
CLOVER SPP	347	Both	BRAMBLE	1	East
COMMON CAT'S-EAR	57	Both	BRISTLY OX-TONGUE	4	Both
COMMON DAISY	7	Both	BUTTERCUP SPP	26	Both
COMMON MOUSE-EAR	34	Both	CLOVER SPP	148	Both
COMMON NETTLE	3	West	COMMON CAT'S EAR	15	Both
THISTLE SPP	228	Both	COMMON MOUSE EAR	2	Both
CUT-LEAVED CRANE'S-B	79	Both	COMMON DAISY	2	Both
DANDELION SPP	66	Both	THISTLE SPP	936	Both
DOCK SPP	2	West	CUT-LEAVED CRANESBIL	69	Both
DOVE'S-FOOT CRANE'S-	33	Both	DANDELION SPP	164	Both
FIELD SCABIOUS	3	West	DOVE'S-FOOT CRANESBI	69	Both
SOW-THISTLE SPP	13	Both	FIELD BINDWEED	4	East
GOAT'S-BEARD	50	Both	FOOL'S PARSLEY	1	East
GREATER KNAPWEED	2	West	GOAT'S-BEARD	10	Both
GREATER PLANTAIN	3	Both	GREATER PLANTAIN	72	Both
HAWKBIT SPP	11	Both	HAWKBIT SPP	2	Both
HERB BENNET	6	Both	HAWKWEED SPP	5	East
HERB ROBBERT	1	West	HERB BENNET	1	Both
HOGWEED	3	Both	HOARY PLANTAIN	1	East
KIDNEY VETCH	10	West	HOGWEED	6	Both
LESSER KNAPWEED	3	West	HOP TREFOIL	5	East
MEADOW CRANE'S-BILL	7	West	NIPPLEWORT	32	Both
NIPPLEWORT	1	Both	OX-EYE DAISY	19	Both
WILD CLEMATIS	6	Both	PLANTAIN SPP	9	Both
OX-EYE DAISY	1060	Both	PYRAMIDAL ORCHID	1	East
PLANTAIN SPP	499	Both	RAGWORT	482	Both
RAGWORT	172	Both	SORREL SPP	18	Both
RED CLOVER	116	West	RIBWORT PLANTAIN	17	Both
SORREL SPP	5	Both	SMOOTH CAT'S EAR	1	East
RIBWORT PLANTAIN	1460	Both	SMOOTH HAWK'S-BEAR(	25	Both
SAINFOIN	22	West	SPEEDWELL SPP	4	East
SELFHEAL	51	West	ST.JOHNS WORT	6	East
SMOOTH HAWK'S-BEAR(	3	Both	WHITE CLOVER	417	Both
TEASEL SPP	1	West	WILD CARROT	94	Both
WHITE CLOVER	113	Both	WILLOWHERB	125	Both
WILD CARROT	39	Both	WILD CLEMATIS	5	Both
WILD DAFFODIL	2	West			
WILLOWHERB SPP	19	Both			
YARROW	9	West			
YELLOW RATTLE	101	West			
GRASSES			**GRASSES**		
YORKSHIRE FOG	765	West	QUAKING GRASS	1	Both
QUAKING GRASS	42	Both	MEADOW GRASS SPP	64	Both
MEADOW GRASS SPP	243	Both	FESCUE SPP	7644	Both
FESCUE SPP	7212	Both	CRESTED DOGS-TAIL	1	Both
CRESTED DOGS-TAIL	346	Both			
COCK'S-FOOT	263	West			
Total number of herb sepcies	45		**Total number of herb sepcies**	41	
Total number of grass species	6		**Total number of grass species**	4	
Total number West	19		**Total number East**	13	

Figure. 10 Species of herbs and grasses that were recorded on transects throughout the Diamond Wood between May - October 2020. West data includes transects 1, 2, 3, & 4. East data includes transects 5, 6, 7 & 8.

Species recorded across the Diamond Wood off transects can be found in the complete species list.



- BARE EARTH
- BIRD'S-FOOT TREFOIL
- BLACK MEDIC
- BRISTLY OXTONGUE
- BROOMRAPE
- BUTTERCUP SPP
- CLOVER SPP
- COCK'S-FOOT
- COMMON DAISY
- COMMON MOUSE-EAR
- COMMON NETTLE
- THISTLE SPP
- CRESTED DOG'S-TAIL
- CUT-LEAVED CRANE'S-BILL
- DOCK SPP
- DOVE'S-FOOT CRANE'S-BILL
- FESCUE SPP
- FIELD SCABIOUS
- SOW-THISTLE SPP
- GOAT'S-BEARD
- GREATER KNAPWEED
- HAWKBIT SPP
- HERB BENNET
- HERB ROBBERT
- HOGWEED
- KIDNEY VETCH
- LESSER KNAPWEED
- MEADOW CRANE'S-BILL
- NIPPLEWORT
- WILD CLEMATIS
- OX-EYE DAISY
- PLANTAIN SPP
- QUAKING GRASS
- RAGWORT
- RED CLOVER
- RIBWORT PLANTAIN
- SAINFOIN
- SELFHEAL
- SMOOTH HAWK'S-BEARD
- TEASEL SPP
- WHITE CLOVER
- WILD CARROT
- WILLOWHERB SPP
- YARROW
- YELLOW RATTLE
- YORKSHIRE FOG

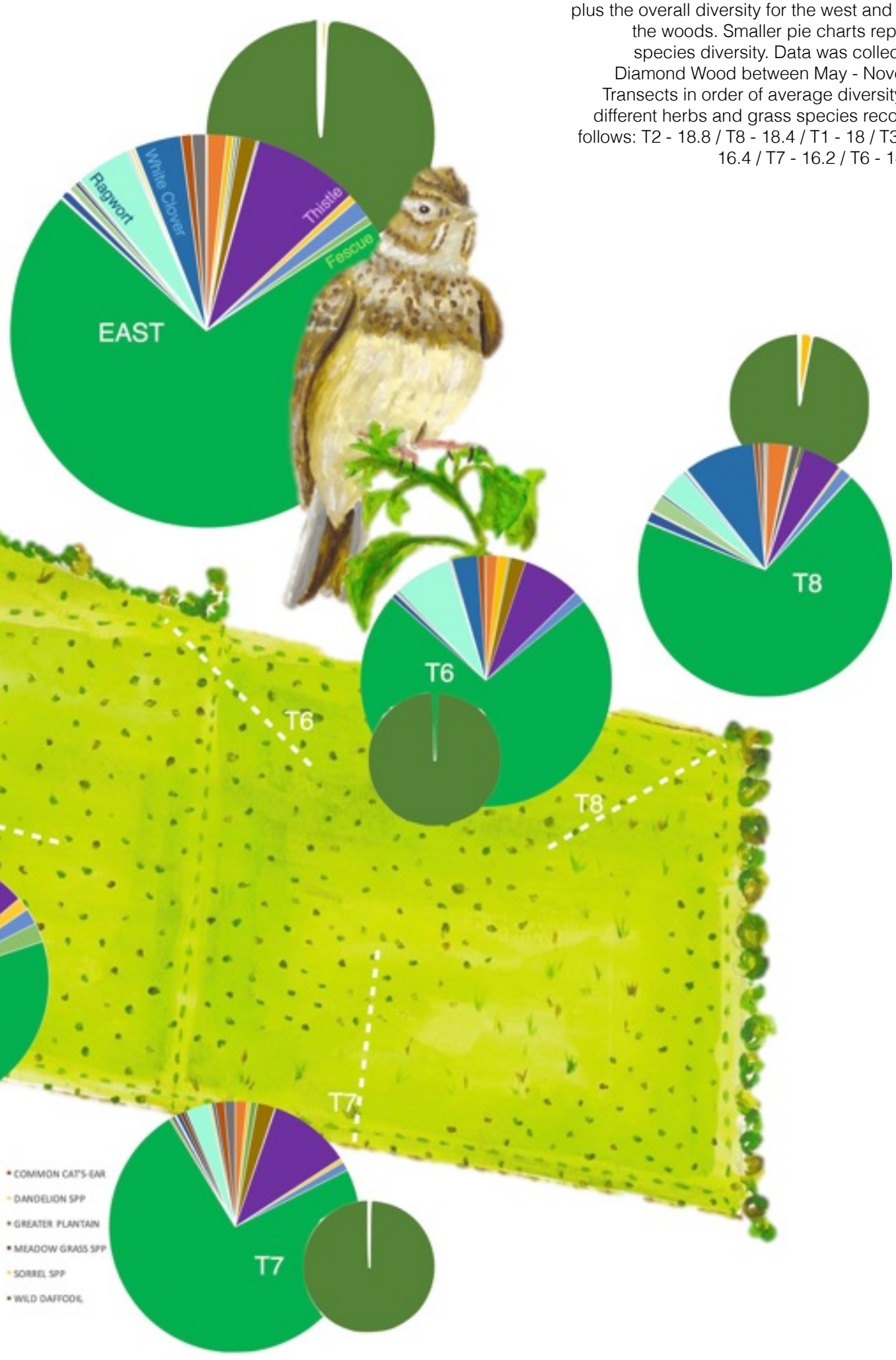
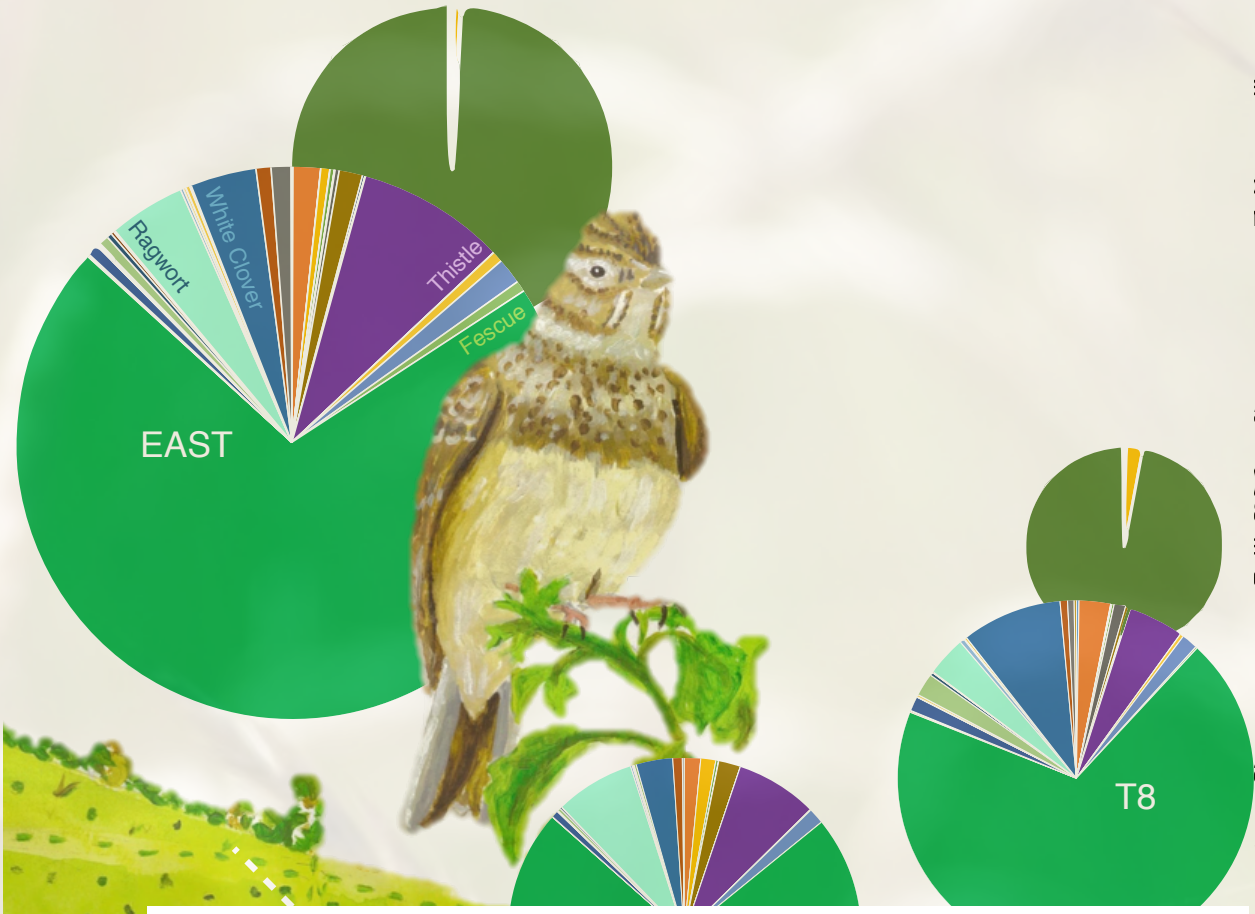


Figure.11 Pie charts represent the diversity of herbs and grasses recorded across each of the 8 transects, plus the overall diversity for the west and east ends of the woods. Smaller pie charts represent grass species diversity. Data was collected from the Diamond Wood between May - November 2020. Transects in order of average diversity (number of different herbs and grass species recorded) are as follows: T2 - 18.8 / T8 - 18.4 / T1 - 18 / T3 - 16.8 / T5 - 16.4 / T7 - 16.2 / T6 - 14.1 / T4 - 14.

Humans and dogs



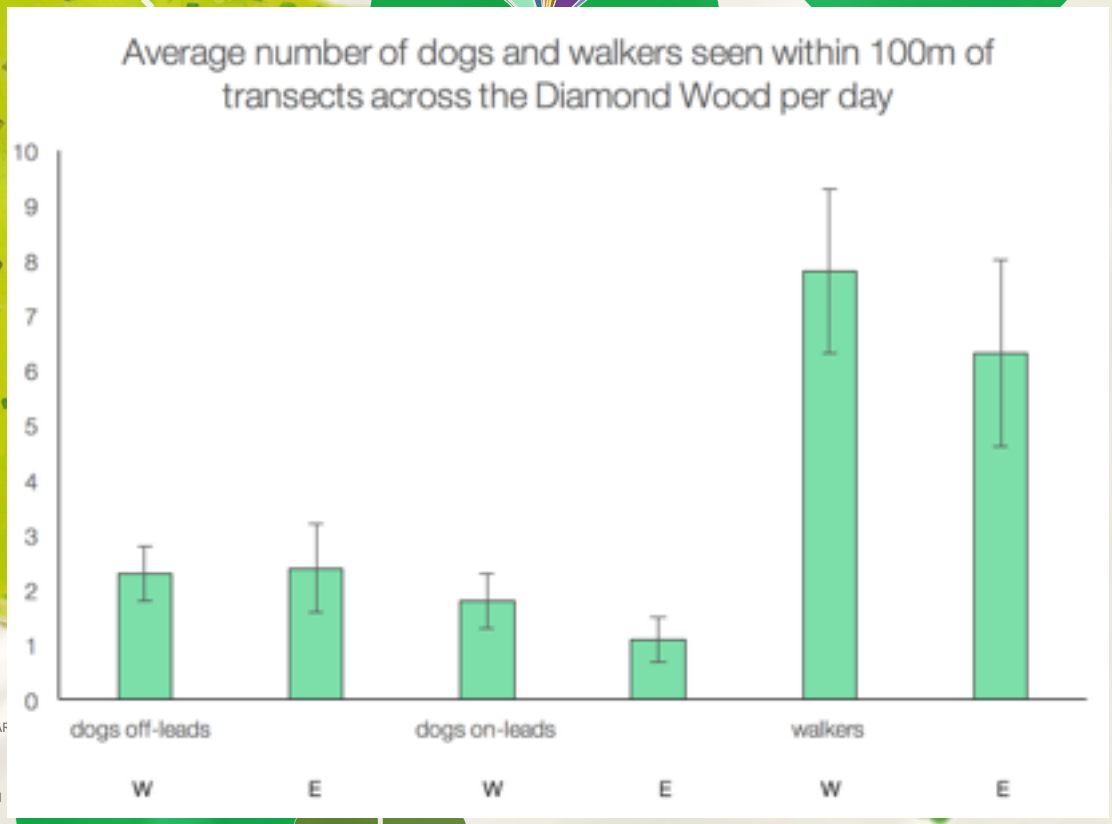


Figure.12 Data was collected during 20 minute bird surveys. The number of walkers, dogs on leads and dogs off leads was recorded on each transect for each day of data collection. An average was calculated from those values. Error bars represent the standard error. Data collected over 22 days between May - October 2020, each day included 1 west and 1 east transect.

COMPLETE LIST OF SPECIES OBSERVED ACROSS THE 44-ACRE DIAMOND WOOD IN 2020

AVES		AVES	
Species Name	**Common name**	**Species Name**	**Common name**
Tito alba	Barn Owl	*Alauda arvensis*	Skylark
Turdus merula	Blackbird	*Sturnus vulgaris*	Starling
Cyanistes caeruleus	Blue Tit	*Saxicola torquatus*	Stonechat
Buteo buteo	Buzzard	*Hirundo rustica*	Swallow
Corvus corone	Carrion Crow	*Apus apus*	Swift
Fringilla coelebs	Chaffinch	*Columba palumbus*	Woodpigeon
Streptopelia decaocto	Collard Dove	*Emberiza citrinella*	Yellowhammer
Emberiza calandra	Corn Bunting	**HYMENOPTERA**	
Carduelis carduelis	Goldfinch	**Species Name**	**Common name**
Dendrocopos major	Great Spotted Woodpecker	*Bombus terrestris*	Buff-tailed Bumblebee
Parus major	Great Tit	Bombus pascourum	Common Carder Bee
Picus viridis	Green Woodpecker	Vespula vulgaris	Common Wasp
Perdix perdix	Grey Partridge	*Bombus patorum*	Early Bumblebee
Larus argentatus	Herring Gull	Bombus campestris	Field Cuckoo Bumblebee
Delichon urbicum	House Martin	Bombus hortorum	Garden Bumblebee
Passer domesticus	House Sparrow	Andrea cineraria	Ashy Mining Bee
Corvus monedula	Jackdaw	*Apis mellifera*	Honey Bee
Garrulous glandarius	Jay	Megachile centuncularis	Patchwork Leafcutter Bee
Falco tinnunculus	Kestrel	Nomada goodeniana	Gooden's Nomad Bee
Larus fuscus	Lesser Black-backed Gull	*Bombus lapidarius*	Red-tailed Bumblebee
Carduelis cannabina	Linnet		Solitary Bee spp
Pica pica	Magpie		Solitary Wasp spp
Anas platyrhynchos	Mallard	*Andrena fulva*	Tawny Mining Bee
Phasianus colchicus	Pheasant (Ring-necked)	*Bombus lucorum*	White-tailed Bumblebee
Motacilla alba yarrellii	Pied Wagtail	**ORTHOPTERA**	
Milvus milvus	Red Kite	**Species Name**	**Common name**
Erithacus rubecula	Robin	*Chorthippus brunneus*	Common Field Grasshopper
Columba livia	Rock Dove / Feral Pigeon	*Omocestus viridulus*	Common Green Grasshopper
Corvus frugilegus	Rook	*Chorthippus parallelus*	Meadow Grasshopper

COLEOPTERA	
Species Name	**Common name**
Agelastica alni	Alder Leaf Beetle
Rhagonycha fulva	Common Red Soldier Beetle
Coccinella septempunctata	Lady Bird (7-spot)
Oedemera lurida	
Oedemera nobilis	Thick-legged Flower Beetle
Clytus arietis	Wasp Beetle

NEUROPTERA	
Species Name	**Common name**
Chrysoperla carnea	Green Lacewing

ODONATA	
Species Name	**Common name**
Libellula depressa	Broad-bodied Chaser
Zygoptera	Damselfly spp
Pyrrhosoma nymphula	Large Red Damselfly

MAMMALIA	
Species Name	**Common name**
Myodes glareolus	Bank Vole
Lepus europaeus	European Hare
Apodemus sylvaticus	Field Mouse
Vulpes vulpes	Red Fox

MYRIAPODA	
Species Name	**Common name**
	Millipede Spp
	Centipede Spp

ISOPODA	
Species Name	**Common name**
Oniscus asellus	Common Woodlouse

DIPTERA	
Species Name	**Common name**
Eupeodes spp	Hoverfly
Brachypalpoides spp	Hoverfly

DIPTERA	
Species Name	**Common name**
Merodon equestris	Greater Bulb-Fly
Scaeva pyrastri	Pied Hoverfly
Episyrphus balteatus	marmalade hoverfly
Chrysotoxum bicinctum	Two-banded Wasp Hoverfly
Helophilus spp	Hoverfly
Syrphus spp	Hoverfly
Eristalis spp	Hoverfly
Eupeodes luniger	Common Spotted Hovefly
Eristalis tenax	Common Drone Fly
Eupeodes corollae	Migrant Hoverfly
Ferdinandea cuprea	Common Copperback Hoverfly

MOLLUSCA	
Species Name	**Common name**
Monacha cantiana	Kentish Snail
Cornu aspersum	Garden Snail
Arion hortensis	Garden Slug

AMPHIBIA	
Species Name	**Common name**
Rana temporaria	Common Frog
Bufo bufo	Common Toad
Lissotriton vulgaris	Smooth Newt

GRASSES	
Species Name	**Common name**
Dactylis glomerata	Cock's-foot
Cynosurus cristatus	Crested Dog's-tail
Festuca	Fescue spp
Poa	Meadow Grass spp
Lolium perenne	Perennial Ryegrass
Briza media	Quaking Grass
Holcus lanatus	Yorkshire Fog

LEPIDOPTERA	
Species Name	**Common name**
Gonepteryx rhamni	Brimstone
Aricia agestis	Brown Argus
Mythimna conigera	Brown Line Bright Eye Moth
Phalera bucephala	Buff-tip Moth
Euclidia glyphica	Burnet Companion Moth
Tyria jacobaeae	Cinnabar Moth
Lomographa temerata	Clouded Silver Moth
Polygonia c-album	Comma
Polyommatus icarus	Common Blue
Euxoa	Dart Moth spp
Eilema griseola	Dingy Footman Moth
Pelosia muscerda	Dotted Footman Moth
Lateroligia ophiogramma	Double Lobed Moth
Polymixis lichenea	Feathered Ranunculus Moth
Pyromania tithonus	Gatekeeper
Crambidae	Grass Moth spp
Pieris napi	Green-veined White
Tholera cespitis	Hedge Rustic Moth
Celastrina argiolus	Holly Blue
Pieris brassicae	Large White
Lacanobia w-latinum	Light Brocade Moth
Eupithecia centaureata	Lime Speck Pug Moth
Abraxas grossulariata	Magpie Moth
Melanargia galathea	Marbled White
Maniola jurtina	Meadow Brown
Callistege mi	Mother Shipton Moth
Anthocharis cardamines	Orange-tip
Vanessa cardui	Painted Lady
Aglais io	Peacock
Eilema pygmaeola	Pigmy Footman Moth
Vanessa atalanta	Red Admiral

LEPIDOPTERA	
Species Name	**Common name**
Phragmatobia fuliginosa	Ruby Tiger Moth
Eilema complana	Scarce Footman Moth
Zygaena filipendulae	Six-spot Burnet Moth
Cupido minimus	Small blue
Lycaena phlaeas	Small Copper
Coenonympha pamphilus	Small Heath
Thymelicus sylvestris	Small Skipper
Aglais urticae	Small Tortoiseshell
Pieris rapae	Small White
Pararge aegeria	Speckled Wood
Thalpophila matura	Straw Underwing Moth
Hoplodrina octogenaria	Uncertain Moth

TREES AND SHRUBS	
Species Name	**Common name**
Rhamnus frangula	Alder Buckthorn
Populus tremula	Aspen
Fagus sylvatica	Beech
Prunus padus	Bird Cherry
Populus nigra betulifolia	Black Poplar
Rubus fruticosus	Bramble
Alnus glutinosa	Common Alder
Malus sylvestris	Crab Apple
Cornus alba	Dogwood
Betula pubescens	Downy Birch
Sambucus nigra	Elder
Ulmus minor 'Ademuz'	Elm
Acer campestre	Field Maple
Salix caprea	Goat Willow
Salix cinerea	Grey willow
Viburnum opulus	Guelder Rose
Crataegus monogyna	Hawthorn

TREES AND SHRUBS	
Species Name	**Common name**
Corylus avellana	Hazel
Ilex aquifolium	Holly
Quercus ilex	Holm oak
Carpinus betulus	Hornbeam
Aesculus hippocastanum	Horse Chestnut
Hedera Helix	Ivy
Juniperus communis	Juniper
Quercus robur	Pedunculate Oak
Sorbus aucuparia	Rowan
Betula pendula	silver birch
Tilia cordata	Small-Leaved Lime
Euonymus europaeus	Spindle
Sorbus aria	Whitebeam
Prunus avium	Wild Cherry
Sorbus torminalis	Wild Service
Taxus baccata	Yew

HERBS	
Species Name	**Common name**
Scorzoneroides autumnalis	Autumn Hawkbit
Lotus corniculatus	Bird's-foot trefoil
Solanum dulcamara	Bittersweet
Fallopia convolvulus	Black Bindweed
Medicago lupulina	Black Medic
Erigeron acer	Blue Fleabane
Borago officinalis	Borage
Helminthotheca echioides	Bristly Oxtongue
Orobanche minor	Broomrape
Buttercups	Buttercup spp
Trifolium	Clover spp
Hypochaeris radicata	Common Cat's-ear
Bellis perennis	Common Daisy

HERBS	
Species Name	**Common name**
Pulicaria dysenterica	Common Fleabane
Malva sylvestris	Common Mallow
Cerastium fontanum	Common Mouse-ear
Artemisia vulgaris	Common Mugwort
Urtica dioica	Common Nettle
Papaver rhoeas	Common Poppy
Dactylorhiza fuchsii	Common Spotted-orchid
Linaria vulgaris	Common Toadflax
Anthriscus sylvestris	Cow Parsley
Primula veris	Cowslip
Geranium dissectum	Cut-leaved Crane's-bill
Taraxacum	Dandelion spp
Rumex	Dock spp
Geranium molle	Dove's-foot Crane's-bill
Convolvulus arvensis	Field Bindweed
Myosotis arvensis	Field Forget-me-not
Knautia arvensis	Field Scabious
Aethusa cynapium	Fool's Parsley
Pilosella aurantiaca	Fox-and-cubs
Tragopogon pratensis	Goat's-beard
Centaurea scabiosa	Greater Knapweed
Plantago major	Greater Plantain
Leontodon	Hawkbit spp
Picris hieracioides	Hawkweed Oxtongue
Hieracium	Hawkweed spp
Galium mollugo	Hedge Bedstraw
Geum urbanum	Herb Bennet
Geranium robertianum	Herb Robert
Plantago media	Hoary Plantain
Heracleum sphondylium	Hogweed
Trifolium campestre	Hop Trefoil

HERBS		HERBS	
Species Name	**Common name**	**Species Name**	**Common name**
Anthyllis vulneraria	Kidney Vetch	*Hypochaeris glabra*	Smooth Cat's-ear
Galium verum	Lady's Bedstraw	*Crepis capillaris*	Smooth Hawk's-beard
Centaurea nigra	Lesser Knapweed	*Rumex*	Sorrel spp
Geranium pratense	Meadow Cranesbill	*Sonchus*	Sow-thistle spp
Lapsana communis	Nipplewort	*Veronica*	Speedwell spp
Leucanthemum vulgare	Oxeye Daisy	*Anagallis arvensis*	Scarlet Pimpernel
Matricaria discoidea	Pineappleweed	*Hypericum perforatum*	St. John's Wort
Plantago	Plantain spp	*Dianthus barbatus*	Sweet William
Anacamptis pyramidalis	Pyramidal orchid	*Dipsacus*	Teasel epp
Lychnis flos-cuculi	Ragged-robin	*Cirsium*	Thistle spp
Senecio jacobaea	Ragwort	*Torilis japonica*	Upright Hedge-parsley
Silene dioica	Red Campion	*Trifolium repens*	White Clover
Trifolium pratense	Red Clover	*Daucus carota*	Wild Carrot
Plantago lanceolata	Ribwort Plantain	*Clematis vitalba*	Wild Clematis
Kickxia spuria	Round-leaved Fluellen	*Narcissus pseudonarcissus*	Wild Daffodil
Onobrychis viciifolia	Sainfoin	*Reseda lutea*	Wild Mignonette
Sanguisorba minor	Salad Burnet	*Epilobeum*	Willowherb spp
Prunella vulgaris	Selfheal	*Achillea millefolium*	Yarrow
		Rhinanthus minor	Yellow Rattle

DISCUSSION AND WIDER IMPLICATIONS

BIRDS

The bird diversity of the western end of the Diamond Woods is significantly higher than the eastern end. This could be due to the fact that the western end of the woods contains a greater heterogeneity of habitats, including the wildlife pond, supporting a greater range of organisms and therefore a greater range of bird species. Alternatively, this could be because the western end may provide greater food resources than the eastern end, which could be a result of differences in vegetation composition (Tworek, S., 2007). The east and west ends were found to have no significant difference in vegetation diversity, however, the composition of plants between each end were notably different.

Both the west and east ends of the Diamond Wood have large proportions of Skylark and Wood Pigeon. Although in the west, Skylark numbers are more than double that of the east. Reasons for this could be linked to the fact that the east had well over twice as many Jackdaw compared to the west, and corvids are one of the main predators of Skylarks (Praus, L. et al, 2014).

Predation is a major cause of nest failure for many birds. In particular, breeding populations of some ground-nesting birds of open habitats (Praus, L. et al, 2014). The study by Praus, L. et al, (2014) found the main predators of Skylark nests to be Red Fox *Vulpes vulpe*s, Carrion Crow *Corvus corone* and European Adder *Vipera berus.* Praus, L. et al, (2014) goes on to explain that although the Red Fox was the primary predator of this study, further clarification is needed to know whether foxes actively search for skylark nests or find them incidentally while searching for their primary prey - small rodents. Evidence of small rodent activity is very prevalent through the diamond wood, and so it could be that the Red Foxes primarily hunt for them, and birds are an alternative food source.

However, this wouldn't explain why the Jackdaws are highest in density in the east, and are not predating at an equal rate across the entire wood. Furthermore the number of Crows present across the site was equal between the west and east.

Another reason for higher numbers of Skylark in the western end could be the increased habitat heterogeneity and vegetation structure. Skylarks require structurally diverse crop mosaics in order to make multiple nesting attempts without territory enlargement or abandonment (Wilson, J.D., et al, 1997). Moreover, a study by Chamberlain, D.E, et al (1999) showed that Skylark density increased with increasing habitat diversity.
Furthermore, a study by Wakeham-Dawson, A., et al (1998) showed that singing skylark density was greater on chalk downland arable reversion (arable land that has reverted to grassland) than on permanent grassland reversion, and in swards above 4 cm in height and in fields without boundary scrub. A greater variety of chalk meadow species were recorded in the western end of the woods compared to the eastern.

T6 seems to be significantly lower in bird diversity than T1, T2, T3, T4 and T5. One reason for this is because the transect spans 2 busy footpaths, and even when it enters the long grass area, the transect is in close proximity (within 10m) of the footpaths still. Being near footpaths means being near humans and dogs, a position that would be disadvantageous to a bird, particularly a nesting bird. Studies show that human presence and dog presence can evoke anti-predatory responses in birds (Banks, P.B. and Bryant, J.V., 2007). Particularly ground-nesting birds. This could be an explanation for the lower number of skylarks recorded in the east. Dogs, or their close ancestors, have also evolved as top predators in many ecosystems and hunt a wide range of fauna (Macdonald & Sillero-Zubiri 2004, in Banks, P.B. and Bryant, J.V., 2007), and thus it is no surprise that the sight of the dog will induce predator-avoidance and defence behaviours in birds. The skylark anti-predator response can include flocking, refuge-seeking and song. As well as an indication of an individual's quality, song is used as a pursuit-deterrent signal, and is used with respect to other anti-predation options such as flocking (Cresswell, W., 1994.). For breeding birds there is clear evidence, both research-based and anecdotal, that disturbance and therefore anti-predatory responses such as flocking will expose the eggs or young to a greater risk of loss to opportunistic predators, especially corvids (Taylor., K. et al, 2005). The authors continue, stating

that this appears to be the greatest risk arising from disturbance on sites where visitor and dog numbers are high and that this effect is greatest for ground nesting birds in a variety of habitats.

Banks and Bryant (2007) found that dog walking caused a 41% reduction in the numbers of bird individuals detected and a 35% reduction in species richness compared with controls. Humans walking alone also induced some disturbance but typically less than half that induced by dogs. Furthermore, ground dwelling birds appeared most affected. For birds which did not flee the site, there were 76% fewer individuals within 10 m of the trail when dog walking occurred compared with control sites, suggesting that birds were seeking refuge away from the immediate vicinity of the threat. This could further explain why transect 6 saw fewer bird species than any other.

POLLINATORS

The average diversity of Hymenoptera recorded on transects in the western end was significantly higher than in the eastern end. This could be due to differences in the habitat heterogeneity.

Increased landscape heterogeneity and the amount of high-quality (natural and semi-natural) habitat typically enhances species richness and abundance (Senapathi, D., *et al*, 2017). The western end has a greater habitat heterogeneity due to the presence of the chalk meadow, chalk scrape and pond - 3 habitats that are absent in the eastern end. The presence of these habitats suggests and explanation for greater diversity of pollinators in the western end as they provide a greater variety of resources. In a study by Hanley, M.E., *et al* (2008), the nutrient content of pollen from wildflowers were analysed and pollinator preference was compared amongst flower species. They found a clear relationship between pollen protein content and pollinator attraction; bumblebees appear to fine-tune their foraging behaviour to select plants offering the most rewarding pollen. Hanley, M.E., *et al* (2008) found that the wildflowers with the highest protein content, and therefore the highest-quality food resource were as follows (in order of highest to lowest): *Trifolium pratense* (red clover); *Onobrychis viciifolia* (Sainfoin); *Lotus corniculatus* (bird's-foot trefoil); and *Trifolium repens* (white clover). The Asteraceae family was intermediate in pollen quality, and the lowest quality pollen was found in the Rosacea family. When looking at the plant composition of east and west, the west has greater numbers of the Fabacea family - namely, the red clover, Sainfoin, bird's-foot trefoil, black medic and white clover. Whereas the eastern end has white clover, black medic, hop trefoil and much greater densities of Thistle and Ragwort - which are from the Asteraceae family.

Another reason for differences in pollinator diversity between the east and west could be to do with that fact that as well as the abundance or diversity of floral food sources, wild pollinators depend on a range of other resources, for example, the majority of Hymenoptera requires nest sites, whilst Diptera and Lepidoptera require larval host habitat, which is often species-specific (Senapathi, D., *et al*, 2017). There could be lower nest site resources or larval host habitat resources in the eastern end of the woods. However, this would need to be studied further.

LEPIDOPTERA

The overall number of butterflies recorded on the registered butterfly transect was shown to have increased in 2020 from previous years. This could be due to the increasing numbers of butterfly food plants year on year - particularly chalk meadow species. Alternatively, this could be due to an increase in the number of surveys undertaken in 2020 compared to previous years.

WILDFLOWERS AND GRASSES

The average diversity of wildflowers and grasses recorded in the western end had no statistical significant difference to that of the eastern end.

Although diversity is not significantly different, the species present between the east and the west were notably different. Transect 2, the transect that crossed the chalk meadow was the most diverse of all.

This is likely to be due to differences in land management. The east contains more competitive and generalist species of plants such as ragwort, thistle and bindweed. The west contains species that have been sown or planted by the ATU team such as sainfoin and kidney vetch, the thistle and ragwort is kept in check by volunteers and there is no use of chemicals. The west also contains a chalk meadow that is routinely cut once a year - to mimic grazing, reduce nutrient richness and enable chalk-loving species to thrive. The chalk meadow has also seen an introduction of yellow rattle in order to reduce the prevalence of competitive grasses. This reduction in nutrient level, the scraping back of top soil to reveal chalk, and the reduction in competitive species such as thistle and ragwort will have made way for the natural introduction of other less-competitive species as well as the establishment of those planted by the team.

Shellswell, C.H., et al (2016) states that positive indicator species of lowland grasslands include: crested dog's-tail *Cynosurus cristatus*, meadow buttercup *Ranunculus acris*, red clover *Trifolium pratense*, and yellow rattle *Rhinanthus minor* - all of which can be found in the more managed areas of the western end of the woods. Early successional species of lowland grassland habitats can include cowslip *Primula veris*, common knapweed *Centaurea nigra*, oxeye daisy *Leucanthemum vulgare*, yellow rattle *Rhinanthus minor* and ribwort plantain *Plantago lanceolata.* Again, these are all present in the more managed areas of the western end of the woods.

Negative indicator species of lowland grassland habitats , that indicate soil nutrient enrichment include creeping thistle *Cirsium arvense, ragwort Senecio jacobaea* and cow parsley *Anthriscus sylvestris.* Creeping thistle and common ragwort was found across both ends of the woods - but in much greater numbers where the land had little to no human intervention (transect 4, 5, 6, 7, & 8), where they have been able to spread across large areas of the existing grassland and woodland.

This suggests that the management techniques used by Andover Trees United within the Harmony Woods boundary have been advantageous in the creation of a richly diverse chalk meadow, and the diverse community of invertebrates and bird species, too, and this informed management style should continue across the whole 44-acre site whilst still being ecologically considerate to other habitats such as the wooded areas, hedgerows and grasslands. For example, Fescues are an important food plant for the larvae of the Small Heath butterfly (a priority species and currently present in the Diamond Woods) , so care should be taken not to loose areas of Fescue cover.

Moreover, it will be important to keep areas of varying intervention. We have seen that areas of very little input has developed a species composition that differs greatly to the chalk meadow, however, this environment is just as diverse and does contain important species, too, such as the thistle, ragwort, hawkbits and plantains, for example, which should not be completely eradicated.

Monitoring should be maintained in order to ensure that all management decisions of areas are informed, and that any competitive species (such as scrub) do encroach and do not compromise others. Priority species should be monitored and special care taken to ensure their populations are maintained.

HUMANS AND DOGS

No significant difference was found in the numbers of dogs off leads between the western and eastern ends. However, this is likely to change as communication efforts between the ATU team and the site visitors are ever-increasing , along with the understanding from visitors on which part of the Diamond Woods are allocated as dogs on-leads areas.

During the surveying, the majority of dog walkers were compliant when asked to put their dogs onto leads. However, there were multiple occasions when dog walkers were abusive to survey recorders and non-compliant, despite attempts of explaining the reasoning. With an increased communication effort, it is likely that the number of compliant visitors will increase.

There was a statistical difference in numbers of dogs on-leads between the two ends. This is likely due to those visitors who are aware of the dog walking guidelines.

There were significantly more walkers in the western end than the eastern end. This is likely due to the fact that transect 3, in the west, runs alongside a very frequently visited footpath towards the north of the woods which connects the housing estate in the south to the village of Enham Alamein in the north. It was at this transect that the majority of human and dog recordings were made.

The data on human and dog usage of the site was recorded along with the bird recordings, rather than having its own dedicated survey method and allocated time in which to collect. Therefore, the results from the humans and dog data are not statistically powerful and should not be taken at face value.

The large amount of dog walkers and especially dogs off-leads has wider implications for the conservation of the flora and fauna in the Diamond Wood.

Jenkinson., S (2011) reports that off lead dogs can cause the following negative impacts on natural spaces: stress, injury or death of animals from being chased or attacked; reductions in breeding success due to disturbance at nesting time; permanent displacement from habitat; enriched nutrient levels from canine urine and faeces and consequential changes in biodiversity. Furthermore, Enderby., R (no date) states that on small nature reserves dogs can cause a 40% reduction in bird species across the whole reserve. This is a worrying statistic as Skylarks are already a priority and red-listed species (UK BAP).

Many visitors to the Diamond Wood are also nature lovers and don't inherently wish to cause any harm to the wildlife or environment. However, they, along with many people in today's society, lack the environmental and ecological knowledge about, and emotional connection to, the natural world that is needed to understand how to, and to have a desire to, behave responsibly within it. Unfortunately, therefore, people unknowingly inflict harm on wildlife, for example, by allowing their dogs into wild spaces off-leads, sometimes out of control, or not picking up after their dogs. It is no surprise that a mismatch between the behaviours of nature conservationists and nature visitors is a story told time and time again.

This mismatch hints to a much wider issue that surrounds countries such as the UK, in which environmental education is lacking, and the needs of nature are often not acknowledged as equal needs to other members of society, namely, people. This is something that needs urgent change, considering the poor state of nature we currently find ourselves in. Andover Trees United recognises this problem and works to change it.

It must be acknowledged that dogs bring positives to human lives in the form of: promotion of health and well-being; use as working dogs; use to assist people with illnesses or disabilities; economic benefits in terms of sales of dog-related goods (Taylor., K. et al, 2005).

However, in a world where economic growth takes priority, and where the need to enhance the human's 'experience' of nature seems to be more important the nature's 'experience' of humans, we experience the exploitation and ecological breakdown of the natural world. As a result we would ague that hose benefits of dogs to human lives are considerably outweighed by the negative impacts to the natural ecosystem.

It therefore follows that, behaviour in wildlife parks and nature reserves should be an ongoing responsible and environmentally conscious decision of all visitors, in the same way that the purchasing of goods, choice of transportation, recycling and other lifestyle behaviours are.

Overall, the Nature in Harmony 2020 report provides a positive and promising starting point. It highlights areas for improvement such as the unimproved grassland in the east and the communication with users of the site. It highlights priority species for which care should be taken to conserve, such as the Skylark and Small Heath butterfly. It provides an insight into consequences of different management strategies and provides a good baseline that can be added to and developed further in the years to come. It will allow the managers of the land to recognise trends and changes in species populations and compositions, and allow ATU to continue providing citizen science training opportunities to their volunteers with easy-to-replicate survey methods.

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‘Freddie’ the Skylark - photo by Jack Kennie