

# Nature in Harmony 2022





## **Nature in Harmony 2022**

A report on the 'Nature in Harmony' flora and fauna surveys undertaken between April and August 2022 in the Diamond Wood and Harmony Woods, Andover, Hampshire.

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## ABSTRACT

The 'Nature in Harmony' wildlife survey programme for Harmony Woods and the wider Diamond Wood in Andover, Hampshire, was established in 2020. Except for the results of a registered Butterfly Conservation Trust transect undertaken annually between 2016 and 2019, no historic data for wildlife on the site was available prior to this.

Bird, pollinator, and flora data is grouped into the west and east sides of the wood to reflect the difference in land management style between each end. An objective of the survey programme is to gain a better understanding of whether this difference in management style has led to any significant differences in biodiversity - in birds, pollinators, and plants - between each side. Andover Trees United has now secured the lease to manage the whole 44 acres, although there will be a softer approach to management in the eastern half of the site.

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

This report builds upon the Nature in Harmony 2020 and 2021 reports, adding to the baseline dataset and species list of the flora and fauna observed in the 44-acre site between April and October 2020 and 2021. Due to unforeseen circumstances, the 2022 surveys did not continue past the end of August 2022.

Birds, Pollinators and Flora were more diverse in the west, this is consistent with from previous years. Diversity is statistically different between both ends for all but birds, species composition was also notably different between each end. Butterfly diversity increased in 2022 despite a much lower sample size. There was the greatest increase in species identified in the Lepidopteran family, plus several new additions to the complete species list including species of bird, spiders and other invertebrates.

Reasons for this year's findings and their wider implications are discussed.

## ACKNOWLEDGEMENTS

I would like to thank:

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## INTRODUCTION

The 'Nature in Harmony' wildlife monitoring programme was established in 2020 by Andover Trees United, in order to gather a data set for the wildlife present in their 12-acre community woodland Harmony Woods, and the wider Diamond Wood in which it sits. The site is former arable land on the northern edge of Andover in Hampshire.

In 2012 the 44-acre site was set aside by the Trinley Estate for a Queen Elizabeth II Diamond Jubilee Woodland, including 12 acres for the Andover Trees United (ATU) community planting project 'Harmony Woods'. Since then the site has been owned and part-managed by Hampshire County Council. ATU have managed the 12-acre Harmony Woods section, and in late 2022 secured the lease to manage the entire 44 acres.

No historic wildlife data is available prior to 2020, except for the results of a registered Butterfly Conservation Trust transect undertaken annually between 2016 and 2019. Although there is no historical data, it is assumed that before 2012, the biodiversity of flora and fauna would have been lower than it is today due to crop homogeneity.


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

Between 2016 and 2019, data was collected as part of a registered Butterfly Conservation Trust transect in Harmony Woods. The 'Nature in Harmony' project in 2020 provided the first baseline dataset of the site for other types of fauna and flora, set up methods for ongoing monitoring, and allowed the land managers (Andover Trees United) to make more informed decisions to better conserve their habitats and species. The project also provides ongoing opportunities for citizen science and community engagement in environmental education, which meets Andover Trees United's constituted aims.

Due to the differing ways in which Harmony Woods and the wider Diamond Wood have been managed, the site offers a unique opportunity to survey adjoining parcels of land that vary in their use and management.

The eastern end of the site was planted with native trees and sown with fescue grass in 2012/13, and since then 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 main pathway running around the edge of the site as well as a public Right of Way, and is used frequently by local residents from an adjacent housing development to walk their dogs.





The western end contains Harmony Woods, which is surrounded by two main pathways. The pathways are similarly managed and used as those 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, with the aims of nature conservation, environmental education, and nature connection. The wooded area has grown in succession with 1000 new native British trees planted by local school children each year between 2012 and 2021, rather than all being planted at once as was done in the east.

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 some 'pinch points' were created along one of the pathways to help reduce the size of the path and encourage more animals to migrate into the space.

As ATU takes on the management of 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, lowland calcareous grassland, and chalk wildflower meadow.

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 rare and under threat, with an estimated total of 38,687 ha covering around 3% of England's land area. 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 2020 and 2021 include: Skylark, Common Linnet, Corn Bunting, Yellowhammer, Grey Partridge, Swift, House Martin, Common Starling, Brown Hare, Small Heath butterfly, Small Blue butterfly, Marsh Fritillary butterfly, Forester moth, Argent & Sable moth, Galium Carpet moth, Speckled Footman moth, Dingy Mocha moth, Shoulder-striped Wainscot moth, Cinnabar 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 events, and volunteer work days. The site is used as a learning resource, community space, and volunteer base. It is located just south of the village of Enham Alamein, and within 200m of the large Augusta Park housing development on the edge of Andover. 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.

This report presents the results of year 3 of the 'Nature in Harmony' wildlife monitoring programme.





© Pyramid Orchid (*Anacamptis pyramidalis*) in Harmony Woods. Photo taken by Stewart

## METHODS

### 1 DATA COLLECTION

#### 1.1 The Field Site

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

The Diamond Wood and Harmony Woods offer a unique opportunity to investigate a site where the two sides are managed in different ways. To compare the two sides and gain an insight into the impact that the differing management styles has had on the biodiversity of the site, the site was divided into East and West sides. Four 100m transects were placed across each side, making eight transects in total across the site, as seen below in Figure 1.

Each week two randomly selected transects were surveyed, one from the West and one from the East, for wildflowers and grasses, birds, and pollinators. In addition, butterfly data was collected from the registered Butterfly Conservation Trust transect in Harmony Woods.

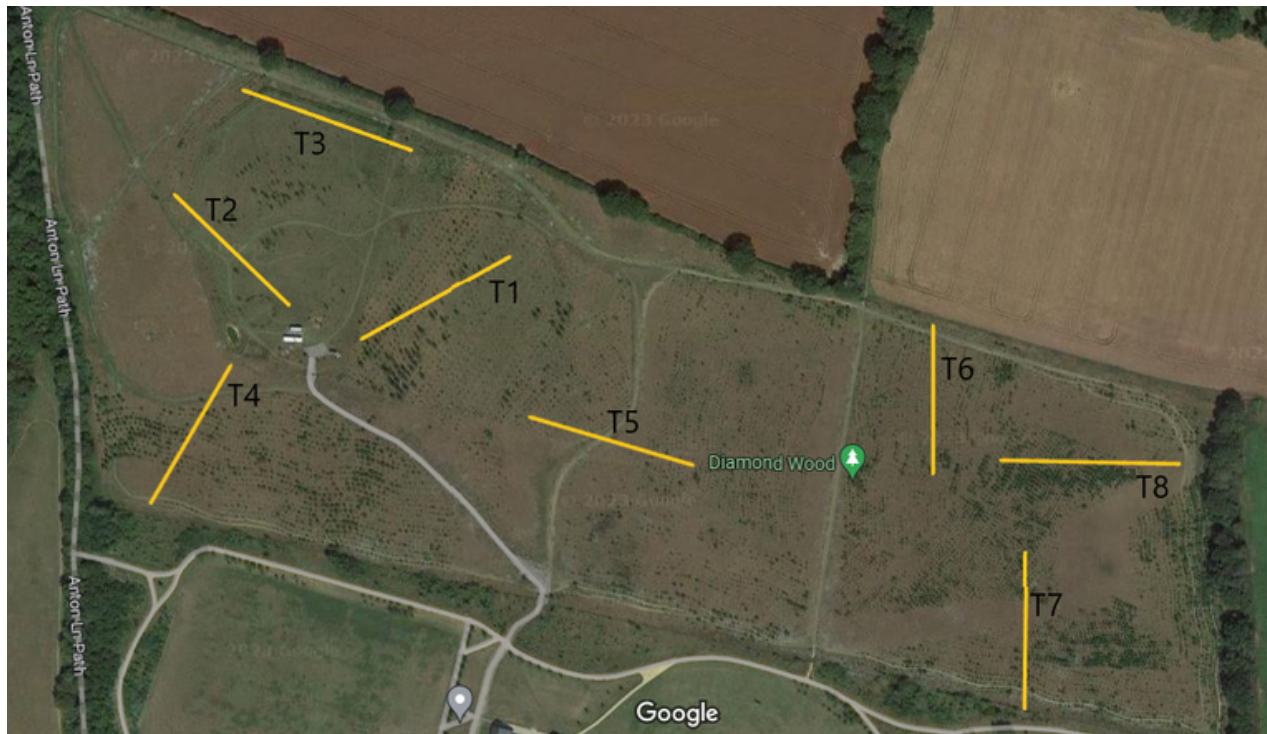


Figure 1: Map of the Diamond Wood, showing the approximate locations of the 2022 transects.

## **1.2 Birds**

A random number between 0 and 100 is generated and used as the point, in metres, along the selected transect at which a fixed-point bird survey will take place. At this point, the recorder stands for 15 minutes and notes down every bird sighted within 100m of them. Birds seen overhead are included, regardless of how high in the sky they are spotted. Binoculars can be used.

Abiotic data including date, time, and weather conditions are also recorded. Bird species as well as number of individuals are recorded, and care taken not to record the same individual twice (although this is an assumption).

## **1.3 Pollinators**

The selected transects are walked at a slow pace. During the walk, recorders made a note of any pollinators seen within a 5m belt of the transect. This includes Hymenoptera, Diptera, Lepidoptera and Coleoptera (if seen on a flower head).

## **1.4 Wildflowers and Grasses**

A random number between 0 and 5 is generated and used as the starting point, in metres, along the selected transect. At the starting point, recorders place a 50x50cm quadrat on the ground on the left- or right-hand side of the transect. Then the number of squares containing grass (out of 25) is noted, and the dominant grass species present. Species of wildflower and other grasses within the quadrat are recorded along with the number of squares each appears in. Any unsure observations are looked up in an ID guide or photographed for later analysis. Then, the recorder takes 5 big steps, approximately 5 metres, and the quadrat is placed on the ground on the same side of the transect, and the process is repeated.

## **1.5 Butterfly Transect**

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 is a count of 0 butterflies this is recorded.

## **1.6 All Other Observations**

All other observations are collated into a 'complete list of species' spotted in the Diamond Woods, that can be found at the end of this report. This data contains off-transect observations and citizen science observations made during public events, in addition to species recorded in the 'Nature in Harmony' surveys.

## **2 STATISTICAL ANALYSIS**

### **2.1 Birds, Pollinators, Wildflowers and Grasses**

The number of different species recorded on each transect for each day of data collection was summed to give 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' groups. The 'west' group contains data collected from transect 1, 2, 3 & 4. The 'east' group contains data collected from transects 5, 6, 7 & 8.

Google Sheets was used to produce all graphs and calculate descriptive statistics such as averages, standard deviation and standard error on all datasets.

## RESULTS

*Please note that for all results, the Western end of the wood contains data from transects 1, 2, 3, and 4, and the Eastern end of the wood contains data from transects 5, 6, 7, and 8.*

### 1 BIRDS

Birds were recorded as follows, on 31 days between mid-April and the end of August:

T1: 4 times; T2: 4 times; T3: 5 times; T4: 6 times; (Total for West: 19 times)

T5: 2 times; T6: 3 times; T7: 4 times; T8: 5 times. (Total for East: 14 times)

In total, 388 individuals of 21 species of bird were recorded over the eight transects. 20 species were recorded in the western half of the wood, and 16 species were recorded in the eastern half, as seen in Figure 2 and Table 1 below. The number of individuals of each species of bird that was recorded on the transects were summed to give an overall frequency value per species in the Diamond Wood.

Skylark was by far the most numerous species recorded this year, with 109 individuals across the whole site, followed by Wood-pigeon at 76. The west had higher numbers of most species, particularly Skylark, Wood pigeon, Linnet, and Blackbird, while the east side had significantly higher numbers of House martins and Swifts. Birds that were recorded in equal numbers on both sides, or with a difference of only one individual, are Blue tit, Chaffinch, Kestrel, and Pheasant. Yellowhammer was the only species not recorded in the western end, while the eastern end did not have Buzzard, Collared dove, Great tit, Greenfinch, or Herring gull.

*Please see Table 1 on the following page for a full breakdown by transect, of species and number of individuals recorded, with totals for West, East, and the Whole Wood.*

Greenfinch was recorded for the first time. Pheasant, which was recorded in 2020 but not in 2021, was recorded again. Gull was recorded in 2020 but not in 2021, and Herring gull was recorded this year. Bird species that were recorded in 2021 but not in 2022 are: Grey partridge, Robin, Rook, Sparrowhawk, Swallow, and Willow warbler.

Priority bird species, as given in the UK BAP Priority Species List, recorded in the Diamond Wood in 2022 are: Common linnet, Herring gull, Skylark, and Yellowhammer.

*Please see the Complete Species List for species seen off-transect during citizen science events.*

## Bird species and number of individuals recorded in the Diamond Wood

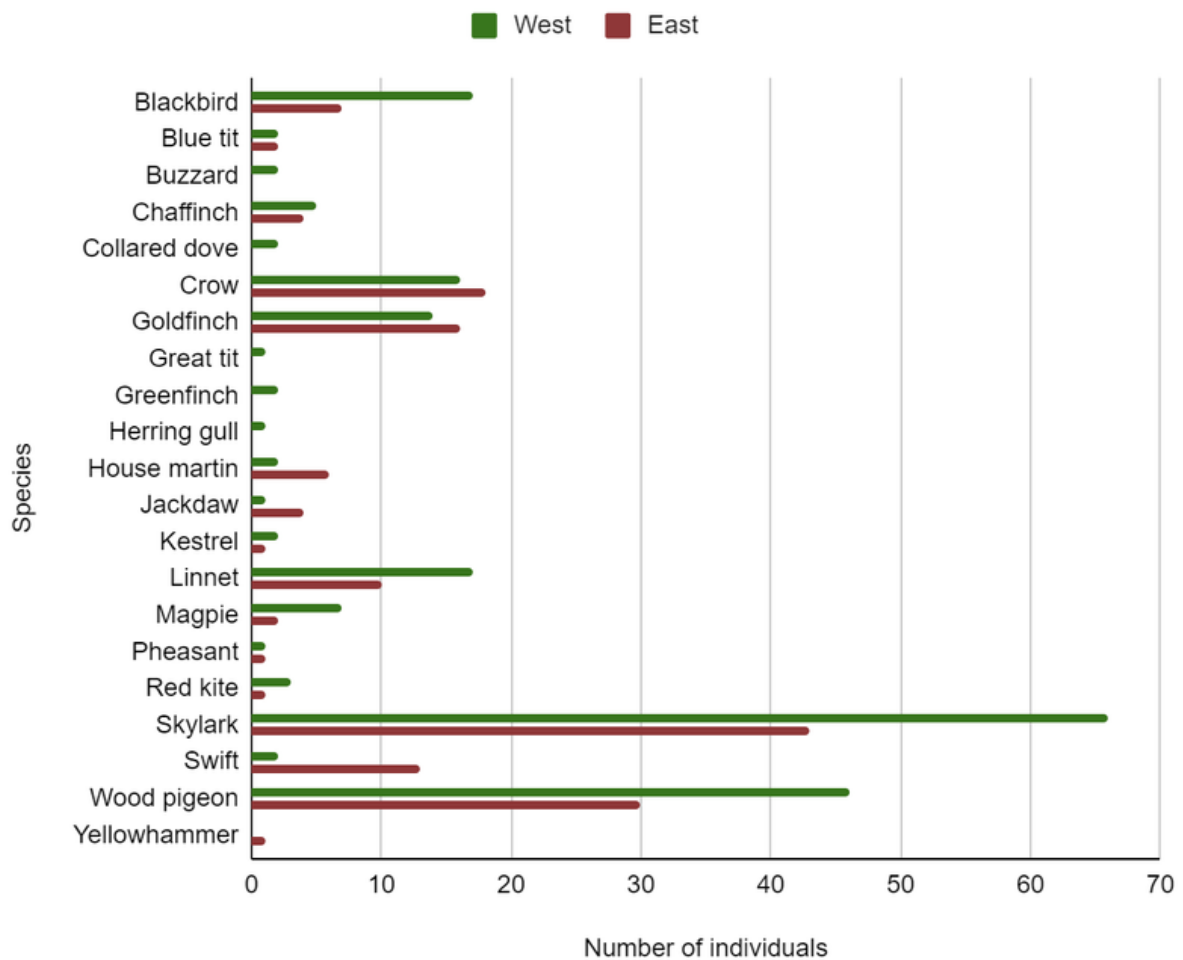


Figure 2: Bird species and number of individuals recorded in the Diamond Wood.

Table 1: The number of individuals of each species recorded on transects in the western end, eastern end and the whole Diamond Wood between April - August 2022.

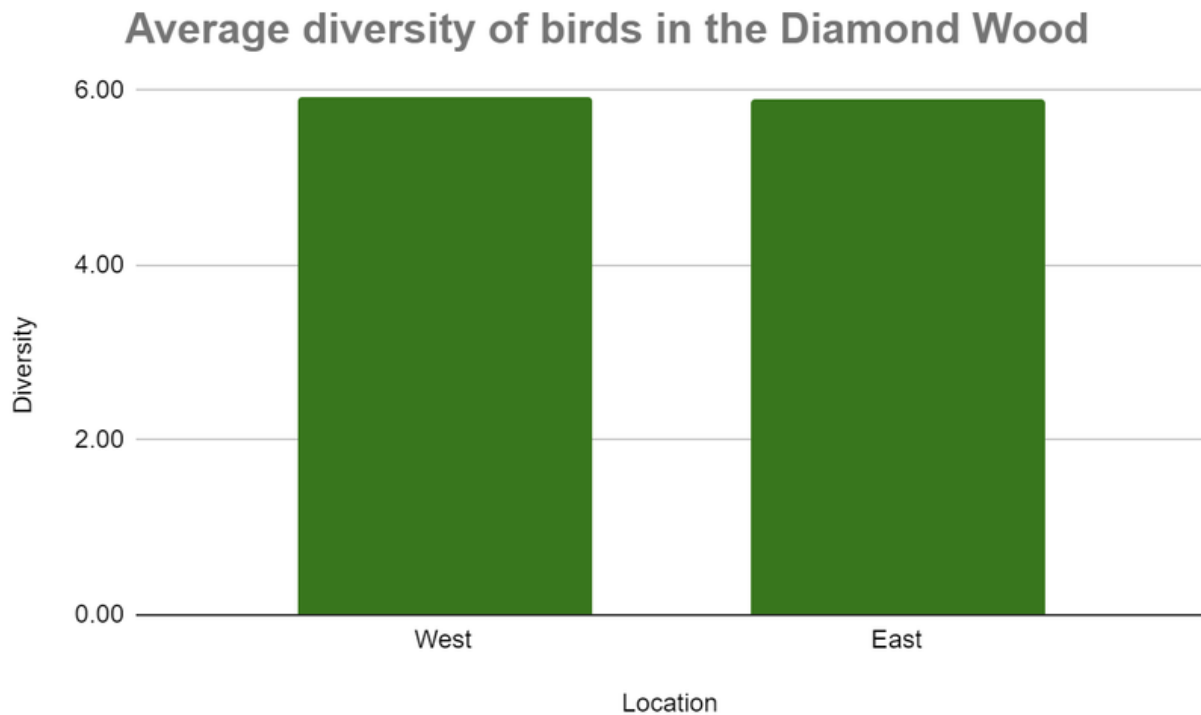
Species of Bird and Number of Individuals Recorded in each Transect												
BIRDS	T1	T2	T3	T4	TOTAL WEST	T5	T6	T7	T8	TOTAL EAST	WHOLE WOOD	
Blackbird	4	3	4	6	17	3	0	1	3	7	24	
Blue tit	1	0	1	0	2	0	0	0	2	2	4	
Buzzard	1	0	0	1	2	0	0	0	0	0	2	
Chaffinch	0	2	3	0	5	1	0	0	3	4	9	

<b>Collared dove</b>	0	2	0	0	<b>2</b>	0	0	0	0	<b>0</b>	<b>2</b>
<b>Crow</b>	5	2	6	3	<b>16</b>	1	0	3	14	<b>18</b>	<b>34</b>
<b>Goldfinch</b>	5	1	0	8	<b>14</b>	4	2	2	8	<b>16</b>	<b>30</b>
<b>Great tit</b>	1	0	0	0	<b>1</b>	0	0	0	0	<b>0</b>	<b>1</b>
<b>Greenfinch</b>	0	0	2	0	<b>2</b>	0	0	0	0	<b>0</b>	<b>2</b>
<b>Herring gull</b>	1	0	0	0	<b>1</b>	0	0	0	0	<b>0</b>	<b>1</b>
<b>House martin</b>	0	1	1	0	<b>2</b>	0	1	3	2	<b>6</b>	<b>8</b>
<b>Jackdaw</b>	0	0	1	0	<b>1</b>	0	0	0	4	<b>4</b>	<b>5</b>
<b>Kestrel</b>	1	0	1	0	<b>2</b>	1	0	0	0	<b>1</b>	<b>3</b>
<b>Linnet</b>	3	10	2	2	<b>17</b>	0	5	2	3	<b>10</b>	<b>27</b>
<b>Magpie</b>	1	3	2	1	<b>7</b>	0	0	0	2	<b>2</b>	<b>9</b>
<b>Pheasant</b>	0	0	0	1	<b>1</b>	0	0	1	0	<b>1</b>	<b>2</b>
<b>Red kite</b>	1	1	0	1	<b>3</b>	0	0	1	0	<b>1</b>	<b>4</b>
<b>Skylark</b>	12	9	19	26	<b>66</b>	11	4	8	20	<b>43</b>	<b>109</b>
<b>Swift</b>	0	0	0	2	<b>2</b>	2	11	0	0	<b>13</b>	<b>15</b>
<b>Wood pigeon</b>	13	10	9	14	<b>46</b>	6	5	5	14	<b>30</b>	<b>76</b>
<b>Yellowhammer</b>	0	0	0	0	<b>0</b>	0	0	0	1	<b>1</b>	<b>1</b>
<b>TOTAL SPECIES (diversity)</b>	<b>13</b>	<b>11</b>	<b>12</b>	<b>11</b>	<b>20</b>	<b>8</b>	<b>6</b>	<b>9</b>	<b>12</b>	<b>16</b>	<b>21</b>
<b>TOTAL INDIVIDUALS</b>	<b>49</b>	<b>44</b>	<b>51</b>	<b>65</b>	<b>229</b>	<b>29</b>	<b>28</b>	<b>26</b>	<b>76</b>	<b>159</b>	<b>388</b>

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, and an average was calculated from these values. This gave the average number of different species recorded in each group, as seen in Figure 3. Rounded to the nearest whole number, the average diversity of birds in the West and East is 6 species recorded per transect per day. The data shows that there is no statistical difference between the East and West. Descriptive statistics are as follows:

	<b>West</b>	<b>East</b>
<b>Average diversity (d = no. of species recorded per transect per day)</b>	5.93	5.89
<b>Standard Deviation (SD) [of no. of individuals]</b>	16.91	11.96
<b>Standard Error (SE)</b>	3.78	2.99
<b>Total number of different species recorded (21 total)</b>	20	16

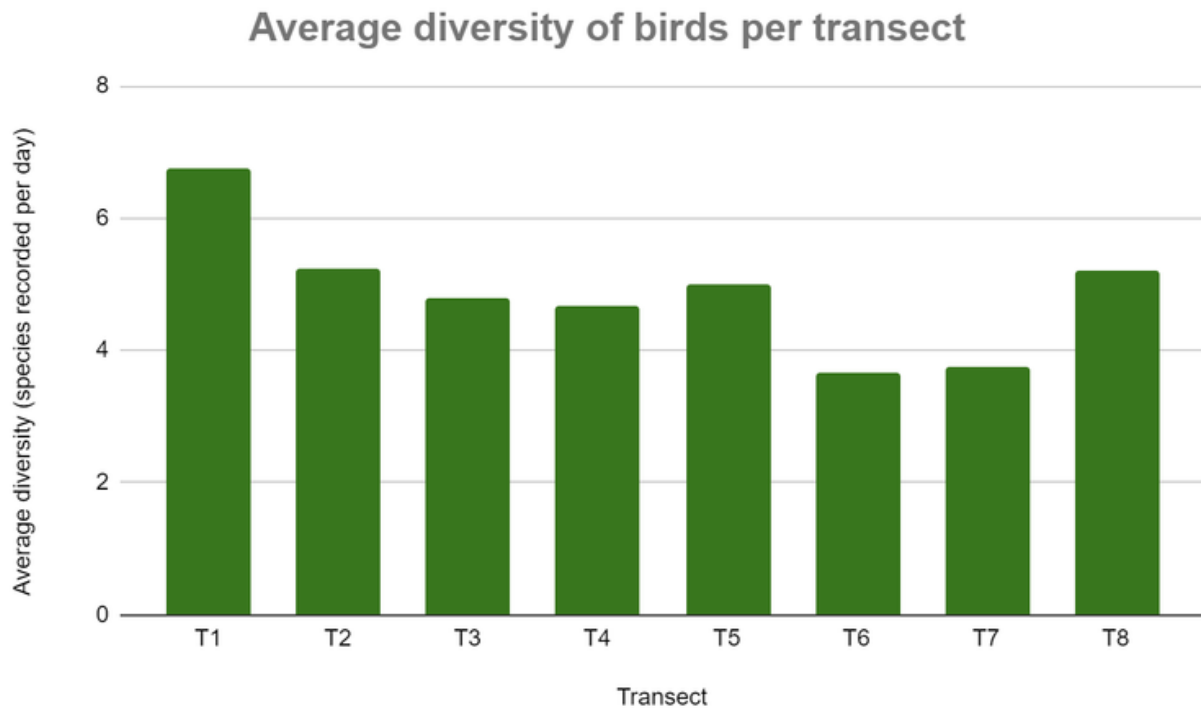




*Figure 3: The Average Diversity of the bird species in the diamond wood, divided by east and west.*

Finally, when comparing the average diversity of birds recorded between each transect (Figure.4), the data suggests that transect 1 is the most diverse (6.75), and transect 6 the least (3.67). Transects 6 and 7, have little difference in average, all being between 3 & 4. As do transects 2, 5, and 8 (5.25, 5.00, and 5.20 respectively), and transects 3 and 4 (4.80 and 4.87).

Transect 1 is statistically significant when compared to all other transects. Transect 6 and 7 are significantly different to all other transects but each other. Transects 2, 3, 4, 5 and 8 show no statistically significant difference between them, but are all significantly different to Transects 1, 6 and 7. Reasons for this are discussed.



*Figure 4: Average number of bird species recorded per transect per day of collection (average diversity).*

## 2 POLLINATORS

Pollinators were recorded as follows, on 31 days between mid-April and the end of August:

T1: 4 times; T2: 4 times; T3: 6 times; T4: 5 times; (Total for West: 19 times)  
 T5: 2 times; T6: 3 times; T7: 4 times; T8: 4 times. (Total for East: 13 times)

In total, 308 individuals of 27 species of pollinator were recorded over the eight transects. 169 individuals of 24 species were recorded in the western half of the wood, while 139 individuals of 21 species were recorded in the eastern half, as seen in Figure 5 and Table 2 below. The number of individuals of each species of pollinator that was recorded on the transects were summed to give an overall frequency value per species in the Diamond Wood.

The Marbled White butterfly was by far the most numerous pollinator species recorded this year, with 61 individuals across the whole site, followed by the Meadow Brown butterfly at 37. The west had higher numbers of most species, particularly 7-spot ladybird, Bee fly, Bluebottle, Emerald beetle, Greenfly, Hoverfly, Lacewing, and Spittlebug. However the East side had almost double the number of Small Skipper butterflies than the West.

13 species were recorded in equal numbers on both sides or had a difference of only one individual: Ashy mining bee, Brimstone butterfly, Cinnabar moth, Fruit fly, Grasshopper, Greenfly, Lacewing, Peacock butterfly, Red-tailed bumblebee, Ringlet butterfly, St Mark's fly, White-tailed bumblebee, and Woodlouse. Species not recorded in the western end are Alder leaf beetle, Gatekeeper butterfly, and Peacock butterfly, while the eastern end did not have 7-spot ladybird, Emerald beetle, Greenfly, Lacewing, Ringlet, and Spittlebug.

*Please see Table 2 for a full breakdown by transect, of species and number of individuals recorded, with totals for West, East, and the Whole Wood.*

Six pollinator species were recorded for the first time: Emerald beetle, Bluebottle, Fruit fly, St Mark's fly, Greenfly, and Spittlebug. There are nine species that were recorded in 2021 but not in 2022.

The species recorded are grouped into the following taxonomic Orders:

<b>Coleoptera:</b>	7-spot ladybird Alder leaf beetle Emerald beetle Red soldier beetle	<b>Isopoda:</b>	Woodlouse
<b>Diptera:</b>	Bee fly Bluebottle Fruit fly Hoverfly	<b>Lepidoptera:</b>	Brimstone butterfly Cinnabar moth Gatekeeper butterfly Grass moth Marbled White butterfly Meadow brown butterfly Peacock butterfly Ringlet butterfly Small skipper butterfly
<b>Hemiptera:</b>	Greenfly Spittlebug	<b>Neuroptera:</b>	Lacewing
<b>Hymenoptera:</b>	Ashy mining bee Carder bee Red-tailed bumblebee White-tailed bumblebee	<b>Orthoptera:</b>	Grasshopper

Lepidoptera had the highest numbers of species and individuals in both halves of the site. The East had a higher number of Lepidoptera species than the West, but the West had more Coleoptera species than in the East. Hemiptera and Neuroptera species were only found in the west. Please see Figure 5 for more details.

Only one Priority pollinator species, as given in the UK BAP Priority Species List, was recorded in the Diamond Wood in 2022 - the Cinnabar moth.

*Please see the Complete Species List for species seen off-transect during citizen science events.*

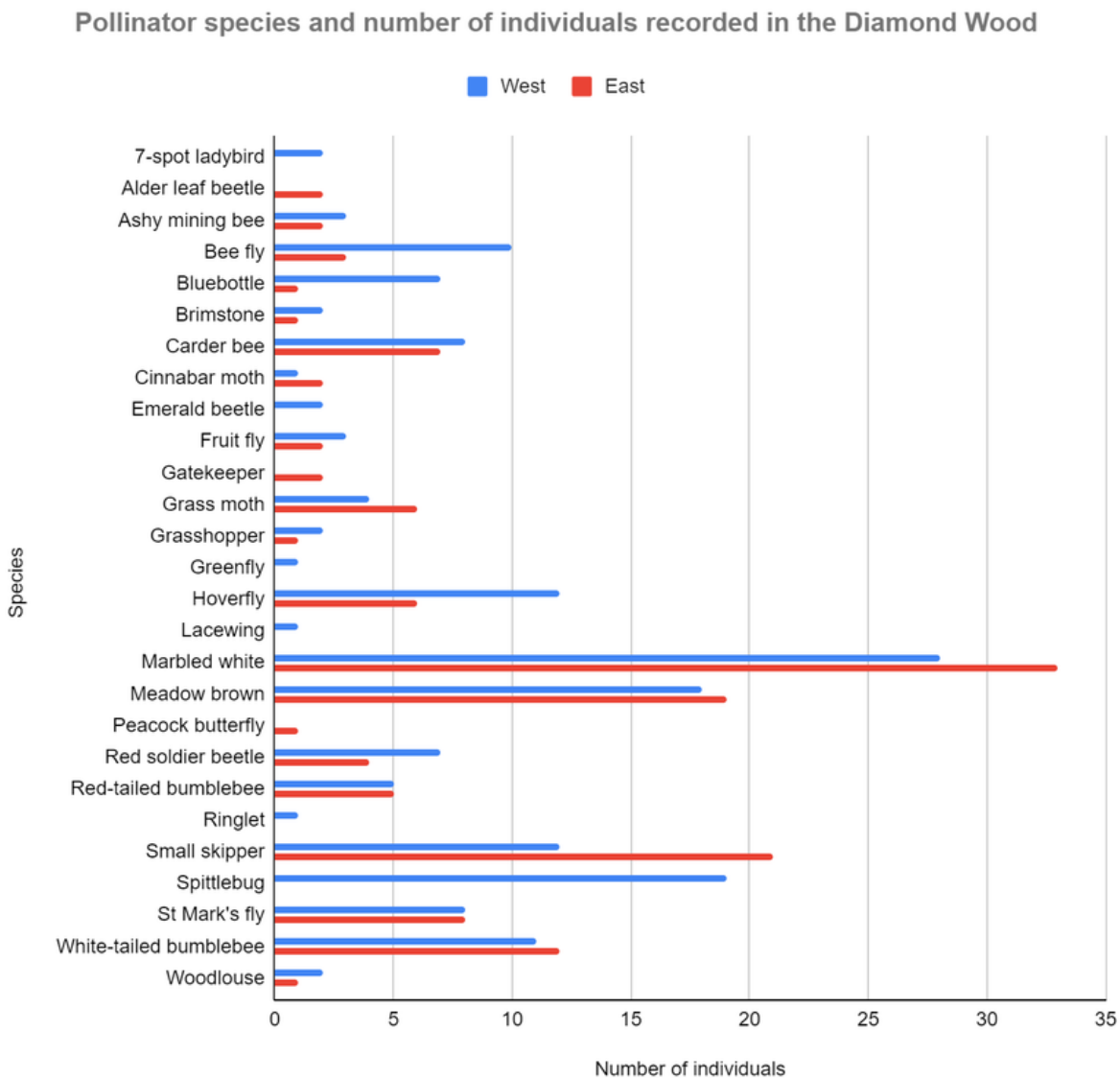
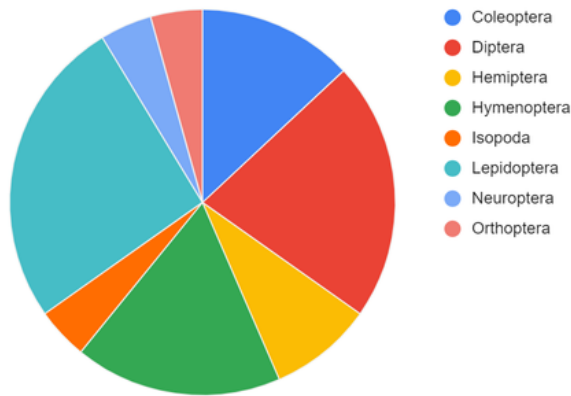


Figure 4: Pollinator species and number of individuals recorded in the Diamond Wood.



**Taxonomic Orders of pollinator species recorded in the West of the Diamond Wood**



**Taxonomic Orders of pollinator species recorded in the East of the Diamond Wood**

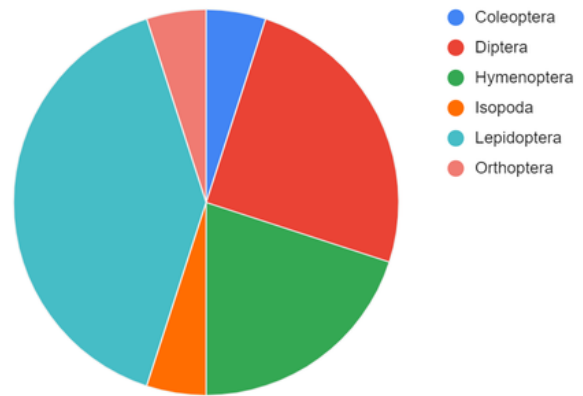


Figure 5: Taxonomic Orders of pollinator species recorded in the West and East of the Diamond Wood .

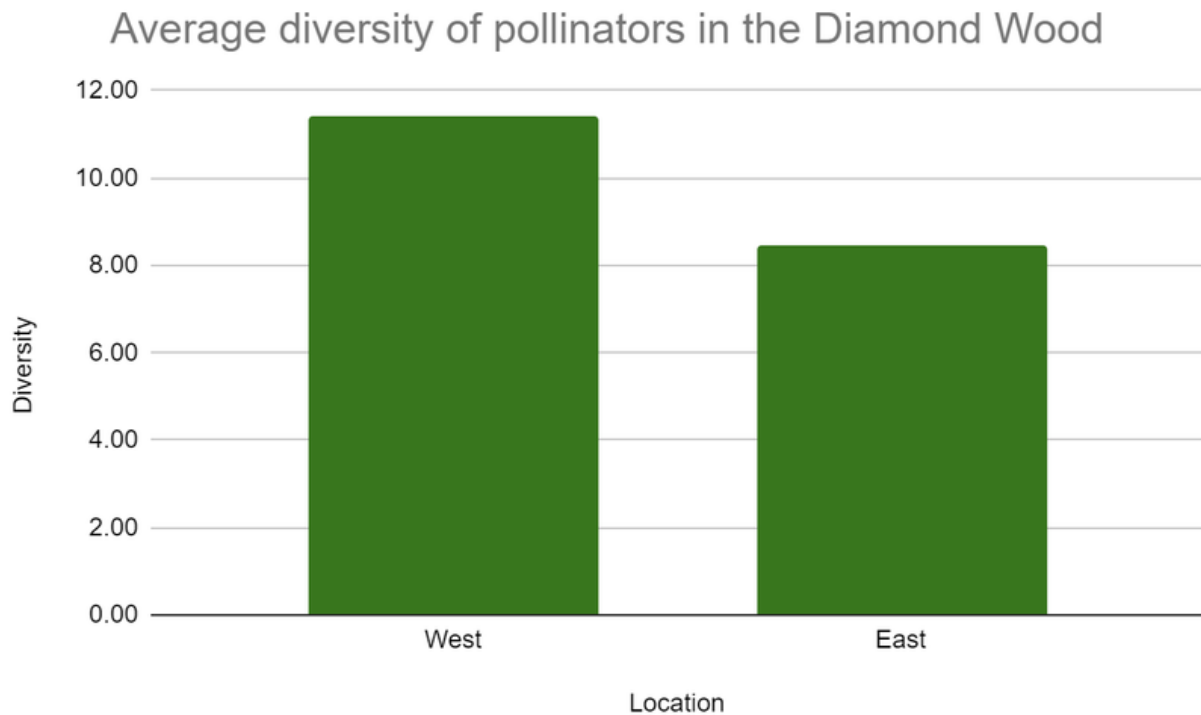
Table 2: The number of individuals of each species recorded on transects in the western end, eastern end and the whole Diamond Wood between April - August 2022.

Species and number of individuals recorded in each transect											
POLLINATORS	T1	T2	T3	T4	TOTAL WEST	T5	T6	T7	T8	TOTAL EAST	WHOLE WOOD
7-spot ladybird	0	0	2	0	2	0	0	0	0	0	2
Alder leaf beetle	0	0	0	0	0	1	0	0	1	2	2
Ashy mining bee	1	0	2	0	3	0	1	1	0	2	5
Bee fly	4	2	0	4	10	2	0	0	1	3	13
Bluebottle	4	1	1	1	7	0	1	0	0	1	8
Brimstone	1	0	0	1	2	0	1	0	0	1	3
Carder bee	0	4	1	3	8	0	3	0	4	7	15
Cinnabar moth	0	0	1	0	1	0	0	1	1	2	3
Emerald beetle	0	0	0	2	2	0	0	0	0	0	2
Fruit fly	1	0	1	1	3	0	0	1	1	2	5
Gatekeeper	0	0	0	0	0	0	1	0	1	2	2
Grass moth	0	0	1	3	4	2	1	1	2	6	10
Grasshopper	0	1	1	0	2	1	0	0	0	1	3

<b>Greenfly</b>	1	0	0	0	<b>1</b>	0	0	0	0	<b>0</b>	<b>1</b>
<b>Hoverfly</b>	4	1	4	3	<b>12</b>	3	0	1	2	<b>6</b>	<b>18</b>
<b>Lacewing</b>	0	0	1	0	<b>1</b>	0	0	0	0	<b>0</b>	<b>1</b>
<b>Marbled white</b>	8	0	11	9	<b>28</b>	10	6	10	7	<b>33</b>	<b>61</b>
<b>Meadow brown</b>	2	1	8	7	<b>18</b>	5	4	6	4	<b>19</b>	<b>37</b>
<b>Peacock butterfly</b>	0	0	0	0	<b>0</b>	0	0	0	1	<b>1</b>	<b>1</b>
<b>Red soldier beetle</b>	3	0	4	0	<b>7</b>	0	0	4	0	<b>4</b>	<b>11</b>
<b>Red-tailed bumblebee</b>	2	0	2	1	<b>5</b>	3	2	0	0	<b>5</b>	<b>10</b>
<b>Ringlet</b>	0	1	0	0	<b>1</b>	0	0	0	0	<b>0</b>	<b>1</b>
<b>Small skipper</b>	3	0	4	5	<b>12</b>	2	8	9	2	<b>21</b>	<b>33</b>
<b>Spittlebug</b>	8	0	4	7	<b>19</b>	0	0	0	0	<b>0</b>	<b>19</b>
<b>St Mark's fly</b>	0	4	4	0	<b>8</b>	0	2	0	6	<b>8</b>	<b>16</b>
<b>White-tailed bumblebee</b>	2	3	3	3	<b>11</b>	4	0	3	5	<b>12</b>	<b>23</b>
<b>Woodlouse</b>	0	0	0	2	<b>2</b>	0	0	1	0	<b>1</b>	<b>3</b>
<b>TOTAL SPECIES (diversity)</b>	<b>14</b>	<b>9</b>	<b>18</b>	<b>15</b>	<b>24</b>	<b>10</b>	<b>11</b>	<b>11</b>	<b>14</b>	<b>21</b>	<b>27</b>
<b>TOTAL INDIVIDUALS</b>	<b>44</b>	<b>18</b>	<b>55</b>	<b>52</b>	<b>169</b>	<b>33</b>	<b>30</b>	<b>38</b>	<b>38</b>	<b>139</b>	<b>308</b>

The number of different species recorded on each transect for each day of data collection was summed to give the diversity. The pollinator diversity values were allocated between 'west' and 'east' groups, and an average was calculated from these values. This gave the average number of different species recorded in each group, as seen in Figure 6. Rounded to the nearest whole number, the average diversity of pollinators in the West is 11 species recorded per transect per day, and in the East is 8 species recorded per transect per day. The data shows that there is a statistical difference between the East and West. Descriptive statistics are as follows:

	<b>West</b>	<b>East</b>
<b>Average diversity (d = no. of species recorded per transect per day)</b>	11.43	8.45
<b>Standard Deviation (SD) [of no. of individuals]</b>	6.91	8.29
<b>Standard Error (SE)</b>	1.41	1.81
<b>Total number of different species recorded (21 total)</b>	24	21



*Figure 6: The Average Diversity of the pollinator species in the diamond wood, divided by east and west.*

Finally, when comparing the average diversity of pollinators recorded between each transect (Figure. 7), the data suggests that transect 5 is the most diverse (7.50), and transect 2 the least (3.00).

Transect 7 is slightly more diverse than this with an average of 3.50. Transects 1, 3, and 8 have no difference in average (5.00), and transect 4 is only slightly less diverse with an average of 4.80.

Transect 5 is statistically significant when compared to all other transects. Transect 2 is statistically different from all other transects except transect 7. Transects 1, 3, 4, 6, 7 and 8 show no statistically significant difference between them, but are all significantly different to Transects 2 and 5. Reasons for this are discussed.

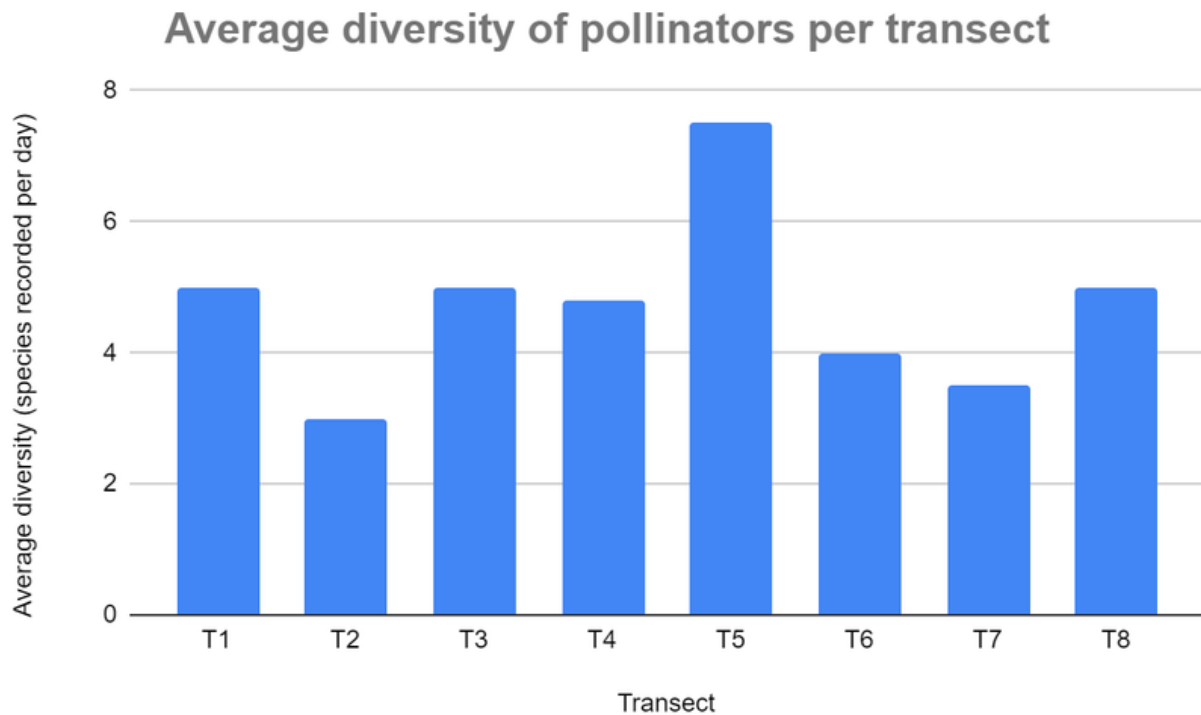


Figure 6: Average number of pollinator species recorded per transect per day of collection (average diversity).

### 3 LEPIDOPTERA

The butterfly transect was walked on 9 days between June - August 2022. Greater detail can be found in the Harmony Woods Butterfly Results report by Graeme Davis.

The overall number of butterflies recorded on the registered Butterfly Conservation transect was shown to have increased in 2022 from 2021 (Figure 7). Similarly to 2021, the butterfly populations that are doing well (based on population sizes) appear to be the Meadow Brown, Marbled White and the Small Heath, as well as the Small Skipper and Small White. Interestingly, there was a significant increase in Small Blue and Large White populations in 2022.

In total 374 butterflies were recorded throughout 2022, this is a small increase from the 333 butterflies that were seen in 2021. These figures can be compared to historical data: 157 butterflies recorded in 2016, 298 in 2017, 248 in 2018, 699 in 2019 and 1176 in 2020 (Previous butterfly results analysed by Graeme Davis).

It is important to note that the number of days surveyed in 2022 was 9, whereas in 2020 the butterfly transect was surveyed on 13 separate days; 4 days less. The collection also didn't start until June 2022 and finished in late August. Therefore the numbers recorded in 2022 are not directly proportional to those in 2021, this suggests that any species decreases should be read carefully and any increases are quite significant.



Moreover, 9 is 69.2% of 13. 69.2% of 333 (2021's total) is 230.4, showing a significant increase between 2021 and 2022 where 374 individuals were recorded.

20 different species were recorded in Harmony Woods in 2022, compared to 24 in 2021, 21 in 2020, 17 in 2019 and 12 in 2018.



Small Skipper Btterfly on Knapweed

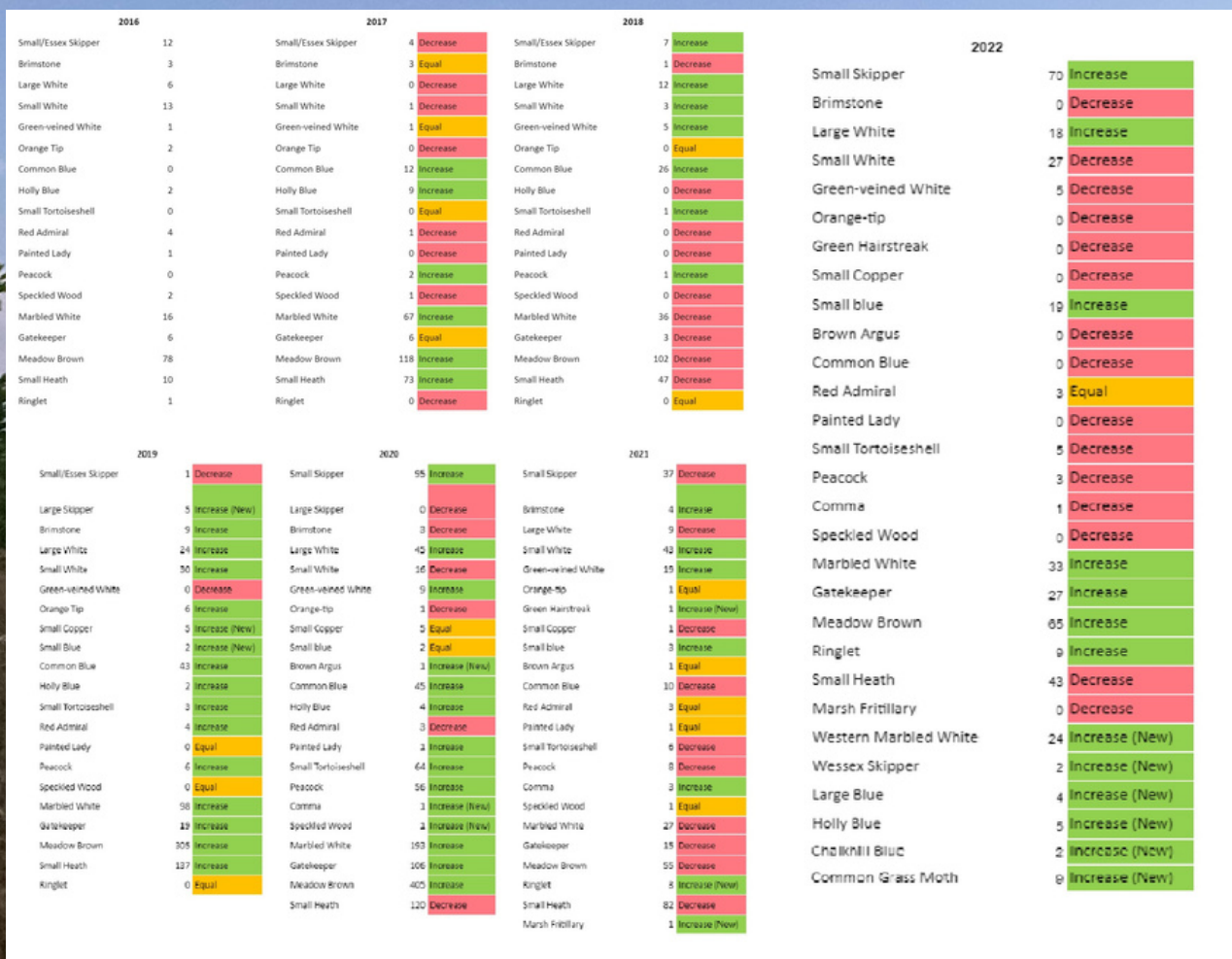


Figure 7: Historical data and the 2022 data that was collected from the Harmony Woods butterfly transect. Historical data is taken from the Harmony Woods Butterfly Reports 2016-19 by Graeme Davis. 2020 and 2021 data is taken from the Nature in Harmony 2020 report and the Nature in Harmony 2021 report.

## 4 WILDFLOWERS AND GRASSES

As mentioned in the Method, the 50x50cm quadrats used for floral data collection are split into 25 boxes, and the number of boxes containing each plant species is recorded, rather than the number of individual plants. For simplicity in discussion, I will refer to the number of plants rather than boxes, as at least 1 plant has to be present in a box for the box to be recorded, and we can view the numbers of individual plants recorded as a minimum, but still indicative.

Wildflowers and grasses were recorded as follows, on 32 days between mid-April and the end of August:

T1: 4 times; T2: 4 times; T3: 6 times; T4: 5 times; (Total for West: 19 times)

T5: 2 times; T6: 3 times; T7: 4 times; T8: 5 times. (Total for East: 14 times)

In total, 26,279 plants of 61 species were recorded across the eight transects. 15,414 plants of 50 species were recorded in the western half of the wood, while 10,865 plants of 47 species were recorded in the eastern half, as seen in Figure 8 and Table 3 below. The number of individuals of each species of flora that was recorded on the transects were summed to give an overall frequency value per species in the Diamond Wood.

Only 10 species of grass were recorded in 2022, with Fescue Grass being the most abundant with 14,117 individual plants being recorded. Cock's Foot Grass and Red Fescue were also common grasses of 2022, and the least common grass was Sweet Vernal.

The most abundant wildflower by far in the west (and overall) was Ribwort plantain (1974 in the west, 205 in the east), while White clover was the most abundant in the east, almost double that of the west (912 E, 470 W). The flowers found least were Barren strawberry, Cowslip, and Ragged robin, with only 1 plant of each recorded in the whole wood.

Absent from the west were Barren strawberry, Dock, Field bindweed, Hogweed, Lady's bedstraw, Lesser knapweed, Mugwort, Nipplewort, Poppy, Restharrow, and Willowherb. Absent from the east were Bird's-foot trefoil, Broomrape, Common sorrel, Cowslip, Meadow buttercup, Old man's beard, Ragged robin, Sainfoin, Speedwell, Wild daffodil, Yellow rattle, Sweet Vernal Grass, Common Couch Grass and Timothy Grass.

36 species were recorded on both sides of the wood. 14 were recorded only in the west, and 11 were recorded only in the east. Species recorded in equal numbers each side or with a difference of only one plant are: Barren strawberry, Centaury, Cowslip, Hawk's-beard, and Ragged robin.

Please see Table 3 for a full breakdown by transect of wildflower and grass species and number of plants recorded, with totals for West, East, and the Whole Wood.

Species recorded for the first time were; Barren Strawberry, Broomrape, Centaury, Common Sorrell, Creeping Thistle, Field Bindweed, Hawks Beard, Mugwort, Old Man's Beard, Poppies, Restharrow, Small-leaved Cranesbill, Tiny Vetch, Yellow Rattle, Common Couch, Red Fescue, Timothy and Tall Fescue.

No Priority wildflower species, as given in the UK BAP Priority Species List, were recorded in the Diamond Wood in 2022.

Please see the Complete Species List for species seen off-transect during citizen science events.

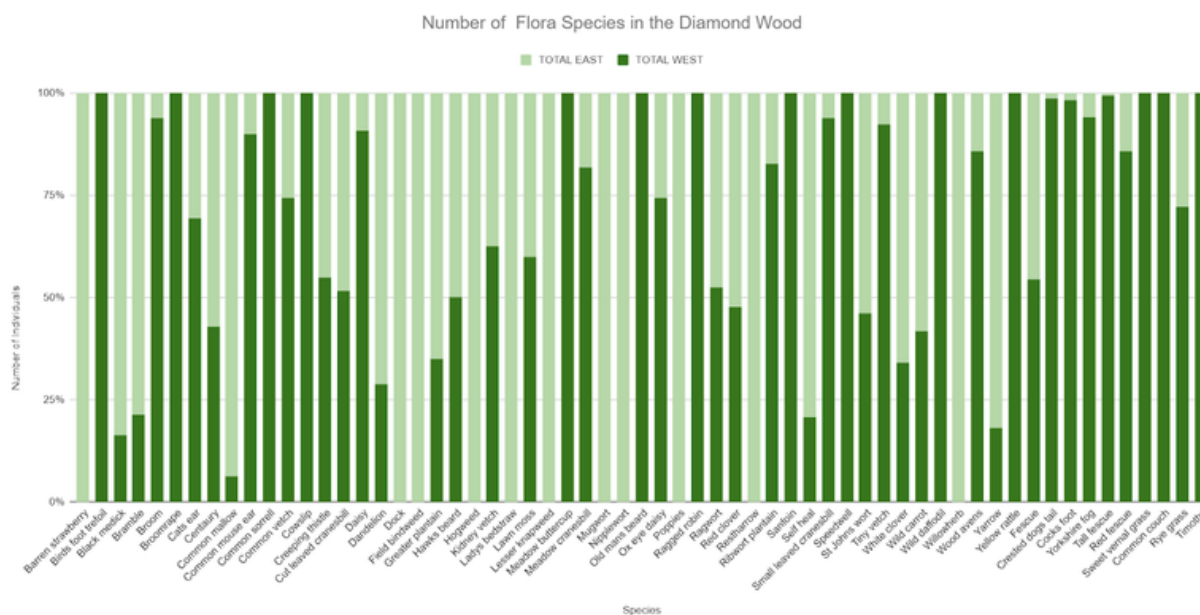


Figure 8: Flora species and number of individuals recorded in the Diamond Wood.

Table 3: Species and numbers of wildflowers and grasses recorded in each transect

Species and number of plants present in each transect											
WILDFLOWERS AND GRASSES	T1	T2	T3	T4	TOTAL WEST	T5	T6	T7	T8	TOTAL EAST	WHOLE WOOD
Barren strawberry	0	0	0	0	0	1	0	0	0	1	1
Birds foot trefoil	9	3	22	0	34	0	0	0	0	0	34
Black medick	0	2	7	63	72	0	191	63	114	368	440
Bramble	0	0	0	3	3	0	4	6	1	11	14
Broom	10	0	35	1	46	0	0	1	2	3	49
Broomrape	0	2	0	2	4	0	0	0	0	0	4
Cats ear	1	21	35	49	106	18	18	9	2	47	153
Centaury	0	3	0	0	3	0	0	4	0	4	7
Common mallow	0	0	0	1	1	0	8	0	7	15	16

Common mouse ear	0	14	13	0	27	0	3	0	0	3	30
Common sorrell	0	3	0	0	3	0	0	0	0	0	3
Common vetch	0	28	0	4	32	4	0	7	0	11	43
Cowslip	0	0	1	0	1	0	0	0	0	0	1
Creeping thistle	81	34	90	128	333	57	49	84	84	274	607
Cut leaved cranesbill	18	7	23	3	51	12	5	17	14	48	99
Daisy	30	0	0	0	30	3	0	0	0	3	33
Dandelion	28	21	98	34	181	64	198	50	133	445	626
Dock	0	0	0	0	0	0	0	0	2	2	2
Field bindweed	0	0	0	0	0	0	0	0	2	2	2
Greater plantain	0	9	21	7	37	9	13	5	42	69	106
Hawks beard	14	25	72	34	145	17	26	33	69	145	290
Hogweed	0	0	0	0	0	3	20	0	51	74	74
Kidney vetch	0	1	0	4	5	0	0	0	3	3	8
Lady's bedstraw	0	0	0	0	0	3	0	0	0	3	3
Lawn moss	70	61	151	0	282	116	9	18	46	189	471
Lesser knapweed	0	0	0	0	0	0	0	0	8	8	8
Meadow buttercup	0	2	0	0	2	0	0	0	0	0	2
Meadow cranesbill	2	4	3	0	9	0	0	0	2	2	11
Mugwort	0	0	0	0	0	0	0	0	5	5	5
Nipplewort	0	0	0	0	0	0	0	0	4	4	4
Old man's beard	0	0	0	7	7	0	0	0	0	0	7
Ox eye daisy	41	34	33	100	208	10	0	61	1	72	280
Poppies	0	0	0	0	0	0	0	0	5	5	5
Ragged robin	0	1	0	0	1	0	0	0	0	0	1
Ragwort	49	37	80	261	427	41	96	100	150	387	814
Red clover	0	102	71	92	265	53	59	16	164	292	557
Restharrow	0	0	0	0	0	0	2	0	0	2	2
Ribwort plantain	441	325	151	57	974	31	18	94	62	205	1179
Sainfoin	0	7	10	1	18	0	0	0	0	0	18
Self heal	3	2	1	0	6	0	0	4	19	23	29
Small leaved cranesbill	1	2	25	3	31	0	1	0	1	2	33
Speedwell	0	0	3	0	3	0	0	0	0	0	3
St John's wort	0	18	0	0	18	0	0	19	2	21	39
Tiny vetch	5	0	69	22	96	4	0	4	0	8	104
White clover	0	139	168	163	470	43	581	42	246	912	1382
Wild carrot	17	49	87	171	324	13	174	99	165	451	775
Wild daffodil	0	18	0	0	18	0	0	0	0	0	18
Willowherb	0	0	0	0	0	0	0	11	12	23	23
Wood avens	0	0	0	6	6	0	0	1	0	1	7
Yarrow	2	0	2	4	8	0	29	0	7	36	44
Yellow rattle	0	120	5	0	125	0	0	0	0	0	125
Fescue	1724	1784	2377	1806	7691	905	1274	1810	2437	6426	14117
Crested dogs tail	34	21	183	0	238	0	0	1	2	3	241
Cocks foot	140	32	388	841	1401	0	13	5	6	24	1425
Yorkshire fog	0	32	0	0	32	0	2	0	0	2	34
Tall fescue	170	72	101	186	529	0	0	0	4	4	533
Red fescue	37	487	206	158	888	0	0	0	148	148	1036

Sweet vernal grass	0	3	0	0	3	0	0	0	0	0	3
Common couch	0	0	0	4	4	0	0	0	0	0	4
Rye grass	19	0	187	0	206	22	16	0	41	79	285
Timothy	0	0	10	0	10	0	0	0	0	0	10
<b>TOTAL SPECIES (diversity)</b>	<b>24</b>	<b>37</b>	<b>33</b>	<b>30</b>	<b>50</b>	<b>21</b>	<b>24</b>	<b>26</b>	<b>37</b>	<b>47</b>	<b>61</b>
<b>TOTAL INDIVIDUALS</b>	<b>2946</b>	<b>3525</b>	<b>4728</b>	<b>4215</b>	<b>15414</b>	<b>1429</b>	<b>2809</b>	<b>2564</b>	<b>4063</b>	<b>10865</b>	<b>26279</b>

The number of different species recorded on each transect for each day of data collection was summed to give the diversity. The wildflower diversity values were allocated between 'west' and 'east' groups, and an average was calculated from these values. This gave the average number of different species recorded in each group, as seen in Figure 9. Rounded to the nearest whole number, the average diversity of pollinators in the West is 4 species recorded per transect per day, and in the East is 3 species recorded per transect per day. The data shows there is a statistical difference between the East and West. Descriptive statistics are as follows:

	West	East
<b>Average diversity (d = no. of species recorded per transect per day)</b>	3.71	2.73
<b>Standard Deviation (SD) [of no. of individuals]</b>	1122.23	935.74
<b>Standard Error (SE)</b>	158.71	136.49
<b>Total number of different species recorded (61 total)</b>	50	47

Average Diversity of Wildflowers and Grasses in the Diamond Wood

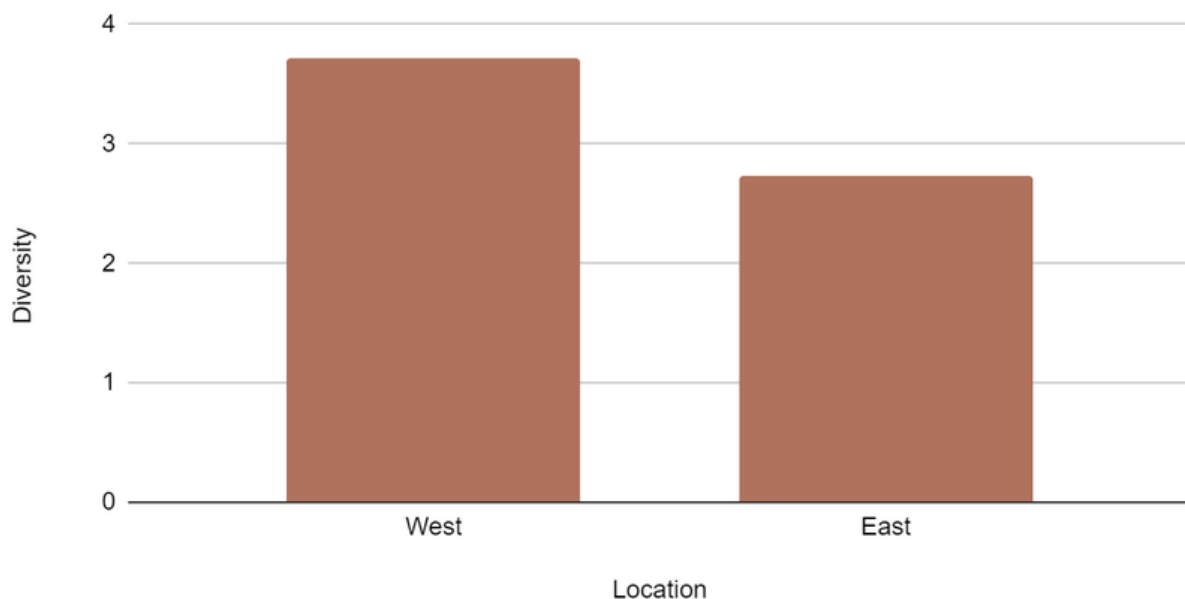


Figure 9: The Average Diversity of the flora species in the diamond wood, divided by east and west.

Finally, when comparing the average diversity of wildflowers and grasses recorded between each transect (Figure. 10), the data suggests that transect 2 is the most diverse (21.25), closely followed by transect 8 (19.00), but not statistically different. Transect 1 was the least diverse (14.00). Transects 3, 4, 6, and 7 have very little difference in average: 18.00, 16.80, 17.00, and 15.67 respectively. There is no statistical difference between any of the transects. Reasons for this are discussed.

Average Divesity of Wildflowers and Grasses per Transect

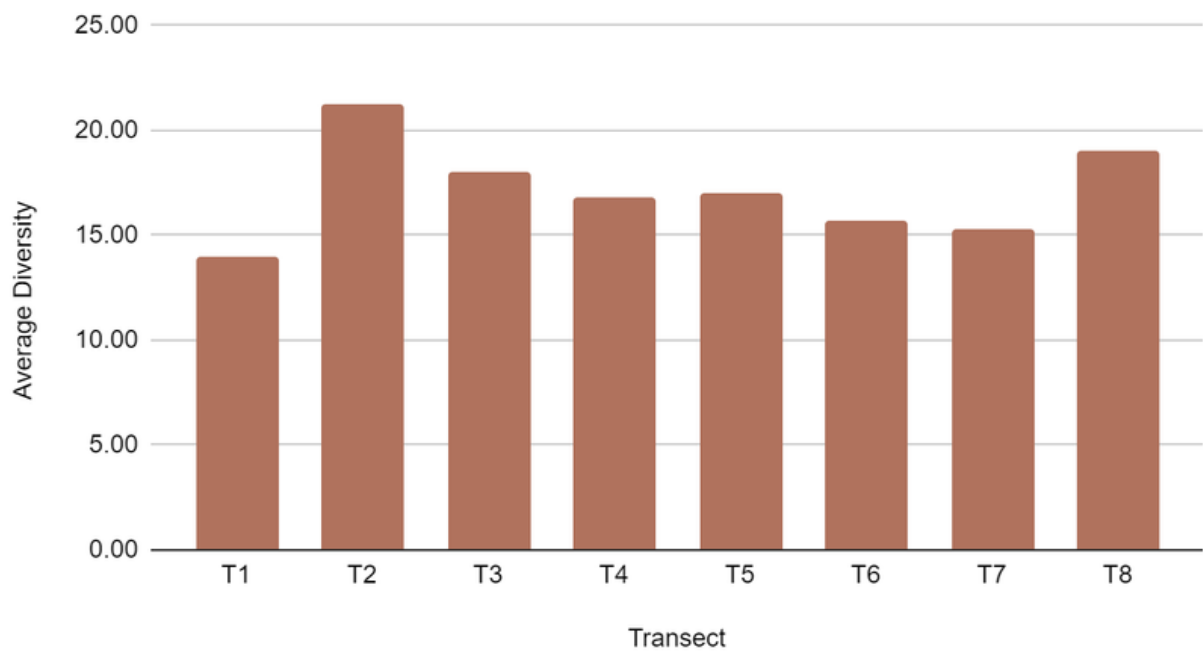


Figure 10: Average number of flora species recorded per transect per day of collection (average diversity)





## **DISCUSSION**

Firstly, and before the results are discussed in more detail, it needs to be noted that the 2022 data was not sufficient enough to carry out robust statistical analysis, and therefore, this year's analysis derives mostly from descriptive statistics and standard error.

The lead recorder did not complete the data collection season, finishing at the end of August instead of the end of September. They also did not collect data consistently, with some transects being recorded just twice while others were recorded six times, therefore, fewer data points were collected across all taxa compared to 2021 and 2020 reducing the sample size of the data.

The quality of the data collected has been affected by the level of experience and expertise of survey assistants and the efficiency of the lead recorder. A surveyor with low levels of experience and/or expertise may overlook or misidentify species present, or not look closely enough to spot small pollinators. For example, a range of yellow Asteraceae could be recorded as "Dandelion". Where outliers have been identified in the form of species names that are unlikely to live in Harmony Woods, they have been omitted from this report rather than report false results, and thus this has reduced the sample size of our data. However, far less 'errors' were made in 2022 when compared to 2021 as fewer survey assistants were used.

Furthermore, the registered butterfly transect was carried out by one volunteer. In 2020 we had a butterfly survey rota team made up of half a dozen skilled surveyors, whereas in 2022 it was done by one person. This would have contributed to the fewer surveys completed as this person had other commitments that meant they were unable to collect data before June and after August.

Weather conditions before and during the survey can affect fauna seen. Generally, animals are less likely to be out in cold, wet, or windy weather. Also, birds are most active in the early mornings, many butterflies only fly when it is warm and dry, and invertebrates will be higher in number following damp or wet weather than during a period of hot, dry days which leave the habitat of the ground parched and hard. These conditions will contribute to the taxa seen on any given day of data collection and should be considered when interpreting the results.

For the remainder of the discussion, I would like to explain the results for each taxa and compare how they compare to 2021, as well as highlight any important results or trends from this year.

## **BIRDS**

The numbers of avian species recorded in 2022 were 21 different species with a total of 388 individuals. When compared to the previous two years, 2021 had 434 individuals of

24 bird species and 2020 had 660 birds of 29 species, a year-on-year decrease is shown. That is a 10.60% decrease from 2021 and 41.22% decrease from 2020 for individuals. Species have declined by 12.50% from 2021 and 27.59% from 2020. This could be due to the increased human activity in the diamond woods area (Ramalho, C.E. et al., 2014). However, a more likely scenario is that fewer recording days per transect, survey assistants with less experience, and the prolonged period of extreme heat and drought during summer 2022 has caused this decline.

There was very little difference in average diversity between the east and west of the woods. The western end was slightly higher with 5.93 species recorded per transect per day, in comparison to the eastern end having 5.89 species recorded per transect per day. This is not consistent with the two previous years of data. New species spotted this year include the Greenfinch and the Herring Gull, both of which were spotted in the western end. The bird average diversity of the western end of the Diamond Woods is slightly higher than the eastern end, but is not statistically different. It does however contain different species of bird. This could be due to ecological niche between bird species and the heterogeneity of habitats, including the wildlife pond, in the western end (Roth, R.R., 1976) 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). Interestingly, the species richness for east and west ends were higher in the west and found to have a significant difference in average vegetation diversity.

Both the west and east ends of the Diamond Wood have large proportions of Skylark and Wood Pigeon, this is consistent with both 2021 and 2020 reports. In 2021, the eastern end had more skylarks, however in 2022 (like 2020) the western end recorded higher numbers. Reasons for this could be the efforts made by ATU to keep the general public and volunteers out of the long grass during nesting season in the western end, whereas the eastern end is not so policed. As the previous Nature in Harmony report (Marshall, A.L., 2020) suggests that human presence is linked to reduced skylark numbers. 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. 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.).

Alternatively, this could be due to the increased number of corvids in the eastern end in 2022 compared to 2021 and 2020. The increased corvid numbers could suggest a decrease in Skylark numbers, as corvids are natural predators of Skylarks (Praus, L. et al, 2014). 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 (Lind, J. & Cresswell, W., 2005). This could also suggest an alternating trend between the two ends for skylark nesting, in order to reduce predation (Wilson, J.D., et al., 1997). The

western end transects were also walked more often than the eastern end transects, meaning that less data was recorded for the eastern end. This strengthens the point made earlier, that a higher quantity and consistency of surveys would have increased data quality and increased its reliability.

Wood pigeons were also in higher numbers in the western end when compared with the eastern end. Reasons for this could be attributed to the same arguments as above, but also because there is a higher volume of mature tree coverage at the western end. Allowing for denser coverage from predators and more space for nesting and roosting (Riddle, G., 1969).

The eastern end had the highest numbers of both house martins and swifts, a change from 2021. This could be due again to increased human activity in the western end, causing their food source (flying insects) to move to the eastern end where there is less traffic (Bryant, D.M., 1975). The presence of humans, and in particular walkers with a dog, can reduce the number of individuals recorded. As the eastern end typically has less footfall, this could be the reason for the reduced number in the western end. 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.

Yellowhammer was only present in the eastern end of the diamond wood. The yellowhammer is a bird of dry, open country, preferably with a range of vegetation types and some trees from which to sing (Snow, D. & Perrins, C., 1998). The eastern end has a larger number of taller trees due to them all being planted at the same time, whereas the western end was planted over 10 years. The eastern end backs on to more agricultural land, which Snow and Perrins (1998), suggest the yellowhammer benefits from, as it creates extensive open areas with hedges and clumps of trees.

Finally, when comparing the average diversity of birds recorded between each transect the data suggests that transects 6 and 7, have little difference in average, all being between 3 & 4. As do transects 2, 5, and 8 (5.25, 5.00, and 5.20 respectively), and transects 3 and 4 (4.80 and 4.87) - this is a trend that was also seen in 2021 and 2021. However, transect 1 is statistically significant when compared to all other transects and transect 6 and 7 are significantly different to all other transects but each other. Transect 1 also has the highest numbers and 6 and 7 the lowest.

One reason for this is because transect 1 does not cross any paths, whereas the other transects do. Transect 6 and 7 slightly cross a busy footpath as opposite sides of the wood, which could explain why they are different from the rest but not each other. Being near footpaths means being near humans and dogs, a position that would be disadvantageous to a bird, particularly a nesting bird, resulting in the lowest results. 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 (Banks, P.B. and Bryant, J.V., 2007). This could further explain why transect 6 and 7 saw fewer bird species than any other.

## **POLLINATORS**

A total of 27 pollinator species were recorded in 2022 with a total of 308 individuals. When compared to the previous two years, it shows a significant increase for 2021 (where 139 individuals of 18 pollinator species were recorded) and a large decrease from 2020 (where 613 individuals of 25 Hymenoptera and Diptera species were recorded, plus 1176 individuals of 21 species of Lepidoptera). That is 121.58% increase from 2021 and 82.78% decrease from 2020 for individuals. Species have risen by 50% from 2021 and declined 41.30% from 2020. This is likely due to fewer recording days per transect and survey assistants with less experience in 2021 and 2022.

The west end of the woods recorded the highest average number of pollinator species per transect per day (11.43), this is a result consistent with the 2021 and 2020 reports. The eastern end had an average diversity of 8.45 species per transect per day. The two ends are statistically different, meaning that there is a difference in pollinator diversity between the east and west ends of the Diamond Wood. This could be due to the variation of source plants in the east and west, as it is well documented that some plants are better than others for pollinators as seen in a study by Hanley, M.E., et al (2008). They found a clear relationship between pollen protein content and pollinator attraction. The western end was specifically planted with pollinator friendly wildflowers by ATU, the eastern end however, was sown with grasses and then has self-seeded over the ten years. Alternatively, this could be because the western end had more transects surveyed (19), compared to the eastern end (13), over the 31 recording days.

In 2022, the average diversity of Coleoptera was significantly higher in the western end of the Diamond Wood. Hemiptera and Neuroptera species were only found in the western end. However, Lepidoptera was significantly higher in the eastern end. This is different to previous years.

One reason for the western end having more Coleoptera and the only recordings of Hemiptera and Neuroptera species could be due to variations in 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, deadwood piles and pond - 4 habitats that are absent in the eastern end. The presence of these habitats suggests an explanation for greater diversity of pollinators in the western end as they provide a greater variety of resources.

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 Coleoptera requires nest sites, Foltz Johnson et al., 2020 suggests that while flowering plants provide pollinators with food, insects also require suitable shelter for nesting and overwintering. They continue to say that beetles seek shelter in places that offer protection from predators and the elements, such as leaf litter and wood piles. The western end has several piles of wood that would help with this. Hemiptera and Neuroptera require larval host habitat, which is often species-specific (Senapathi, D., et al, 2017). Gibb, 2014, states that the larvae of several members of Hemiptera and Neuroptera are aquatic and commonly concealed under stones in streams or ponds. The adults of aquatic immatures usually remain on vegetation near water. The western end has a pond, and therefore could explain why Hemiptera and Neuroptera species were only found there. This lack of nest site resources or larval host habitat in the eastern end of the woods could explain the distribution. However, this would need to be studied further.

Lepidoptera was significantly higher in the eastern end, especially small skippers. This could be due to a higher amount of food source plants (specifically wildflower species) being found in the eastern end this year. Conversely to previous years, the eastern end had a significantly higher average diversity of wildflowers - however the grass numbers meant that the overall diversity was higher in the west - when compared to the western end in 2022, the opposite of 2021 and 2020. Hanley, M.E., et al (2008) study found a clear relationship between pollen protein content and pollinator attraction. For example 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 Rosaceae family. When looking at the plant composition of east and west, the east has greater numbers of the Fabacea family - namely, the red clover, black medic and white clover. Whereas the western end has much greater densities of Thistle and Ragwort - which are from the Asteraceae family. For the Small Skipper (*Thymelicus sylvestris*) the imago (adults) feed primarily on Brambles (*Rubus* spp.), Knapweeds (*Centaurea* spp.), Red Clover (*Trifolium pratense*), Thistles (*Carduus* spp. and *Cirsium* spp.), and Selfheal (*Prunella vulgaris*), all of which are found in higher quantities in the east when contrasted with the west (UK Butterflies, n.d.).

Finally, when comparing the average diversity of pollinators recorded between each transect the data suggests that transect 5 was the most diverse, whereas transect 2 was the least. They are both statistically different from each other and all other transects. Transect 5 crosses one central path and is located across the centre of the wood (crossing into both east and west, but is classed as east). The mixing of the two ends of the wood could be the reason for the high diversity. Transect 2 crosses several paths and

is in the middle of Harmony Woods at the western end. The high foot traffic and differences in land use could be the reason for the low diversity. Transects 1, 3, 4, 6, 7 and 8 have little difference in average and show no statistically significant difference between them. Again, the robustness of these results is not high. It could be that transect 5 was surveyed on a particularly warm and sunny day, or was surveyed by a recorder who was confident in their bee identification.

## **LEPIDOPTERA**

The overall number of butterflies recorded on the registered Butterfly Conservation transect was shown to have increased in 2022 from 2021. This could be due to the lack of skilled recorders in 2021. Similarly to 2021, the butterfly populations that are doing well (based on population sizes) appear to be the Meadow Brown, Marbled White and the Small Heath, as well as the Small Skipper and Small White. Interestingly, there was a significant increase in Small Blue and Large White populations in 2022.

A notable species of 2022, the Small Blue more than tripled in population size from 2021. Efforts have been made by the ATU volunteers for the past 6 years to introduce the Small Blue into Harmony Woods through the growing and planting of Kidney Vetch. Western Marbled White, Wessex Skipper, Large Blue, Holly Blue, Chalkhill Blue and Common Grass Moth were all new species found this year, however the identification skills of the surveyor were not robust so there could be some miss identification.

In total 374 butterflies were recorded throughout 2022, this is a small increase from the 333 butterflies that were seen in 2021. It is important to note that the number of days surveyed in 2022 was 9, whereas in 2020 the butterfly transect was surveyed on 13 separate days; 4 days less. The collection also didn't start until June 2022 and finished in late August. Therefore the numbers recorded in 2022 are not directly proportional to those in 2021, this suggests that any species decreases should be read carefully and any increases are quite significant. Moreover, 9 is 69.2% of 13. 69.2% of 333 (2021's total) is 230.4, showing a significant increase between 2021 and 2022 where 374 individuals were recorded. 20 different species were recorded in 2022, compared to 24 in 2021 and 21 in 2020. This suggests a reduction in the diversity of butterflies, however the skills of the identifier were not as robust as previous years, so this conclusion is not reliable.

## **WILDFLOWERS & GRASSES**

A total of 61 wildflower and grass species were recorded in 2022 with a total of 26,279 individuals. When compared to the previous years, it shows a decrease for 2021 in species but a significant increase in individuals (where 5,253 individuals of 66 flora were recorded). That is a 400% increase from 2021 for individuals, and species have dropped by 7.58%. This is likely due to inconsistent recording methods and days per transect, and survey assistants with less experience in 2022.

There was an inconsistency in recording methods between wildflowers and grasses. As mentioned in the Method, the 50x50cm quadrats used for floral data collection are split into 25 boxes, and the number of boxes containing each plant species is recorded for wildflowers, whereas for grasses (especially fescue) the individual plants have been counted. Our smaller sample sizes and inconsistency of data collection has led to lower statistical power and thus a reduced ability to detect a true difference in the data. However, using standard error, there is a statistical difference in the average diversity of wildflowers and grasses between the east and the west, with the west having the highest diversity.

The west end of the woods recorded the highest average number of wildflower and grasses per transect per day (3.71), this is a result consistent with the 2021 and 2020 reports. The eastern end had an average diversity of 2.73 species per transect per day. The two ends are statistically different, meaning that there is a difference in the diversity of wildflowers and grasses between the east and west ends of the Diamond Wood. This could 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 and raked once a year - to 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 topsoil 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 (Marshall, 2021).

In 2022, when comparing the average diversity of wildflowers and grasses recorded between each transect, the data suggests that transect 2 is the most diverse (21.25), closely followed by transect 8 (19.00), but not statistically different. Transect 1 was the least diverse (14.00). Transects 3, 4, 6, and 7 have very little difference in average: 18.00, 16.80, 17.00, and 15.67 respectively. There is no statistical difference between any of the transects. This could be because of the differences in management techniques used in the opposite ends of the wood.

Meadow buttercup (*Ranunculus acris*) and yellow rattle (*Rhinanthus minor*) were only found in the western end of the wood; Shellswell, C.H., et al (2016) states that they are positive indicator species of lowland grasslands. Early successional species of lowland grassland habitats can include cowslip (*Primula veris*) and yellow rattle (*Rhinanthus minor*). Again, these are both only present in the more managed areas of the western end of the woods.

Interestingly, Crested dog's-tail (*Cynosurus cristatus*), another indicator species, was found in both ends but significantly more in the west. Ribwort plantain (*Plantago lanceolata*) and oxeye daisy (*Leucanthemum vulgare*) are also early successional species of lowland grassland and found at both ends, but more so in the west. Further to this, the indicator species red clover (*Trifolium pratense*) and lady's bedstraw (*Galium verum*), were most abundant in the east; and the early successional specie Common knapweed (*Centaurea nigra*) was only present in the eastern end. This suggests that the management techniques that ATU are using are working in order to improve the lowland grassland habitat and even beginning to naturally spread to the un-managed eastern end of the wood.

Negative indicators are often agricultural weeds that either indicate soil nutrient enrichment – such as creeping thistle (*Cirsium arvense*) – or high levels of ground disturbance for periods of time (Shellswell, C.H., et al., 2016). Negative indicator species of lowland grassland habitats, as suggested by Shellswell, C.H., et al (2016) include white clover (*Trifolium repens*), docks (*Rumex* sp.) and other widespread grassland species all of which are present in higher numbers or only in the eastern end. This suggests that the management techniques used by Andover Trees United within the Harmony Woods boundary have been advantageous.

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 (the most abundant grass across the whole wood) 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 lose areas of Fescue cover (Marshall, 2021).

Finally, 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 as they are often source plants for many species (UK Butterflies, n.d.).

## **CONCLUSION**

In total; 388 bird individuals, 308 pollinator individuals and 26,279 plant individuals of 21 bird species, 27 pollinator species and 61 plant species, were recorded in the Diamond Wood during the 2022 survey programme. On a 44 acre site, (Rounded to the nearest whole number) this averages at 9 individuals and 1 bird species per acre; 7 individuals and 1 pollinator species per acre; and 597 individuals and 1 flora species per acre. Overall, this provides a positive build onto the last two years' reports. We continue to discover new species and, despite the drop in data quantity, trends of increased diversity are still shown (for example, with the Flora and and pollinators).



In line with 2021, the report highlights areas for improvement such as the unimproved grassland in the east (though there are starting signs of natural migrational improvement). It highlights priority species for which care should be taken to conserve, such as the Skylark and Small Heath butterfly, as well as providing 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 also highlights the importance of reliable and consistent data collection when it comes to impacting the quality data, it also hints to how species have been impacted by our disturbance (the lower numbers of Skylark).

These reports 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. 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.

Finally, I would like to suggest that the Nature in Harmony report be updated yearly as it is here, with comments on new species or noticeable trends, however in order to report robust statistical analysis, I think that the data should also be combined each year and analysed together as one dataset every 5 years. This should enable us to have an even clearer view of the difference between the west and east sides of the Diamond Woods, which is a very unique and exciting research opportunity in the world of wildlife conservation and rewilding.



**APPENDIX I: COMPLETE LIST OF SPECIES OBSERVED ACROSS THE 44-ACRE DIAMOND WOOD IN 2022.**

**These observations were made off-transe during walks, citizen science events and Bioblitz.**

An additional 45 species were recorded at a Bioblitz citizen science event in May 2022. This includes four birds, three bee species, six butterfly species, three moth species, two beetles, one dragonfly, one damselfly, one spider, one mollusc, and more.

AVENS		AVENS	
Common Name	Species Name	Common Name	Species Name
Buzzard	<i>Buteo buteo</i>	Gull Sp.	<i>Laridae sp.</i>
Common Chiffchaff	<i>Phylloscopus collybita</i>	Magpie Sp.	<i>Corvidae sp.</i>
Feral Pigeon	<i>Columba livia domestica</i>	Red Kite	<i>Milvus milvus</i>
Great Tit	<i>Parus major</i>	Skylark	<i>Alauda arvensis</i>
Green Woodpecker	<i>Picus viridis</i>	Starling	<i>Sturnus vulgaris</i>
Goldfinch	<i>Carduelis carduelis</i>	Yellowhammer	<i>Emberiza citrinella</i>
ARACHNIDA		COLEOPTERA	
Common Name	Species Name	Common Name	Species Name
Cucumber Green Orb Spider	<i>Araniella cucurbitina</i>	False Oil Beetle	<i>Oedemera nobilis</i>
Cricket Bat Orb Spider	<i>Mangora acalypha</i>	Weevil Sp.	<i>Curculio sp.</i>
DIPTERA		HYMENOPTERA	
Common Name	Species Name	Common Name	Species Name
Two-Banded Wasp Hoverfly	<i>Chrysotoxum bicinctum</i>	Buff-Tailed Bumblebee	<i>Bombus terrestris</i>
Cranefly Sp.	<i>Tipuloidea sp.</i>	Carder Bee	<i>Bombus pascuorum</i>
LEPIDOPTERA		Honeybee sp.	<i>Apis sp.</i>
Common Name	Species Name	Red-Tailed Cuckoo Bee	<i>Bombus rupestris</i>
Chalkhill Blue Butterfly	<i>Polyommatus coridon</i>	LEPIDOPTERA	
Cinnabar Moth	<i>Tyria jacobaeae</i>	Common Name	Species Name
Common Blue Butterfly	<i>Polyommatus icarus</i>	Six-Spot Burnet Moth	<i>Zygaena filipendulae</i>
Fritillary Butterfly Sp.	<i>Nymphalidae sp.</i>	Small Blue Butterfly	<i>Cupido minimus</i>
Large Blue Butterfly	<i>Phengaris arion</i>	Small Heath Butterfly	<i>Coenonympha pamphilus</i>
Mother Shipton Moth	<i>Callistege mi</i>	Yellow Shell Moth	<i>Camptogramma bilineata</i>

ODONATA		MOLLUSCA	
Common Name	Species Name	Common Name	Species Name
Broad-Bodied Chaser Dragonfly	<i>Libellula depressa</i>	Common garden snail	<i>Cornu aspersum</i>
Damselfly Sp.	<i>Zygoptera sp.</i>	TREES AND SHRUBS	
GRASSES		Common Name	Species Name
Common Name	Species Name	Field Maple	<i>Acer campestre</i>
Cocksfoot Grass	<i>Dactylis glomerata</i>	Hawthorn	<i>Crataegus</i>
Creeping Soft Grass	<i>Holcus mollis</i>	Hazel	<i>Corylus</i>
False Oat-Grass	<i>Arrhenatherum elatius</i>	Oak	<i>Quercus</i>
Quaking Grass	<i>Briza</i>	Silver Birch	<i>Betula pendula</i>
Red Fox Grass	<i>pennisetum rubrum</i>	Wild Cherry	<i>Prunus avium</i>
Soft Brome Grass	<i>Bromus hordeaceus</i>	HERBS	
Velvet Grass	<i>Holcus lanatus</i>	Common Name	Species Name
HERBS		Kidney Vetch	<i>Anthyllis vulneraria</i>
Common Name	Species Name	Lacy Phacelia	<i>Phacelia tanacetifolia</i>
Baby's Breath	<i>Gypsophila</i>	Marsh Marigold	<i>Caltha palustris</i>
Bird's Foot Trefoil	<i>Lotus corniculatus</i>	Oxeye Daisy	<i>Leucanthemum vulgare</i>
Black Medic	<i>Medicago lupulina</i>	Prickly Lettuce	<i>Lactuca serriola</i>
Bristly Oxtongue	<i>Helminthotheca echioides</i>	Ragged Robin	<i>Silene flos-cuculi</i>
Broom Rape	<i>Orobanche</i>	Ragwort	<i>Jacobaea vulgaris</i>
Cleaver	<i>Galium aparine</i>	Red Campion	<i>Silene dioica</i>
Crested Dog's Tail	<i>Cynosurus cristatus</i>	Red Clover	<i>Trifolium pratense</i>
Dwarf Spurge	<i>Euphorbia exigua</i>	Sainfoin	<i>Onobrychis</i>
Field Pansy	<i>Viola arvensis</i>	Scarlet Pimpernel	<i>Anagallis arvensis</i>
Forget-Me-Not Sp.	<i>Myosotis sp.</i>	Selfheal	<i>Prunella vulgaris</i>
Foxglove Sp.	<i>Digitalis sp.</i>	Small Mousetail	<i>Myosurus minimus</i>
Goat's-Beard	<i>Aruncus dioicus</i>	Spear Thistle	<i>Cirsium vulgare</i>
Hawkbit Sp.	<i>Leontodon</i>	Teasel	<i>Dipsacus</i>
Hawkweed Sp.	<i>Hieracium Sp.</i>	Water Iris Sp.	<i>Iridaceae sp.</i>
Herb Robert	<i>Geranium robertianum</i>	Yellow Rattle	<i>Rhinanthus minor</i>
Horsetail	<i>Equisetum</i>		

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