THE POLLINATORS OF WYTHAM WOODS
2017-2020 SURVEY

Version 1 (February 2021)

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A report for Wytham Woods, University of Oxford

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Cover images: Marley Wood in spring (top), female Red-tailed Cuckoo Bee *Bombus rupestris* (bottom left, Batman Hoverfly *Myathropa florea* (bottom right). All images in this report © Steven Falk unless stated.

SUMMARY

- Between 2017 and 2020, 37 full-day surveys of flower-visiting insects at Wytham Woods, west of Oxford, were carried out using a combination of active sampling and (on most days) simultaneous pan trapping. Surveying has covered the period late March to mid-October.

- These visits, and few extra visits by the author and Dr Liam Crowley, University of Oxford, have produced records for 679 flower-visiting taxa, mostly representing verified species but also a few aggregate or indeterminate taxa. The list includes records for 114 species of hoverfly and 94 species of bee and 30 species of butterfly (see associated spreadsheet).

- For each taxon at each site visit, the author recorded all flower visits, the observed abundance level and the number of individuals caught in pan traps (see associated spreadsheet).

- The list includes records for 59 species currently with national rarity or conservation status, though it should be noted that some of these are now known to be more frequent than their status suggests.

- The dataset has produced flower-visiting records for about 130 plant species, revealing the popularity of different plant species to pollinators, the sorts of insects that visit a particular plant species, and the period of the year in which they do this.

- The data allows direct comparison of an active survey protocol with a pan-trapping protocol designed to run simultaneously using single-day visits of about 7 hours duration. It reveals that pan-trapping is less effective at sampling species richness than active surveying by an experienced entomologist, and that pan trapping produces a very different estimate of the abundance of flower-visiting species present, one that frequently differs from what is observed.

- However, the data also show that pan-trapping extended the species list a little and revealed the presence and/or abundance of some species that were not observed during active sampling. Pan-trapping proved to be very effective for recording taxa such as sarcophagid flies and pompilid wasps. It was also relatively good at generating data on cooler, breezier days in the spring.

- The data allow assessment of the current condition and ongoing management of Wytham Woods. Pollinators could benefit from improvements in the sequence and abundance of spring-blossoming shrubs plus the widening and scalloping of rides to create sunnier woodland edge and more flowery woodland conditions.

1. INTRODUCTION

1.1 Background

There is growing concern in Britain and beyond for the decline of pollinators and the ecosystem services that they provide (e.g. Biesmeijer et. al., 2006; Powney et. al., 2019). Domestically, this has resulted in much recent activity including the UK Insect Pollinator Initiative and publication of the England National Pollinator Strategy (DEFRA, 2014). Britain may support as many as 6000 species of flower-visiting insect (Falk, unpublished data), most of which are likely to be pollinators of varying effectiveness. This important ecological assemblage plays a crucial role in the long-term viability of habitats and ecosystems and is responsible for pollinating many of the crops we depend upon (Ollerton, 2020).

Flower-visiting insects are probably better documented in Britain than any other part of the world as a result of a long history of recording by both amateurs and professionals, the rich literature to help identify them, the important influence of national recording schemes such as the Hoverfly Recording Scheme and the Bees, Wasps and Ants Recording Society (BWARS), and pioneering work by British universities such as Oxford, Bristol, Sussex, Reading and Leeds. Nevertheless, there are still substantial gaps in our understanding of these insects, including:

- A paucity of hard data to support the prevailing view that overall pollinator abundance is declining;
- Published data on which insect species visit what flowers;
- The full lifecycle requirements of many pollinators;
- Precise distributions of many pollinators.

It is well known that many flower-visiting bees, wasps, flies, beetles and butterflies are expanding their ranges, in many cases almost certainly as a result of climate change. It is often exciting to find new British ones or to add them to a county list. We celebrate such discoveries in publications, tweets and sometimes even the national media. Declines and range-contractions by contrast are usually far less noted or trumpeted but the Powney et. al. paper cited above, which analyses the data of various national recording schemes, suggests that more flower-visiting species are declining than increasing.

The author of this report, an active entomologist of more than 45 years, can certainly testify that assemblages of flower-visiting insects are different now to those of the 1970s and 1980's. Bees and hoverfies that were quite frequent then are now almost impossible to find in the same areas whilst species never seen in those periods are now common and increasing.

It is, therefore, timely that structured pollinator surveying and monitoring has been initiated at Wytham Woods by Oxford University. It provides an exciting opportunity to check the flower-visiting assemblages for what is clearly a very fine and important wildlife site, and to see if changes and trends can be detected. Hopefully this work

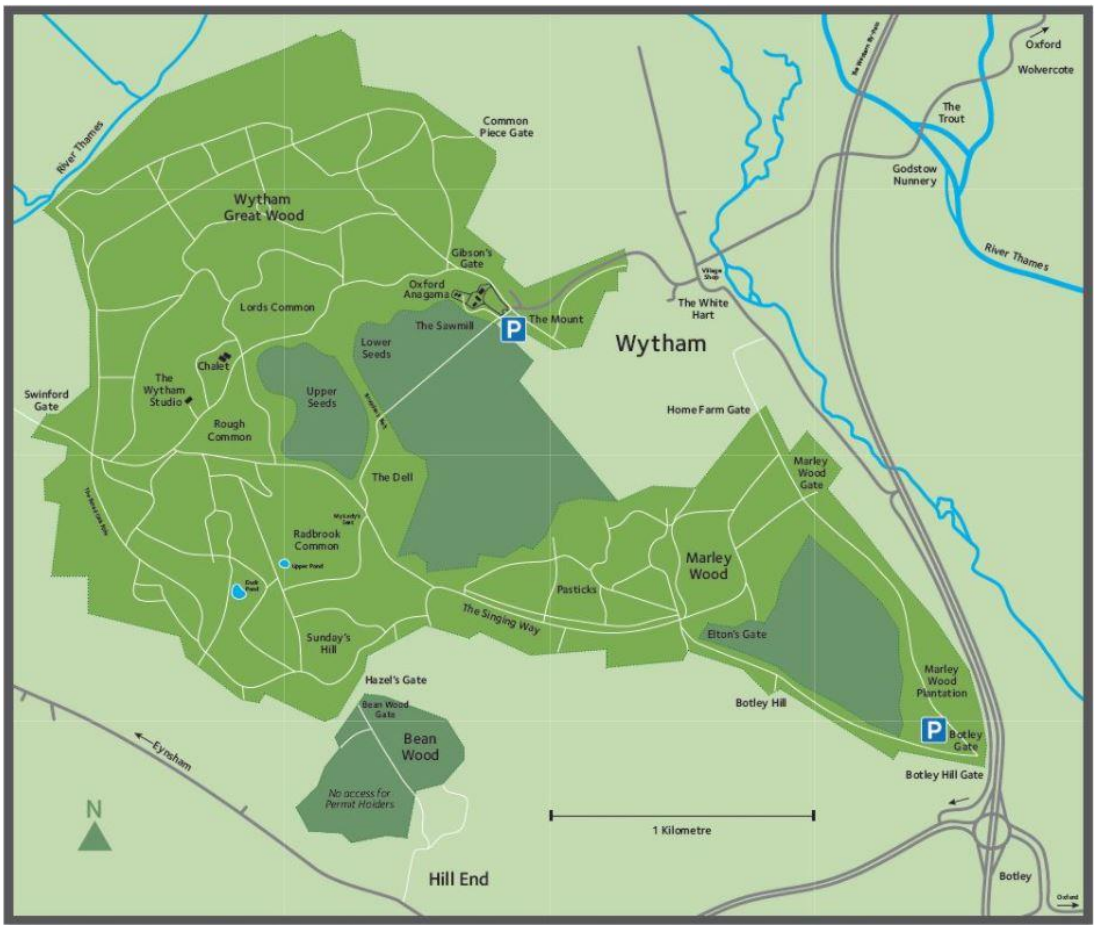
can contribute to national efforts to monitor, understand and promote pollinators, and provide a basis for involving students, volunteer naturalists and other 'citizen scientists' in monitoring flower-visiting insects.

1.2 Site description

The Wytham Woods complex is located about 3km west of Oxford city centre between the settlements of Botley and Eynsham, just west of the A34 (central grid reference SP 46072 08154). It is located within the modern county of Oxfordshire but the biological Vice-county of Berkshire due to its location west of the River Thames (which forms part of the Vice-county boundary). The area was bequeathed to Oxford University in 1943 by the Ffennell family for research and for the enjoyment of the people of Oxford. It now constitutes one of the most studied areas of woodland in the world with bird data stretching back for over 60 years, Badger *Meles meles* data for over 30 years and climate change data for the last 20 years.

The area managed by Oxford University covers about 325 ha and is actually considerably more diverse than just woodland. The main woodland areas are Wytham Great Wood at the north of the site (SP 45984 08992, centralised) and the adjacent Radbrook Common at the west (SP 45837 07609). This woodland area extends east to another woodland block, Marley Wood (SP 47484 07624), and a further separate block of woodland, Bean Wood, occurs to the south (SP 46358 06798) but has not been subject of this survey. The woodland varies greatly in character, with classic English Oak, Ash and Hazel-dominated ancient broadleaved woodland dominating much of Wytham Great Wood and Marley Wood. Blocks of coniferous woodland have been established both within former ancient woodland and within the secondary woodland of Radbrook Common, much of which was once farmland. Ash tends to dominate the secondary woodland and there are also some patches of secondary Beech woodland (e.g. SP 46151 07198). An extensive system of rides occurs throughout the woodland, some of which are quite wide and sunny whilst others are narrower and rather shaded. Older specimens of English Oak, Beech, Ash, Common Lime and Hornbeam occur scattered throughout the woodland. The oldest of these probably originate from the late 1700s. They can support decay, fungi and other saproxylic features of value for scarce invertebrates, though none can yet be classified as ancient trees. Clearings within the woodland are rather few but include a superb seepage-fed mire within Marley Wood (SP 47684 07885), some blossom-rich scrub and grassland areas within Wytham Great Wood (e.g. SP 45723 09249) and Radbrook Common (e.g. SP 46407 07463) and a relatively newly-created pool within Radbrook Common (SP 45837 07464).

The underlying geology and soils vary considerably, so that some of the woodland has a more acidic character with much Bracken whilst other areas are clearly calcareous, with an Ash-dominated canopy and much Dog's Mercury in the ground layer. Variable hydrology further diversifies these ground conditions, with areas of impeded drainage and seepages creating damp woodland conditions locally whilst other areas are relatively well drained. The topography of the site (which cloaks a low hill) also means that some areas of the woodland are on average cooler, either because they are on north-facing slopes, or because they are elevated and tend to



Map 1. Wytham Woods showing the main areas and access routes (from the Wytham Wood Permit Holder's Map leaflet).

catch the prevailing breeze, notably woodland along the ridge of the Singing Way between Radbrook Common and Marley Wood.

Relatively unimproved and floristically diverse grassland occurs within the middle of the site, notably within Upper Seeds (SP 46165 08167) and Rough Common (SP 45722 08072). This is mostly limestone grassland featuring calcicolous plants such as Wild Parsnip, Wild Basil, Hoary Ragwort and Woolly Thistle, though some patches of Bracken here indicate that some soil may be of a more leached and acidic nature. A small experimental arable plot occurs adjacent to Upper Seeds at SP 46387 07937 and a larger area of rather floristically-poor sheep pasture occurs within the Lower Seeds (SP 46577 08425). The Sawmills (Wood Yard) area (SP 46720 08585) supports staff offices, wood piles and storage areas and has some quite disturbed weedy ground that can become quite flowery.

1.3 Objectives

The Wytham Woods complex one of the most researched areas of woodland in the world. However, whilst there is a fairly long history of entomological recording in the woods, it has mostly been less intense and structured than the recording of some other wildlife groups, despite the fact that insects are likely constitute a very high proportion of the biodiversity here. The objectives of the study are thus two-fold:

Map 2. An aerial view of Wytham Woods at the same scale as Map 1 (from Google).

1. Develop a list of all the flower-visiting insects to assess the richness and characteristics of this assemblage and consider the conservation issues that might be associated with pollinators;
2. Initiate long-term, standardised monitoring of pollinators to help identify and understand any long-term changes that might be taking place;
3. Produce a detailed dataset that can be analysed by others outside of the scope of this general report.

In addition to this survey, a separate project focussing on monitoring aerial nesting bees was initiated in 2017 by Dr Tonya Lander of the University of Oxford, and historical records of pollinators at Wytham Wood (paper records and specimens) have been assembled by Ceri Watkins, also of the University of Oxford. Regular moth and butterfly recording/monitoring already takes place at the site.

The Wytham Woods complex comprises a variety of woodland and grassland types.

2. METHODOLOGY

2.1 Dates of visits

An initial walkover of the site was carried out on 23 January 2017 in the company of Dr Keith Kirby (University of Oxford, Department of Plant Sciences) to learn more about the history and ecological characteristics of the site. Full-day survey visits then took place across four years (2017-2020) on the following dates (with weather conditions during surveying period noted):

2017

- 25 March (12-17 °C depending on location, sunny but mostly cool with a breeze from SSE)
- 2 April (13-19 °C, the morning rather cool and cloudy with ESE breeze but afternoon summer and warmer)
- 9 April (18-23 °C, warm and sunny but S breeze increasing during afternoon)
- 23 April (18 °C, cloudy with sunny spells, cool breeze from NNW)
- 18 May (17-20 °C, sunny in morning but getting cloudy and cool with a S breeze during afternoon)
- 26 May (22-24 °C, sunny, slight breeze from SSW)
- 26 June (18-22 °C, sunny, barely any breeze)
- 27 August (22-26 °C sunny, slight breeze from E)
- 24 September (18-20 °C, sunny spells in morning but cloudy in afternoon, slight breeze from SE)
- 15 October (16-18 °C, sunny spells but rather strong breeze from SSW).

2018

- 21 May (20-23°C, sunny spells but cloudy later, gentle NNE breeze)
- 27 May (21-24°C, mostly sunny, slight breeze from various directions)
- 10 June (19-21°C, mostly sunny, slight breeze from NNE)
- 24 June (21-24°C, sunny, slight breeze from NNE)
- 15 July (26-28°C, sunny, barely any breeze)
- 28 July (20°C, sunny spells, moderate breeze from S)
- 20 August (22-25°C, sunny spells, gentle breeze from SW)
- 27 August (18-19°C, sunny spells, moderate breeze from W)

2019

- 15 April (12-14°C, fairly sunny, gentle breeze from E)
- 2 June (20°C, sunny spells am, then cloudy, rain by 3pm, moderate breeze from SW)
- 6 July (18-21°C, light cloud, gentle breeze from N)
- 11 August (19-21°C, sunny spells, occ' shower, moderate breeze from SW)
- 25 August (25-30°C, sunny, slight breeze from SE)
- 21 September (20-23°C, sunny, moderate breeze from SE)

2020

- 25 Marsh (15°C, fairly sunny, slight breeze from SE)
- 8 April (20°C, hazy sunshine, slight breeze from NE)
- 24 April (20°C, sunny, slight breeze from N, NE)
- 7 May (20°C, sunny, gentle breeze from S)
- 25 May (23°C, sunny, gentle breeze from SW)
- 13 June (21°C, sunny spells, moderate breeze from SE)
- 23 June (26°C, sunny, gentle breeze from S)
- 11 July (20°C, sunny spells, gentle breeze from N)
- 21 July (19°C, sunny spells, gentle breeze from N)
- 11 August (32°C, sunny, slight breeze from E)
- 23 August (20°C, sunny spells, 2 short showers, gentle breeze from SW)
- 14 September (27°C, sunny, slight breeze from E)
- 21 September (22°C, morning fog then sunny with gentle breeze from N)

Wet, fully cloudy, and excessively breezy days were avoided – most days coincided with at least partially sunny conditions. No more than a few short showers and one morning of fog affected the entire survey. A little extra data was also obtained from educational events led by the author, plus specimens collecting by the author and Dr Liam Crowley (University of Oxford, Department of Zoology) in 2020 for the Darwin Tree of Life project.

2.2 Active surveying

This entailed selecting a defined compartment of the site e.g. Wytham Great Wood, Rough Common, Marley Wood, or Rough Close (see Map 3), and recording as many flower-visiting species in a compartment as possible. On most visits, several compartments were recorded but on a couple of visits an entire day was spent at Marley Wood and one entire day was also spent at Radbrook Common.

On all visits great effort was made to observe and record flower-visitations (i.e. insect X visits flower Y). However, pollinators also spend some of their time basking on foliage or ground, flying or hovering, so it was important to record known pollinators even if they were not visiting a flower. A 'known pollinator' was defined as ***'a species known or suspected (through the expertise of the author) to regularly visit flowers and likely to be capable of transferring pollen between flowers with various levels of efficiency'***. Inevitably, this is a fairly subjective judgement for some species and some insect groups that are marginal (e.g. ladybirds, pollen beetles and tephritid fies) were not recorded as assiduously as the more obvious pollinator groups such as bees, hoverflies, butterflies, blowflies, muscid flies and certain wasps and sawflies. Only diurnal pollinators (including day-flying moths) were recorded. Moth recording is carried out as a separate project and good data is available (Boyes, 2020).

Much of the recording involved identification in the field (e.g. for butterflies, most hoverflies and some bees) but individuals of species that could not be reliably identified in the field were netted and transferred variously to pooters or tubes for

The author sweeping with a long-handled insect net.

killing and formal identification under a microscope. A little sweeping with a long-handled (1.5-2.5 metre) insect net was carried out to check if any other pollinators were present. However, there can be a conflict between using a sweeping approach (which can be very effective in building up a long species list) and obtaining flower-visitation records, because sweeping creates disturbance and does not always allow a single flower type to be checked for visitations. However, sweeping was quite useful for obtaining samples of pollinators on large single species flower stands such as Wild Parsnip, Wild Angelica, Smooth Hawksbeard, Yarrow plus blossoming Blackthorn, Cherry Laurel, Goat Willow, Grey Willow and Ivy.

Active surveying typically started at 10.00 and continued until 15.30 - 16.00. Within a recording compartment, the amount of time spent was largely influenced by the productivity of that area, so would be longer where pollinator abundance and diversity was higher and shorter where abundance and diversity was lower. Setting a strict time limit for time spent in a given compartment would probably have resulted in a much lower day species-list, also poorer coverage of the best areas because of the time wasted on the poorer areas. Because only a relatively small part of the overall site could be sampled in any given day (due to its large size), some effort was made to vary the choice of locations between visitation dates and to ensure that the flowering peaks of certain important flowers/blossoms were targeted. Thus, about two hours was deliberately spent in the Blackthorn-rich clearings of Wytham Great Wood on 2 April 2017 (the best Blackthorn area), and a large Cherry Laurel bush in Marley Wood was deliberately surveyed on the mornings of 9 April 2017 and 15 April 2019 to hit the blossoming peak of this whilst the sun was on it.

Calcareous grassland areas were targeted from June until September as they were the most flowery parts of the site during this period and held less interest prior to this. Wild Angelica in woodland rides was targeted in late summer. It was usually possible to gauge which parts of a site were likely to be productive several weeks in advance by noting the species and locations where shrubs and pre-flowering plants were present. What is more, setting up pan traps in the morning prior to active sampling involved a drive through the middle of the site which allowed last minute checking of potential survey areas before a final decision was made where to carry out active sampling on a day. Special effort was made to sample a key area when it was sunniest and to avoid sampling a key area once it had become shaded out and much less productive.

For each species recorded, a rough estimate of abundance was made as follows:

- Abundant - hundreds seen during the day, at least in some parts of the site;
- Frequent - dozens seen during the day, at least in some parts of the site;
- Occasional - only a few seen during the day;
- Rare - only one seen during the day.

This was a pragmatic approach because circumstances did not allow anything more precise than this to be carried out (e.g. counting up of individual sightings) without compromising other aspects of the survey such as developing a long species list or observing flower visits. For the same reasons, the abundance level of a species noted on a day related to the site as a whole and not for abundance in different compartments. Fortunately, pan trapping results (which note the number of individuals of each species trapped) helped to compensate for this.

In the accompanying spreadsheet, records obtained from active recording were assigned to the following recording compartments (see Map 3), using the following abbreviations:

1. Arable = the triangular arable plot between Upper Seeds and The Dell centred at SP463080. It is only cultivated occasionally but supports a distinctive, species-rich and very flowery community featuring plentiful arable ‘weeds’ such as Charlock, Field Speedwell, Fool’s Parsley and poppies, plus an abundance of Wild Parsnip and Hoary Ragwort.
2. BugleJ = an area termed the Bugle Junction, which is the grassy roadside junction at SP455080. On the first year of the survey it featured an abundance of Bugle (hence the name) but this had become much less abundant by 2020. Nevertheless, a fairly flowery, sheltered area with a good sunny woodland edge.
3. Central = the woodland between the chalet and Radbrook Common, between Rough Common and Upper Seeds centred on SP458082. Not subject to much surveying but often walked through to get to other parts of the site.
4. Chalet = the gardens of the chalet (SP 45780 08363) which can be quite flowery in places with Hogweed, Bramble, Common Ragwort, Wood Spurge and some cultivated garden plants; very sheltered from winds.

5. Dell = the mildly calcareous, sloping grassland of the Dell area centred on SP463079 – quite flowery in places with locally abundant Wild Thyme, Hogweed, Yarrow, Bramble and clovers.
6. Dell Woods = the Beech Woodland of The Dell, centred on SP463080. Not especially flowery but with some over-mature and fallen Beech.
7. Edrive = Entrance Drive, the road leading up to public car park which is fringed with Cherry Laurel in places, notably at SP470085.
8. Hulk = a specific standing dead Beech at SP 46324 07786 that supports a strong nesting aggregations of assorted hunting wasps and associated insects.
9. Lseeds = the Lower Seeds area, calcareous grassland plots centred on SP465083 with abundant Woolly Thistle, Smooth Hawksbeard, clovers etc. Some areas heavily sheep-grazed from late summer.
10. MW = Marley Wood, the large woodland block centred on SP477077. Very fine ancient broadleaved woodland with some flowery rides and clearings; also large seepage-fed wetland in the middle (centred on SP 47687 07889) featuring Common Reed, Yellow Loosestrife, Wild Angelica, Hemp Agrimony etc.
11. Quarry = the small, shallow limestone quarry close to the Chalet (SP 45758 08252), now a very sheltered grassy woodland clearing that can become quite flowery, with calcicoles such as Rough Hawkbit, Dwarf Thistle, Wild Thyme and Wild Privet; also some fine woodland edge.
12. Radb = Radbrook Common – the very extensive woodland area (with rides and clearings) centred on SP460071. Very flowery within the various rides and clearings with much fine woodland edge; also, a large, relatively new pond with very flowery margins (featuring Water Mint, Hemp-agrimony, Angelica etc.) at SP 45837 07464.
13. Rough = Rough Common – the fenced compartment centred on SP457080. Calcareous grassland that is very species-rich and flowery in places but also with some extensive Bracken stands. Locally abundant Woolly Thistle, Hoary Ragwort, Wild Parsnip, Hogweed, Wild Basil, Yarrow, St John's-wort, Harebell, Red Bartsia and Rockrose.
14. Sway = the Singing Way. The block of woodland centred on SP466074 that connects Marley Wood with the rest of the site complex. Flowery ride margins with Bramble, thistles and spring-blossoming shrubs such as Hawthorn.
15. Track = the main roadway that runs through the site. Most records assigned to this come from the area centred on SP458079.
16. Useeds = The Upper Seeds area, a series of calcareous grassland plots centred on SP462081. The most flowery and floristically diverse part of the site, featuring locally abundant Wild Parsnip, Hoary Ragwort, Field Scabious, Woolly Thistle, hawksbeards, clovers, Traveller's-Joy, Wild Basil, St John's-wort, Common Bird's-foot Trefoil, Agrimony, clovers etc.
17. WGW = Wytham Great Wood, the very large block of woodland dominating the north of the site. Much of it is heavily managed broadleaved, mixed and coniferised woodland on a north-facing slope but areas of more semi-natural

Map 3. The compartments used for assigning data from active surveying (see 2.2) (Based on Google).

Oak-Hazel woodland are widespread. Some flowery rides and clearings, including some Blackthorn-dominated clearings centred on SP 45723 09240.

18. Wyard = the Wood Yard and office area centred on SP467085 with disturbed, weedy ground, log piles, patches of regularly-mown grassland, and a small copse.

2.3 Pan-trapping

The use of pan traps (water traps) is based loosely upon the methodology developed by the Centre of Ecology and Hydrology (CEH) for their National Pollinator and Pollination Monitoring Framework (NPPMF) work. The pan-trapping protocol was designed to work simultaneously with active recording, and in a manner that did not compromise active recording. The bowls used were plastic 120mm wide by 40mm deep with 10oz capacity. These were spray painted using UV-reflective paint in either white, yellow or blue on top of white primer.

On most (but not all) of the active survey days, two sets (triplets) of equal number white, yellow and blue bowls were placed on the ground at five different sampling locations. These locations were for the most part close to the main vehicle track running through the site so that they could be installed and collected quickly before and after active surveying. Locations were selected that were close to flowers, sheltered from strong winds, and unshaded by nearby foliage or tree canopies. Each

trap was filled with a few mm depth of water that contained 1-2 drop of non-perfumed washing up liquid per litre water. The washing up liquid weakens the meniscus of the water meaning that once insects drop into the bowls they cannot escape and drown quickly. Traps were laid out between 09.00 and 10.00 and left for at least 5 hours, usually being collected between 15.30 and 16.00.

Once collected, the contents of the two sets (triplets) of three bowls used at each trap location were then amalgamated into a single sample and placed into a single labelled tube with 70% isopropanol, meaning that each day produced five sample tubes, one for each trap location. No attempt was made to segregate the samples from different coloured bowls (due to time constraints) but in the 2017 season, when the bowls were collected at the end of the day, photos were taken of each set to provide a simple visual record of which colours attracted which pollinators.

A total of 10 pan trap sampling points were used over the 4-year survey period (see Map 4), though five points (2, 3, 4, 10 and 11) were mostly used later in the study as some of the early locations proved to become too shaded once the woodland canopy formed in May. The sample points and dates of sampling are as follows:

- Point 1: 51.7752 -1.3259 (SP 46618 08720) 25.3.17, 9.4.17, 23.4.14, 8.4.20
- Point 2: 51.7705 -1.3389 (SP 45732 08196) 25.3.17, 2.4.17, 9.4.17, 23.4.14, 18.5.17, 26.5.17, 26.6.17, 27.8.17, 24.9.17, 15.10.17, 21.05.18, 10.6.18, 15.7.18, 20.8.18, 14.4.19, 2.6.19, 6.7.19, 11.8.19, 25.8.19, 21.9.19, 25.3.20, 24.4.20, 7.5.20, 25.5.20, 13.6.20, 23.6.20, 11.7.20, 21.7.20, 1.8.20, 23.8.20, 14.9.20, 21.9.20
- Point 3: 51.7690 -1.3400 (SP 45665 08015) 25.3.17, 9.4.17, 23.4.14, 18.5.17, 26.5.17, 26.6.17, 27.8.17, 24.9.17, 15.10.17, 21.5.18, 10.6.18, 15.7.18, 20.8.18, 14.4.19, 2.6.19, 6.7.19, 11.8.19, 25.8.19, 21.9.19, 25.3.20, 24.4.20, 7.5.20, 25.5.20, 13.6.20, 23.6.20, 11.7.20, 21.7.20, 1.8.20, 23.8.20, 14.9.20, 21.9.20
- Point 4: 51.7680 -1.3323 (SP 46175 07917) 25.3.17, 9.4.17, 23.4.14, 18.5.17, 26.5.17, 26.6.17, 27.8.17, 24.9.17, 15.10.17, 21.5.18, 10.6.18, 15.7.18, 20.8.18, 14.4.19, 2.6.19, 6.7.19, 11.8.19, 25.8.19, 21.9.19, 25.3.20, 24.4.20, 7.5.20, 25.5.20, 13.6.20, 23.6.20, 11.7.20, 21.7.20, 1.8.20, 23.8.20, 14.9.20, 21.9.20
- Point 5: 51.7627 -1.3161 25.3.17
- Point 6: 51.7745 -1.3285 (SP 45786 09251) 2.4.17, 8.4.20
- Point 7: 51.7731 -1.3331 2.4.17
- Point 8: 2.4.17 (same as point 10) mix up, sorry
- Point 9: 51.7800 -1.3377 (SP 46563 07504) 2.4.17
- Point 10: 51.7705 -1.3389 (SP 46009 08447) 9.4.17, 23.4.14, 18.5.17, 26.5.17, 26.6.17, 27.8.17, 24.9.17, 15.10.17, 21.5.18, 10.6.18, 15.7.18, 20.8.18, 14.4.19, 2.6.19, 6.7.19, 11.8.19, 25.8.19, 21.9.19, 25.3.20, 8.4.20, 24.4.20, 7.5.20, 25.5.20, 13.6.20, 23.6.20, 11.7.20, 21.7.20, 1.8.20, 23.8.20, 14.9.20, 21.9.20
- Point 11: 51.7690 -1.3409 (SP 45578 08025), 18.5.17, 26.5.17, 26.6.17, 27.8.17, 24.9.17, 15.10.17, 21.5.18, 10.6.18, 15.7.18, 20.8.18, 14.4.19, 2.6.19,

6.7.19, 11.8.19, 25.8.19, 21.9.19, 25.3.20, 24.4.20, 7.5.20, 25.5.20, 13.6.20, 23.6.20, 11.7.20, 21.7.20, 1.8.20, 23.8.20, 14.9.20, 21.9.20

- Point 12: 51.7741 -1.3233 (SP 46785 08606) 8.4.20, 8.4.20
- Point 13: 51.7739 -1.3200 (SP 47009 08588) 8.4.20, 8.4.20

The trap locations were initially logged using longitude and latitude with a smartphone, but I have added a slightly more accurate national grid reference value in brackets afterwards where I have been able to ascertain the spot from satellite imagery using *http://www.gridreferencefinder.com/*.

2.4 Taxonomic scope of recording

The England National Pollinator Strategy suggests that about 1500 pollinator species occur in the UK but the true figure is likely to exceed 6000 species (Falk, unpublished) because it ignores many of the less well-known insect groups (notably assorted fly and beetle families) that are regular flower visitors and capable of transferring pollen. In this study, the members of the following insect groups have been recorded:

Coleoptera: Byturidae, Cantharidae, Cerambycidae, Coccinellidae (only ones seen on flowers), Malachiidae, Oedemeridae, Pyrochroidae.

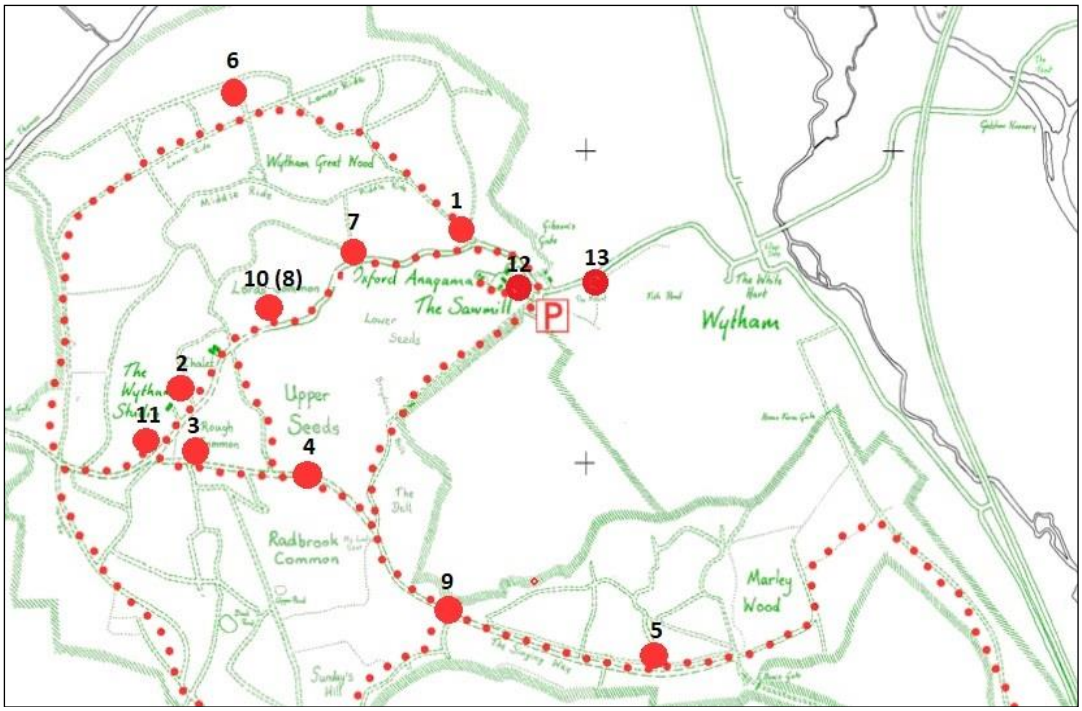
Diptera: primarily Anthomyiidae, Bibionidae, Calliphoridae, Conopidae, Empididae (flower-visiting genera), Fanniidae, Hybotidae (flower-visiting genera), Muscidae, Rhinophoridae, Scathophagidae, Stratiomyiidae, Syrphidae, Tabanidae, Tachinidae; also any flower-visiting observed by members of other families.

Hymenoptera: all bees, aculeate wasps of families Chrysididae, Crabronidae, Mutillidae, Pompilidae, Tiphiidae, Vespidae, and any flower-visiting sawflies (the more readily identified species only). The presence of ichneumons on flowers was sometimes noted, and they are regular flower visitors, but they are very difficult to identify so have not covered in any detail here.

Lepidoptera: All butterflies and day-flying moths.

2.5 Identification of insect specimens

This was carried out using the most up-to-date literature available wherever possible (too many publications to cite but including Falk (2015, 2016), Stubbs and Falk (2002) and assorted Royal Entomological Society handbooks with updating papers). For the pan trap samples (which contained a wide variety of invertebrates), only pollinators were identified, typically to species level, and the numbers of individuals of each species noted. Non-pollinator by-catch (such as grasshoppers, bugs, spiders and robberflies) was not recorded. For some more difficult taxa such as many female *Sarcophaga* fleshflies, many female anthomyiid flies and some sawflies, identification of specimens was often to group level only i.e. '*Sarcophaga* female indet' and '*Athalia* species' due to time contraints. Aggregate ('agg.) taxa were also recorded for females that cannot be assigned beyond a species because no keys are available e.g. *Cheilosia albitarsis* agg. (which could potentially be females of either *C.*



Map 4. The locations of the pan traps (see 2.3).

One *of the two triplets of white, blue and yellow pan traps laid out at 5 locations on most survey visits.*

albitarsis or C. ranunculi) and *Platycheris scutatus* agg. (which could potentially be females of either *P. scutatus*, *P. splendidus* or *P. aurolateralis*).

2.6 Insect nomenclature

Scientific names and classifications are mostly taken from the National Biodviersity Network (NBN) but the latest Dipterists Forum checklist (Chandler, 2020) has been used for Diptera.

2.7 Ascertaining insect conservation statuses

The final list of species recorded was screened for the presence of anything with a national conservation status. This includes Red Data Book Category 1, 2 or 3 statuses, IUCN threat statuses, Nationally Scarce or Notable statuses, or inclusion in the list of Section 41 English conservation priority species. The following status reviews were used for this assessment:

- Beetles — Alexander, 2014, 2019; Alexander et. al., 2014; Hyman & Parsons, 1992, 1994
- Flies — Ball & Morris, 2014; Falk, 1991b; Drake, 2017; Falk, Pont & Chandler, 2005; Falk & Crossley, 2005; Falk, Ismay & Chandler 2016; Falk & Pont, 2017
- Bees, wasps & ants — Falk, 1991a
- Moths and butterflies — Fox et al. 2010; Waring & Townsend, 2003

It should be noted that some of these reviews are nearly 30 years old (e.g. Falk, 1991a, b; Hyman & Parsons, 1992) and many of the conservation statuses they give are badly out of date. This has been highlighted as appropriate in section 3.3. (e.g. *Nomada lathburiana*). Full definitions of the rarity and conservation status categories are provided in Appendix 4.

2.8 Checking national distributions of insects

This was done for some of the scarcer species encountered. Sources of species maps include the National Biodiversity Network (NBN) https://species.nbnatlas.org/, the Bee, Wasp and Ant Recording Society (BWARS): https://www.bwars.com/, the Soldierflies & Allies Recording Scheme https://www.brc.ac.uk/soldierflies-and-allies/ and the Hoverfly Recording Scheme http://sgbtest.me.uk/hrs/. It should be noted that NBN maps can be very incomplete and often contain spurious and unverified data. This affects some insect groups more than others.

2.9 Identification of plants

The author is a fairly experience botanist (author of the last Warwickshire county flora (Falk, 2009) and the identification of plants being visited by insects was mostly possible without the need for critical identification. Most flowers were identified at the species level but a few were treated in an aggregate manner (e.g. St John's-worts and buttercups) so as not to disrupt insect recording.

2.10 Constraints

One-day visits are only a snapshot in time and the data should not be regarded as representing definite species lists for pollinators present in the different recording zones or a definite list of which flowers are visited by individual pollinators species.

Nevertheless, the data is believed to provide a relatively good indication of what pollinators are present and the flowers that they most like to forage on.
A further constraint revolves around the constantly evolving understanding of which insects are regular flower visitors. Insects deemed irrelevant at the start of the survey in 2017 such as *Dryomyza anilis* (Dryomyzidae), *Ctenophora* craneflies and assorted beetles are now known to be occasional flower-visitors. Other species that had been considered likely flower visitors at the start of the survey (mainly because they belong to families that are dominated by flower-visiting species) are now considered to be unlikely or very infrequent flower-visitors e.g. *Xylota xanthocnema* (Syrphidae), *Trixa conspersa* and *Gymnocheta viridis* (Tachinidae) and *Eustalomyia* species (Anthomyiidae). Records of these have been retained in the master dataset just in case they prove to be flower visitors in the future.

3. RESULTS

3.1 Species richness

The four-year period of recording using both active surveying and pan-trapping has resulted in records of 679 pollinator taxa (mostly clear-cut species but also a few aggregate taxa) as follows:

- Coleoptera – 24 taxa (most *Cantharis* species not identified to species level);
- Diptera – 417 taxa, including 114 confirmed hoverfly species;
- Hymenoptera – 200 taxa, including 94 confirmed bee species;
- Lepidoptera – 38 species, 30 species of butterflies and 8 species of day-flying moth.

The full data for species, with dates, recording zones and flower-visitations is provided in a separate spreadsheet. This contains three separate worksheets:

1. Data from active recording;
2. Data from pan traps;
3. A summarised species list based on both these approaches.

Worksheet 3 is reproduced as Appendix 2 at the end of this report.

3.2 Scarce species

Fifty-nine species with national rarity or conservation statuses have been recorded:

Andrena apicata (Hymenoptera: Andrenidae) Nationally Scarce
Andrena bucephala (Hymenoptera: Andrenidae) Nationally Scarce
Andrena fulvago (Hymenoptera: Andrenidae) Nationally Scarce
Andrena hattorfiana (Hymenoptera: Andrenidae) Nationally Rare (RDB3)
Andrena trimmerana (Hymenoptera: Andrenidae) Nationally Scarce
Auplopus carbonarius (Hymenoptera: Pompilidae) Nationally Scarce
Blaesoxipha plumicornis Nationally Scarce (Diptera: Sarcophagidae)
Bombus humilis (Hymenoptera: Apidae) Section 41
Bombus ruderatus (Hymenoptera: Apidae) Nationally Scarce, Section 41
Bombus rupestris (Hymenoptera: Apidae) Nationally Scarce
Cadurciella tritaeniata (Diptera: Tachinidae) Nationally Scarce
Cheilosia barbata (Diptera: Syrphidae) Nationally Scarce
Cistogaster globosa (Diptera: Tachinidae) Near Threatened
Ctenophora pectinicornis (Diptera: Tipulidae) Nationally Scarce
Cyrtophlebia ruricola (Diptera: Tachinidae) Data Deficient
Didineis lunicornis (Hymenoptera: Crabronidae) Nationally Scarce
Dolichovespula media (Hymenoptera: Vespidae) Nationally Scarce
Dolichovespula saxonica (Hymenoptera: Vespidae) RDBK
Epistrophe melanostoma (Diptera: Syrphidae). Nationally Scarce
Eurychaeta palpalis (Diptera: Calliphoridae) Nationally Scarce
Eustalomyia hilaris (Diptera: Anthomyiidae) Nationally Scarce

Fannia gotlandica (Diptera: Fanniidae) Nationally Scarce
Freraea gagatea (Diptera: Tachinidae) Near Threatened
Gorytes laticinctus (Hymenoptera: Crabronidae) Nationally Rare (RDB3)
Hebecnema fumosa (Diptera: Muscidae) Nationally Scarce
Lasioglossum malachurum (Hymenoptera: Halictidae) Nationally Scarce
Lasioglossum pauxillum (Hymenoptera: Halictidae) Nationally Scarce
Lasioglossum puncticolle (Hymenoptera: Halictidae) Nationally Scarce
Lasioglossum quadrinotatus (Hymenoptera: Halictidae) Nationally Scarce
Linnaemyia comta (Diptera: Tachinidae) Near Threatened
Macronychia polyodon (Diptera: Sarcophagidae) Nationally Scarce
Macropis europaea (Hymenoptera: Melittidae) Nationally Scarce
Mallota cimbiciformis (Diptera: Syrphidae) Nationally Scarce
Meligramma euchromum (Diptera: Syrphidae) Nationally Scarce
Merzomyia westermanni (Tephriridae) Nationally Scarce
Microdynerus europaea (Hymenoptera: Melittidae) Nationally Scarce
Mydaea anicula (Diptera: Muscidae) Nationally Scarce
Myolepta dubia (Diptera: Syrphidae). Nationally Scarce
Myopa pellucida (Diptera: Conopidae) Nationally Rare RDB3
Nomada ferruginatus (Hymenoptera: Apidae) Nationally Endangered RDB1, Section 41
Nomada fucata (Hymenoptera: Apidae) Nationally Scarce
Nomada lathburiana (Hymenoptera: Apidae) Nationally Rare RDB3
Osmia bicolor (Hymenoptera: Megachilidae). Nationally Scarce
Parasetigena silvestris (Diptera: Tachinidae) Data Deficient
Pocota personata (Diptera: Syrphidae). Nationally Scarce
Priocnemis hyalinata (Hymenoptera: Apidae) Nationally Scarce
Sarcophaga albiceps (Diptera: Sarcophagidae) Nationally Scarce
Sarcophaga subulata (Diptera: Sarcophagidae) Nationally Scarce
Satyrium w-album (Lepidoptera: Lycaenidae) Section 41
Sphecodes crassus (Hymenoptera: Halictidae) Nationally Scarce
Sphecodes niger (Hymenoptera: Halictidae) Nationally Rare (RDB3)
Sphecodes rubicundus (Hymenoptera: Halictidae) Nationally Scarce
Subclytia rotundiventris (Diptera: Tachinidae) Near Threatened
Thecla betulae (Lepidoptera: Lycaenidae) Section 41
Thecocarcelia acutangulata (Diptera: Tachinidae) Data Deficient
Thecophora fulvipes (Diptera: Conopidae) Nationally Scarce
Tiphia minuta (Hymenoptera: Tiphiidae) Nationally Scarce
Villa cingulata (Diptera: Bombyliidae) Nationally Rare
Xylota xanthocnema (Diptera: Syrphidae) Least Concern/Nationally Scarce

A number of these species require downgrading because the species are now known to be too frequent either because of improved recording or because they have genuinely increased over the past few decades. Those unlikely to merit any status based on current data include *Andrena trimmerana*, *Bombus rupestris*, *Dolichovespula media*, *D. saxonica*, *Hebecnema fumosa*, *Lasioglossum pauxillum*, *L. malachurum*, *Merzomyia westermanni*, *Nomada fucata*, *N. lathburiana*, *Osmia bicolor*, *Sphecodes crassus* and *Tiphia minuta*. Two further scarce species that lack

current rarity grades because they were added to the British list relatively recently are the nomad bee *Nomada facilis* and the hunting wasp *Crossocerus congener*. The former is not a recent colonist but had been overlooked within the very similar taxa *N. integra* (Notton & Norman, 2017). The latter is a tiny wasp first discovered in 1999 (Early & Uffen, 2008). It may be a recent colonist. Species accounts for all the scarcer species are provided in Appendix 1.

3.3 Active surveying versus pan-trapping

Active surveying produced a list of 642 taxa versus 333 taxa obtained from pan-trapping (see Table 1). Flesh-flies (Sarcophagidae), woodlouse-flies (Rhinophoridae) and spider wasps (Pompilidae) were the only groups for which a longer species list came from pan-trapping. The performance of pan traps relative to active surveying tended to be best in early/mid spring and autumn (e.g. 25 March 2017, 2 April 2017, 15 October, 2017, 15 April 2019, 21 September 2019, 25 March 2020, 8 April 2020, 14 September 2020 and 14 September 2020). Performance of pan traps in relation to active sampling during summer was highly variable. On some late spring and summer survey days it could be considerably poorer and producing very small samples when much activity was detected by active recording (e.g. 26 May 2017, 27 August 2017, 6 July 2019)

Table 1. A comparison of species lists generated by active surveying and pan-trapping.

Groups	**Active surveying**	**Pan-trapping**	**Total spp**
All Groups	642	333	679
Orders			
Coleoptera	24	8	24
Diptera	393	198	417
Hymenoptera	188	109	200
Key groups			
Anthomyiidae	33	20	36
Calliphoridae	20	17	21
Conopidae	7	4	7
Empididae	21	8	22
Muscidae	58	25	61
Rhinophoridae	3	5	5
Sarcophagidae	21	22	23
Stratiomyidae	7	5	9
Syrphidae	111	48	114
Tachinidae	58	26	63
Bees	91	66	94
Crabronidae	28	8	30
Pompilidae	5	10	11
Vespidae	8	13	13
Butterflies	30	15	30

3.4 Comparison of compartments

Detailed analysis of data relating to this will be carried out separately to this report. Given that the various recording compartments were not subject to identical levels of active sampling, plus the compartments vary greatly in size, only informal anecdotal results can be reported from the data at this stage.

The data shows that in early and mid-spring, the most productive areas tend to be those where spring blossoming shrubs (e.g. Blackthorn, Wild Cherry, Cherry Laurel, Goat Willow and Grey Willow) and early-blossoming flowers (e.g. Primrose, Lesser Celandine, Bluebell and Dandelion) are present. This includes parts of Wytham Great Wood, Radbrook Common and Marley Wood. By May, the canopy starts to shade out the woodland herb layer and activity becomes concentrated in sheltered, sunny areas supporting plentiful Hawthorn, Cow Parsley, buttercups, Ground-ivy, Bugle and Wood Spurge. Radbrook Common can be especially productive during this period. Overall, woodland areas, especially Marley Wood and Radbrook Common, tend to be the most productive part of the site in spring.

By June, woodland pollinator activity is heavily concentrated on flowers such as Bramble, Hogweed and Bush Vetch and the more shaded woodland supports relatively little pollinator activity. At this point, the calcareous grassland areas of Upper Seeds, Rough Common and the Dell start to become more flowery and productive, especially where they support plentiful umbellifers (e.g. Hogweed, Wild Parsnip, Upright Hedge-parsley), Asteraceae (e.g. ragworts, thistles, hawksbeards, Catsear, knapweeds, Yarrow), lamiates (e.g. Wild Basil, Marjoram, Wild Thyme), legumes (e.g. clovers, Common Bird's-foot Clover, vetches), Red Bartsia, Field Scabious and St John's-worts. From June to August, these calcareous grassland areas are probably the most productive parts of the site. Wild Angelica, particularly within Marley Wood and Radbrook Common, can boost the productivity of woodland in late summer when the Hogweed and Wild Parsnip of the grasslands are past their peak. Once the Angelica is past its peak, much activity is concentrated on the late August and September show of Hoary Ragwort, Yarrow and Smooth Hawksbeard. The arable plot can be particularly productive at this time. Areas of grassland and woodland rides that have been subject to early-mid summer cuts can produce delayed blooms of Hogweed and Creeping Thistle in August and September that can attract large numbers of pollinators but was only observed in certain years.

3.5 Flowers at Wytham Woods visited by insects

Flower-visiting data was obtained for about 130 plant species plus some further aggregate taxa (see Excel spreadsheet, worksheet 1). Detailed analysis will be carried out separately to this report. However, the data obtained clearly shows that:

- Some flower species attract a far greater variety of insect species than others, notable Cow Parsley, Hogweed, Wild Parsnip, Wild Angelica, Bramble, Smooth Hawksbeard, Creeping Thistle, Yarrow and Hoary Ragwort;
- Some flowers can be especially attractive to certain types of insects, including legumes such as clovers and vetches to bees, Figwort to social wasps, and Ground-Ivy to bumblebees and *Bombylius* beeflies;

- Plant species vary in their flowering peaks and flowering durations – creating a flowering sequence that dictates what flowers are visited by specific pollinators at different points of the year;
- The foraging period for pollinators at Wytham is primarily March to October but can vary according to weather conditions.

The data provided in the spreadsheet will allow the precise number of species recorded for each flower type to be ascertained but will be analysed in detail separately to this report.

3.6 Rate of species list growth

The four years of surveying did not experience identical levels of recording effort. Nevertheless, the data produced (summarised in Table 2) could be used to predict the potential total size of the current assemblages of certain key groups.

Table 2. Annual growth of the cumulative species list over the period 2017-20 in aggregate and broken down into three key pollinator groups.

Year	Overall	Hoverflies	Bees	Butterflies	Cum' days
2017	412	83	62	19	10
2018	503	97	76	26	18
2019	563	106	85	27	24
2020	678	114	94	30	37

Some of the scarcer pollinators recorded at Wytham Woods 2017-2020: Bombus ruderatus (top left), Nomada ferruginata (top right), Andrena hattorfiana (middle left), Meligramma euchroma (middle right), Myopa pellucida (bottom left) and Villa cingulata (bottom right).

4. DISCUSSION

4.1 Site quality

The Wytham Woods complex is clearly an important location for pollinators with a good variety of species including some very scarce ones. The data obtained supports its SSSI status. It is clearly one of the most important locations for pollinators in Oxfordshire and seems to hold particularly valuable assemblages of bees, hoverflies (especially those associated with water-filled rot holes of mature trees), sarcophagid flies (fleshflies), tachinid flies and possibly sawflies. The rate at which species have been added to the list over the four-year survey period suggests that much has yet to be discovered, and the list still lacks certain species that ought to be present, even if just as non-breeding visitors, such as *Colletes hederae* (the Ivy Bee) and *Volucella zonaria* (the Hornet Hoverfly).

4.2 Comparison with nearby areas

No detailed appraisal of other Oxfordshire and Berkshire woods has been carried out by the author. However, in 2018 the author carried out a detailed entomological survey of several sites along the Hinksey Stream between North Hinksey and South Hinksey, and also at Iffley Meadows beside the River Thames (Wilson, 2019). These sites are located between 2 and 5 km from the SE edge of Wytham Woods. Whilst these failed to produce some of the records of woodland-loving pollinators recorded at Wytham Woods, they produced records of various additional grassland and wetland pollinators and no doubt benefit from a lower-lying location, plus the presence of some nice wetlands and flowery floodplain grassland. The lower altitude and flatter nature of the Thames floodplain also result in mean temperatures that are higher and mean windspeeds that are lower than at Wytham Woods. Extra hoverflies recorded here include *Heringia senilis* and *Platycheirus occultus*, and the bees *Hylaeus cornutus*, *Hylaeus hyalinatus* and *Lasioglossum smeathmanellum*.

The recent publication of *Shotover – The Life of an Oxfordshire Hill* (Wright & Wright, 2018) allows some comparison with another well-recorded woodland complex about 9 km away on the east edge of Oxford. This site has much sandier soils and once supported extensive open heathland. Its list of bees includes several heathland-loving species that would be unlikely to occur at Wytham, including *Andrena humilis*, *Colletes succinctus*, *Epeolus cruciger* and *Nomada integra*. The hoverfly list for Shotover stands at 136 species (compared with the 113 for Wytham) though 24 of these have not been since 1939 which suggests that the current assemblages are of a broadly similar size.

The assorted sites of the Cothill area (Dry Sandford Pit, Cothill Fen/Parsonage Moor, Upwood Quarry) about 7 km south of Wytham Woods support many further species not recorded at Wytham but also lack some of those found at Wytham. Three scarce wetland-associated soldierflies present at Cothill Fen/Parsonage Moor (*Stratiomys chamaeleon*, *Odontomyia argentata* and *O. angulata*) were searched for in the wetland area of Marley Wood on several occasions without success. It may be that this wetland is too small and isolated or lacks specific conditions necessary for the

presence of these flies. Tubney Wood which is located close to these was a very well recorded site historically and may support some of the scarcer woodland species recorded at Wytham Woods, but no modern data has been seen.

Closer to home, the superb show of blossoming ivy growing on the walls of the White Hart pub and All Saints Church just outside the entrance gate to Wytham Woods, readily produced records of the Ivy Bee and a scarce ivy-associated conopid fly (*Leopoldius signatus*) as the author was departing Wytham Woods on 14 September 2020. There is not a great deal of accessible Ivy within the Wytham Woods complex (what is present tends to be flowering high up in trees) but it is likely that both these species stray into the Wytham Woods complex undetected.

4.3 Seasonal change at Wytham Woods

As noted within section 3.4, the productivity of the site for pollinators, and the relative productivity of the different site compartments, vary somewhat through the year. In early spring, much activity is associated with spring-blossoming Blackthorn, Wild Cherry, Cherry Laurel and willows as few other flowers are out other than the local presence of Lesser Celandine, Ground-ivy, violets and Primrose. By the end of May, the woodland canopy is closing over, and more activity is associated within sunny woodland rides and edge, especially where Hawthorn, Cow Parsley, Bugle, buttercups, Bluebell and Bramble are present. Cowslip and Ground-ivy can add some interest to the grassland areas, but these areas really start to come to life from late June as Wild Parsnip, Woolly Thistle, ragworts and knapweeds start to bloom. The flowering of Bramble and Hogweed can attract much interest in the sunny parts of woodland rides and clearings throughout summer, and Wild Angelica is especially important in late summer.

By late August, most flowers are going over. However, Rough Common, Upper Seeds and the grassland of the Dell area can produce good late summer shows of Yarrow, Hoary Ragwort, Field Scabious, Red Bartsia and Harebell. Any summer mowing or Bracken-bashing of Rough Common has the effect of bringing about some delayed flowering of Wild Angelica, Hogweed and Wild Parsnip which can attract impressive numbers of pollinators on warm, sunny day in September. By October, few flowers are present other than limited amounts of flowering Ivy (which is not very common in the woods), some Smooth Hawksbeard (notably in the small arable plot) plus the occasional dandelion, White Dead-nettle flower and the odd delayed spill-over of a summer flower.

What becomes clear, is that it is the sum of all its parts, and the waxing and waning of different blossoms, flowers and compartments across the Wytham Woods complex that helps to sustain a high diversity of pollinators – many of which have complex lifecycles that involve multiple habitat features and long foraging periods.

4.4 Evidence of historic change

The review of historic ‘Wytham’ (in the loose sense) bee records by Watkins (2018) provides some indication of species that may have disappeared from Wytham Woods or might still be there at low levels, though it covers a much larger area than

was covered by this survey. It includes records for specimens at Oxford University Museum labelled 'Wytham' (many of which may come from a wide area around the village) and the Hill End Centre (SP465065). The data gathered does not demonstrate a substantial loss of bee diversity through time, though *Bombus ruderarius* was recorded from 'The Ridge' (SP4608) in 1948 and *Lasioglossom smeathmanellum* was recorded from Rough Common in 1977. Perhaps of greater interest is the evidence for bees that have probably recently colonised Wytham Woods in recent decades. *Lasioglossum malachurum*. *L. pauxillum*, *L. puncticolle*, *Nomada fucata* and *Sphecodes niger* are bees that were formerly considered scarce southern species but have shown substantial northward expansions over recent decades probably in response to climate change (BWARS data). There is a good chance that none of these existed at Wytham prior to that. Several other species are recent British colonists that have spread rapidly from southern colonisation/introduction points. This includes *Bombus hypnorum* (the Tree Bumblebee) which has colonised most of mainland Britain over the past 20 years, and the nomad bee *Nomada zonata* which first discovered in Britain from Kent in 2016 and seems to have arrived at Wytham Woods during 2019, which fits in neatly to the recorded expansion in southern Britain as a whole. *Andrena hattorfiana* may also have colonised Wytham Woods at about the same time. It has a much longer history in the Oxfordshire, Berkshire and Buckinghamshire area but is clearly increasing within this region and is turning up at scabious-rich sites where it had never been seen before. As Britain's largest mining bee (somewhat larger than a honey bee), it is not an easy bee to overlook.

On the wasp front, relatively recent colonists at Wytham are likely to include *Auplopus carbonarius*, *Crossocerus congener*, *C. distinguendus*, *Dolichovespula media*, *D. saxonica*, *Gorytes laticinctus* and *Microdynerus exilis*. These are species exhibiting a well-documented northward expansion and several are recent British colonists added to the British list since 1980. The Essex Skipper *Thymelicus lineola* butterfly also falls into this category.

No collation of Wytham fly records equivalent to Watkins (2018) has taken place though no doubt much historic information occurs in literature, informal reports, the Thames Valley Environmental Records Centre (TVERC) and museum collections. The colonisation of Wytham by expanding southern species is again apparent, particularly within the family Tachinidae (*Cistogaster globosa*, *Linnaemyia picta*, *Phasia barbifrons*). Flies as a whole are less thermophilic than bees and solitary wasps. Hotter, drier summers can be particularly deleterious to those that need humid woodland conditions or wetlands. Some woodland hoverflies that might have been anticipated to occur at Wytham such as *Dasysyrphus pinastri*, *Meligramma trianguliferum*, *Parasyrphus lineola* and *P. vittiger* could not be found. Is this symptomatic of climate change-driven loss from the Wytham area – or is simply a result of insufficient recording?

What is clear is that Wytham, like so many other well-recorded sites in southern and central Britain, has a changing assemblage of pollinators with new species arriving. The data to hand makes it difficult to assess whether arrivals match losses and whether climate change and other drivers are leading to a long-term loss of

pollinator diversity; but for the time being, Wytham Woods remains a very rich and interesting location.

4.5 Important features for larval development

The adult and larval requirements of pollinators are typically drastically different. Whilst adults are often highly mobile and can move around a site (or landscape) as the flowers and blossoms they require wax and wane, larvae may have highly specific needs that occur in fixed locations. For some restricted species, those breeding habitats may be scarce or absent in the surrounding countryside e.g. collections of old Beech trees or decent patches of good limestone grassland making Wytham Woods especially important for sustaining local pollinator diversity. It is important to recognise the large array of larval development locations used by Wytham Woods pollinators so that these can be conserved. Some of the more important ones are summarised here:

- Dung - for the larvae of assorted anthomyiids (e.g. *Hylemya*, *Pegoplata* and *Lasiomma* species), muscids (e.g. *Musca autumnalis*, *Mesembrina meridiana, Eudasyphora*, *Neomyia* and *Polietes* species), *Scathophaga* dungflies and hoverflies such as *Rhingia* species. Some of these species have strong preferences, e.g. for badger dung or sheep dung;
- Dead wood and old trees – for the larvae of hoverflies such as *Xylota*, *Criorhina*, *Ferdinandea*, *Brachyopa*, *Brachypalpoides*, *Chalcosyrphus*, *Sphegina*, *Myolepta*, *Pocota* and *Mallota* species plus *Volucella inflata*; also *Pyrochroa* cardinal beetles and various longhorn beetles. Some of these insects have very specific 'saproxylic' needs such as sappy wounds, soggy heart-rot, or water-filled rot holes. The ageing of a tree is a complicated process that can generate assorted microhabitats over time, including wood-associated fungi. Dead wood in sunny locations with cavities and beetle holes can also be used as nesting sites for aerial-nesting bees such as *Osmia*, *Megachile* and *Chelostoma* species; also, aerial-nesting wasps such as *Ectemnius*, *Ancistrocerus*, *Crossocerus* and *Pemphredon* species (and the assorted cleptoparasites and inquilines associated with these such as chrysidid wasps and certain sarcophagid and anthomyiid flies). A review of pollinators associated with dead wood and old trees has recently been compiled by the author (Falk, 2021);
- Wet ground and shallow water - for the larvae of hoverflies such as *Eristalis*, *Helophilus*, Parhelophilus, *Orthonevra* and *Chrysogaster* species and some muscid flies such as *Graphomya* species;
- The nests of ground-nesting bees of wasps - for assorted cleptoparasites, parasitoids and inquilines such as cuckoo bees of the genera *Nomada* and *Sphecodes*, *Bombylius* beeflies and anthomyiids of the genera *Leucophora*. Such nests tend to be located in bare or sparsely vegetated dry ground fully exposed to the sun;
- Specific foodplants - for pollinators with phytophagous larvae such as butterflies and moths, sawflies, *Cheilosia* hoverflies, and certain anthomyiids of the genera *Pegomya, Botanophila* and *Delia*;

Some of the dung-associated flies that are common at Wytham Woods: Neomyia viridescens (top left), Musca autumnalis (top right), Rhingia campestris (bottom left) and Hylemya nigrimana (bottom right).

- Carrion - for *Lucilia* greenbottles, *Calliphora* bluebottles, certain muscid flies and some Sarcophaga fleshflies;
- Snails - for several sarcophagid flies and blowflies of the genera *Melinda* and *Eurychaeta*; also empty snail shells as a nesting habitat for the mason bee *Osmia bicolor*;
- Earthworms - for *Pollenia* and *Bellardia* blowflies and certain *Sarcophaga* fleshflies;
- Grasshoppers – for the sarcophagid fly *Blaesoxipha plumicornis* and possibly the Locust Fly *Stomorhina lunata*;
- Woodlice - for rhinophorid flies;
- Caterpillars, bugs, fly larvae and certain beetles - for tachinid flies and many parasitic wasps;
- Bumblebee and social wasp nests - for *Volucella* hoverflies, the sarcophagid *Brachicoma devia*, some *Fannia* species and muscid flies such as *Muscina* species;
- Mammal homes - rodent nests and burrows for bumblebee nesting, badger setts and fox earths for some muscid flies such as *Hydrotaea cyrtoneurina*

- Bird nests - for the blowfly *Protocalliphora azurea*, some *Fannia* species and anthomyiids such as *Anthomyia* species;
- Fungi – for various muscid and anthomyiid flies, and hoverflies such as *Cheilosia scutellata* and *C. soror*.

4.6 Active surveying versus pan-trapping

As stated earlier, this study has provided a valuable opportunity to compare active surveying by an experienced entomologist with a standardised pan-trapping protocol designed to be carried out on the same day for a similar period of time. On the face of it, expert surveying produces longer species lists than pan-trapping as carried out here, though the pan-trapping produced records of 36 species missed by the active surveying (including 3 hoverflies and 3 bees) and showed that some species considered uncommon using active surveying were actually quite frequent e.g. the soldierfly *Sargus iridatus*. Clearly, both approaches have their merits. Active surveying allows more detailed scrutiny of a site, allows flower visits (and other activities) to be logged, and can be adjusted to capitalise on short-term microclimates and flowering peaks (e.g. a nice stand of Hogweed, Wild Parsnip or Blackthorn that happens to be in a warm, breeze-free part of the site for part of a day and pulling in lots of pollinators). Pan traps provide a better basis for replicable, standardised, long-term monitoring and can be installed and collected by non-experts. As noted in 3.3, on certain cool and breezy spring days, the pan traps could sometimes produce lists on par with active recording. However, on certain summer days with good weather and plenty of observed pollinator activity, the pan traps produced very poor samples compared with active surveying. This may be because they were unable to compete with the abundance and attractiveness of flowers.

The survey therefore shows the value of using both approaches and the drawbacks of only using pan-trapping, which is relatively poor at generating lists of hoverflies, butterflies and various other flower-visiting insects.

4.7 Future monitoring and citizen science opportunities

This survey hopefully sees the start of standardised, long-term monitoring of pollinators at Wytham Woods, even if just repeated every few years. Unfortunately, undertaking broad-spectrum pollinator surveying/monitoring that is thorough and accurate requires a good understanding of sampling techniques and also good identification skills. As such it is difficult to modify for citizen science. However some more narrowly-scoped activities may be more suited to citizen science, especially if the activity is mentored and subject to appropriate verification e.g. checking of photographs by an expert.

The main opportunities for involving citizen science in pollinator monitoring include:

- Butterfly transects - linked to Butterfly Conservation;
- Moth recording - also linked to Butterfly Conservation;
- Bumblebee '[BeeWalks](#)' - linked to Bumblebee Conservation Trust;
- Participating in CEH'S [UK Pollinator Monitoring Scheme (PoMS)](#).

Four scarce hoverflies associated with aerial rot holes of mature broadleaved trees at Wytham Woods: Pocota personata (top left), Mallota cimbiciformis (top right), Myolepta dubia (bottom left) and Xylota xanthocnema (bottom right).

It would be worthwhile collaborating with organisations such as Dipterists Forum, BWARS and the Thames Valley Environmental Records Centre (TVERC) to host field days and bespoke 'bioblitzes' that focus on pollinators. Bespoke 'bioblitzes' of this sort, where experienced amateur entomologists are involved, have the potential to substantially expand the current list of pollinator species.There is already a strong tradition at Wytham Woods of hosting research from assorted university departments at Oxford plus other universities and organisations such as the UK Centre for Ecology and Hydrology. It would be great to see more MSc and PhD projects focussed on the pollinators of Wytham, especially if these can use further survey/monitoring techniques such as malaise traps, emergence traps and artificial rot holes.

4.8 Management recommendations

It is not within the remit of this report to produce detailed management prescriptions, but some broad-brush recommendations are provided here:

Calcareous grasslands

Ensure that these remain both '*floristically diverse'* (i.e. plenty of plant species representing different plant families) and '*flowery*' (with an abundance of flowers

irrespective of species) between June and September. As a generalisation, avoid grazing or cutting during this period if possible. The caveat here is that Bracken needs to be controlled at Rough Common, and some areas are cut for experimental or access reasons. Providing this only affects a small proportion of the grassland it will actually help diversify grassland conditions and can produce some delayed flowering of key species such as Hogweed, Wild Parsnip, Smooth Hawksbeard and Creeping Thistle to provide more flowers in September than would occur naturally. There is real value in having structural diversity and plant community diversity within the calcareous grassland, so this report is not advocating uniform management of all the grassland.

Woodland areas

Some broad rides are present, but many others would benefit from widening and scalloping to create more sunny woodland edge, and increase the floweriness of the rides. Encourage flowers such as Bramble, Cow Parsley, Hogweed, Wild Angelica and Bush Vetch within rides and avoid mowing rides between May and August. Maintain flowery and blossom-rich clearings, and produce more where possible, perhaps especially within Wytham Great Wood, which is somewhat less productive for pollinators than Marley Wood or Radbrook Common. The relatively new pond in Radbrook Common provides a superb model of what can be done to diversify woodland and increase local floweriness. Consider introducing more coppicing to woodland areas, also consider planting more blossoming trees and shrubs along rides, ride intersections and along woodland margins (see next).

Strengthen spring blossom sequences

Whilst Hawthorn is quite widespread other spring-blossoming trees and shrubs such as Goat Willow, Grey Willow, Blackthorn, Wild Cherry and Field Maple are very patchily distributed. They can provide a vital forage resource in spring before the Hawthorn blossoms. There seems to be much scope for introducing these to new parts of the site, especially in conjunction with any ride widening. This could include introducing Goat Willow, Blackthorn and Wild Cherry to the southern edge of Radbrook Common and bolstering their presence in the Rough Common area. Given that warm conditions are increasingly starting in late winter, it would also be worth considering the planting of Cherry Plum in some less sensitive locations such as around the wood yard and car park, around the chalet and along fence lines of the Lower Seeds area. This would guarantee some blossom in late February and early March before the Goat Willow and Blackthorn blossom. Essentially, try to create a strong, multi-species blossom sequence over as much of the site as possible, one that extends from early spring to early June (finishing with Dogweed and Elder).

Promote dead wood and old trees

Whilst no ancient trees are present, there is an important concentration of mature and sub-veteran broadleaved trees such as Beech, Sycamore, Oak and Common Lime. Sadly, the very old Hornbeam close to the Gibson gate blew down in 2020. Every effort should be made to protect these old trees and to encourage replacement of them as they eventually die. Where old trees fall, try to retain them in situ if not blocking access routes. The dead wood of old trees is typically much

Some of the more abundant flower-visiting beetles at Wytham Woods: the Red-headed Cardinal Beetle Pyrochroa serraticornis (top left), the longhorn beetle Rutpela maculata (top right), the Thick-thighed Flower Beetle Oedemera nobilis (bottom left) and the Common Malachite Beetle Malachius bipustulatus (bottom right).

more interesting than that of younger trees and can be expected to support some scarcer saproxylic species. Diversify the dead wood resource – encourage some in the sun, some in the shade, dead wood of different trees species, and dead wood of different ages (therefore at different stages of the decay process).

Encourage some bare ground, slopes and clifflets

These features, when in dry sunny locations, can be really important for ground-nesting bees, wasps and their associated cuckoos and parasites (many of which are also flower-visitors). But there is not a lot of this habitat at Wytham other than along some stretches of vehicle track and the odd pit or slope. Can more be created by shallow excavation or banking of some less sensitive areas?

4.9 Species to target in future surveys

In the spirit of wishing to extent the species lists as much as possible to outdo all other Oxfordshire and Berkshire sites, here are some hoverflies and bees that have a reasonable chance of turning up at Wytham Woods if active surveying and trapping continues:

Hoverflies

Anasimyia lineata (swampy ponds)
Brachyopa bicolor (old trees with sap-runs)
Brachyopa insensilis (old trees with sap-runs)
Brachyopa pilosa (freshly fallen wood of trees such as poplars, Aspen and Beech)
Callicera aurata (mature trees wth rot-holes)
Cheilosia albipila (areas with Marsh Thistle)
Cheilosia antiqua (associated with Primrose)
Cheilosia chrysocoma (Angelica-rich areas)
Cheilosia fraterna (areas with Marsh Thistle)
Cheilosia griseiventris (areas with hawksbeards or hawkweeds)
Cheilosia grossa (areas with Spear Thistle)
Cheilosia psilophthalma (areas with Mouse-ear Hawkweed)
Dasysyrphus pinastri (coniferous woodland)
Epistrophe diaphana (umbelifer-rich grassland)
Ferdinandena ruficornis (old trees with sap-runs)
Heringia heringii (areas with elm regrowth)
Heringia pubescens (coniferous/mixed woodland)
Heringia senilis (associated with poplars)
Melangyna quadrimaculata (coniferous woodland)
Meligramma trianguliferum (broadleaved woodland
Orthonevra brevicornis (wet woodland)
Parasyrphus lineola (coniferous woodland)
Parasyrphus vittiger (coniferous woodland)
Parhelophilus versicolor (swampy ponds)
Pipiza austriaca (associated with scrubby grasslands)
Pipiza luteitarsis (associated with elm regrowth)
Platycheirus ambiguus (associated with Blackthorn)
Platycheirus discimanus (associated with old broadleaved woodland)
Platycheirus fulviventris (associated with swampy wetlands)
Platycheirus granditarsus (associated with swampy wetlands)
Platycheirus splendidus
Psilota anthracina (associated with old trees)
Riponnensia splendens
Scaeva selenitica (coniferous woodland)
Sericomyia silentis (wet woodland)
Sphaerophoria virgata (woodland rides and clearings)
Sphegina elegans (wet woodland)
Sphegina verecunda (wet woodland)
Xanthandrus comtus (a migratory species)
Xanthogramma citrofasciatum (scrubby grassland with ant hills)
Volucella zonaria (social wasp nests)

Bear in mind that the hoverfly list grew by 7 species in the final year of surveying (2020). It is very likely that Wytham Woods is supporting over 130 species.

Bees

Andrena florea (forages on White Bryony - recently added to the Oxfordshire list and expanding in SE England)
Andrena fucata (an undated record occurs just north of the wood)
Andrena denticula (likes ragworts)
Andrena labiata (likes Germander Speedwell)
Andrena synadelpha (likes sping blossoms such as Hawthorn)
Andrena varians (likes Blackthorn)
Anthidium manicatum (likely to be present in Wytham village)
Bombus ruderarius (last recorded 1953)
Coelioxys inermis (the cuckoo of *Megachile centuncularis* - likely to be present in Wytham village)
Colletes daviesanus (recorded at Hill End in 2006)
Colletes hederae (established in Wytham village just outside the reserve)
Heriades truncorum (likely to be present in Wytham village)
Hylaeus cornutus (umbellifer-rich grassland)
Hylaeus hyalinatus (frequent in the region)
Lasioglossum laevigatum (occasional in the region, likes calcareous grassland)
Lasioglossum minutissimum (recorded at Hill End in 2006)
Lasioglossum parvulum (recorded at Hill End in 2004)
Lasioglossum smeathmanellum (last recorded 1977)
Lasioglossum xanthopum (occasional in the region, likes calcareous grassland)
Megachile centuncularis (likely to be present in Wytham village)
Melecta albifrons (the cuckoo of *Anthophora plumipes* and likely to be present in Wytham village)
Melitta tricincta (forages on Red Bartsia)
Nomada flavopicta (the cuckoo of *Melitta* species, two of which occur here)
Nomada guttulata (the cuckoo of *Andrena labiata* and espanding within southern Britain)
Nomada hirtipes (the cuckoo of *Andrena bucephala*)
Nomada sheppardana
Nomada striata (the cuckoo of *Andrena wilkella*)
Osmia spinulosa (a bee of composite-rich calcarous grasslands, common at Dry Sandford Pit just a few miiles away)
Sphecodes ferruginatus (recorded at Hill End in 2004)
Stelis ornatula (the cuckoo of *Anthidium manicatum* - likely to be present in Wytham village)

The bee list grew by 9 species in 2020 and it is likely that Wytham Woods is supporting about 120 species.

Some of the flower-visiting sawflies recorded: Athalia rosae (top left), Cephus pygmea (top right), Rhogogaster chlorosoma (bottom left) and Arge cyanocrocea (bottom right).

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Appendix 1 – Accounts for the scarcer species

Andrena apicata (Hymenoptera: Andrenidae) graded Nationally Scarce (Falk, 1991a). A widespread but localised, Honey Bee-sized mining bee that flies in early spring and gathers pollen exclusively from sallows/willows. One found nesting along a footpath within a ride of Radbrook Common in 2018.

Andrena bucephala (Hymenoptera: Andrenidae) graded Nationally Scarce (Falk, 1991a). A widespread but localised, mainly southern mining bee that nests communally with numerous females sharing a common nest entrance (though it is not social). It occurs in a variety of habitats but especially scrubby grassland slopes with False-brome and rabbit activity. It forages heavily from Hawthorn and Field Maple. Recorded in small numbers from several areas. Efforts were made to locate its special cuckoo bee *Nomada hirtipes* without success though there is a good chance it will turn up if recording is continued as it tends to be present at a fairly high proportion of *bucephala* sites.

Andrena fulvago (Hymenoptera: Andrenidae) graded Nationally Scarce (Falk, 1991a). A widespread but localised, mainly southern mining bee associated with dry grasslands supporting plentiful 'hawkish' Asteraceae such as hawkbeards and hawkbits. It nests in small aggregations in short-cropped or sparsely-vegetated dry ground. One male recorded from pan trap site 11 near Rough Common and some females seen at Upper Seeds in 2020. One female of Its' very rare nomad bee, *Nomada facilis* (only recently added to the British list) was recorded in Rough Common on 2 June 2019.

Andrena hattorfiana (Hymenoptera: Andrenidae) graded Nationally Rare (RDB3) (Falk, 1991a). A large mining bee of calcareous grasslands that only obtains pollen from scabiouses, particularly Field Scabious. Recorded in Upper Seeds on two dates in 2020 but searched for unsuccessfully 2017-2019, so this might represent a colonisation event. It has been expanding recently within Oxfordshire, Berkshire and the West Chilterns.

Andrena trimmerana (Hymenoptera: Andrenidae) graded Nationally Scarce (Falk, 1991a). A southern-biased bee that has shown a substantial increase within central England over recent years and would not require a rarity status now. It has two generation a year, the spring one mostly foraging on Blackthorn and willow species and the summer one using Bramble and umbellifers. Nesting occurs in unshaded, bare or sparsely-vegetated ground e.g. footpaths. One recorded from pan trap 10 in 2019.

Auplopus carbonarius (Hymenoptera: Pompilidae) graded Nationally Scarce (Falk, 1991a). A widespread but localised (or perhaps elusive) spider-hunting wasp that has been recorded north to the Midlands. It occurs in a variety of habitats (even urban locations) and nests in assorted natural and artificial cavities within which it creates clay cells. These are stocked with paralysed spiders, especially clubionids. Adults

have been recorded visiting spurge flowers. Recorded from pan trap 4 in 2017 and the wood yard in 2018.

Blaesoxipha plumicornis (Diptera: Sarcophagidae) graded Nationally Scarce (Falk & Pont, 2017). A localised but increasing species of dry open habitats as far north as the Midlands. The larvae develop as internal parasitoids of grasshoppers. Adults fly from June to September and will visit the flowers of umbellifers and Wood Spurge. Very common in the assorted grassland areas here.

Bombus humilis (Hymenoptera: Apidae) - the Brown-banded Carder Bee listed as Section 41 (2006 NERC Act). A formerly widespread bumblebee that declined dramatically in the last century but seems to be making a slow recovery in many areas. It prefers large expanses of dry, flower-rich grassland, dunes or brownfield sites and forages on many types of flowers including various Fabaceae and Lamiaceae. Nesting occurs at ground level amongst low vegetation. One queen recorded in the small arable plot in 2018 but no males or workers seen suggesting it is not established at the site (though a population might be present somewhere nearby).

Bombus ruderatus (Hymenoptera: Apidae) - the Large Garden or Ruderal Bumblebee, graded Nationally Scarce (Falk, 1991a) and listed in Section 41 (2006 NERC Act). A large, long-tongued bumblebee that declined dramatically in the last century but is now showing a recovery in many areas, though it is still rather scarce in most counties and absent in northern Britain. Spring queens like to forage on flowers such as White Dead-nettle and Ground-ivy. Workers forage heavily on Red Clover but will use other lamiates and legumes plus knapweeds. Males are fond of large-flowered thistles e.g. Spear Thistles. One queen was recorded near Sunday's Hill (SP 46202 07124) in 2017 and workers have been recorded in a number of locations since.

Bombus rupestris (Hymenoptera: Apidae) graded Nationally Scarce (Falk, 1991a). The social parasite of *Bombus lapidarius*. Formerly a scarce southern species but much increased in recent decades and no longer warranting a rarity status. Both sexes like to feed on thistles, knapweeds and ragworts but spring females will also use dandelions and Bugle. Fairly common here.

Cadurciella tritaeniata (Diptera: Tachinidae) graded Least Concern/Nationally Scarce in Falk, Pont & Chandler (2005). A widespread but localised fly with larvae that are parasitoids of the larvae of the Green Hairstreak butterfly *Callophrys rubi*. Adults ikely to visit umbellifer flowers. Recorded in Upper Seeds in 2018 and 2020.

Cheilosia barbata (Diptera: Syrphidae) graded Nationally Scarce (Ball & Morris, 2014). A localised hoverfly of calcareous grasslands north to the Midlands. The larvae probably develop in the stems or roots of Wild Parsnip. Adults visit umbellifer flowers such as Parsnip or Hogweed, usually in May and June. Quite common in various areas during in 2017 but only seen once since.

Cistogaster globosa (Diptera:Tachinidae) graded Least Concern/Near Threatened in Falk, Pont & Chandler (2005). This distinctive parasitoid fly has shown a dramatic increase within southern England over recent years, probably in response to the spread of its host, the Bishop's Mitre Bug *Aelia acuminata*, which in turn seems to reflect climate change. Adults visit the flowers of umbellifers and Yarrow. Quite common in various open areas during 2019 and 2020.

Ctenophora pectinicornis (Diptera: Tipulidae) graded Nationally Scarce (Falk, 1991b). Associated with old broadleaved trees with heart rot and other types of decay in old wood, old parkland etc. Adults will occasionally visit flowers such as Hawthorn. One recorded in the Dell in 2020.

Cyrtophlebia ruricola (Diptera:Tachinidae) graded Data Deficient in Falk, Pont & Chandler (2005). Scattered records in southern England and SE Wales. The larvae are parasitoids of the caterpillars of various noctuid moths and occasionally geometrid moths. Adults are likely to visit umbellifer flowers. Two recorded in the arable plot in 2020.

Didineis lunicornis (Hymenoptera: Crabronidae) graded Nationally Scarce (Falk, 1991a). A small black and red wasp associated with sparsely-vegetated, clay-rich soils that develop desiccation cracks during summer. The nest burrows are made within these cracks and the nest cells stocked with cicadellid and delphacid bugs. Adults visit umbellifer flowers. Mostly recorded in the southern half of England. One recorded in the arable plot in 2020.

Dolichovespula media (Hymenoptera: Vespidae) graded Nationally Scarce (Falk, 1991a). A relatively recent British colonist (first recorded in 1980) that has since spread over much of Britain and no longer warrants a rarity status. Occurs in small numbers at Wytham. Usually seen on umbellifer, thistle or bramble flowers.

Dolichovespula saxonica (Hymenoptera: Vespidae) graded RDBK (Falk, 1991a). A relatively recent British colonist (first recorded in 1987) that has since spread over much of Britain and no longer warrants a rarity status. Recorded from various areas and very common in 2020. Usually seen on umbellifer, thistle, figwort or bramble flowers.

Epistrophe melanostoma (Diptera: Syrphidae) graded Nationally Scarce (Ball & Morris, 2014). A hoverfly first recorded as British in 1986 and with widely scattered records since. It is rather sporadic in occurrence, suggesting a migratory and eruptive nature. The larvae are aphidophagous but prey preferences are unclear. Adults visit flowers such as umbellifers. Several recorded in Marley Wood in 2020.

Eurychaeta palpalis (Diptera: Calliphoridae) graded Nationally Scarce (Falk & Pont, 2017). A localised, mostly southern blowfly usually found in calcareous grassland and scrub. The viviparous larvae are parasitoids of terrestrial snails. Adults like to visit umbellifer flowers. Fairly frequent at Wytham.

Eustalomyia hilaris (Diptera: Anthomyiidae) graded Nationally Scarce (Falk & Pont, 2017). A scarce species of southern woodlands. The larvae develop as cleptoparasites in the nests of crabronid wasps such as *Ectemnius* species. One female found associated with an old Beech hulk at SP 46419 07595 in 2018. It is not certain that *Eustalomyia* species are flower-visitors though the majority of anthomyiids seem to be, so *E. hilaris* has been included here just in case it proves to be.

Fannia gotlandica (Diptera: Fanniidae) graded Nationally Scarce (Falk & Pont, 2017). A scarce but widespread species of older woodlands in southern Britain. The larvae develop in wood detritus and rotting wood of trees including elms and Beech. One female found associated with an old Beech stump at the main track junction of SP 46419 07595 in 2018.

Freraea gagatea (Diptera: Tachinidae) graded Near Threatened (Falk, Pont & Chandler, 2005). Scattered records, mostly in southern England where it is usually found in dry grasslands and heathkand. The larvae are parasitoids of adult ground beetles (*Carabus*, *Harpalus*, *Amara*). Adults visit umbellifer flowers. One recorded in Marley Wood in 2020.

Gorytes laticinctus (Hymenoptera: Crabronidae) graded Natioanlly rare (RDB3) (Falk, 1991a). A medium-sized black and yellow hunting wasp that was formerly considered a southern rarity but is now expanding northwards and may soon lose any rarity status. Nesting typically occurs in the ground and the cells are stocked with hopper bugs such as *Philaenus spumarius*, *Cercopis* spp. and *Aphrophora alni.* Adults visit umbellifer flowers. One flew into my car in 2020 as I was collected pan traps from Rough Common.

Hebecnema fumosa (Diptera: Muscidae) graded Nationally Scarce (Falk & Pont, 2017). A widely recorded but localised fly of pastoral landscapes, especially in more wooded settings. Probably too frequent to deserve a rarity status. The larvae develop in animal dung. Likely to visit umbellifer flowers. Recorded from Wytham Great Wood and Marley Wood in 2017 and the Chalet area in 2019.

Lasioglossum malachurum (Hymenoptera: Halictidae) graded Nationally Scarce (Falk, 1991a). A small bee of assorted flowery habitats that used to be considered a scarce southern species but is now locally common over much of southern England and no longer warrants a rarity status. Common in the open areas of Wytham and with a large nesting aggregation along the rough vehicle track near the Dell at SP46338 07999. Foraging occurs on a variety of flowers.

Lasioglossum quadrinotatum (Hymenoptera: Halictidae) graded Nationally Scarce (Falk, 1991a). Typically a species of southern heathland districts but with a cluster of records from the Oxford area. One recorded at the Bugle Junction in 2020. Nesting occurs in dry, bare open ground Foraging occurs on a variety of flowers.

Lasioglossum pauxillum (Hymenoptera: Halictidae) graded Nationally Scarce (Falk, 1991a). A small bee of assorted flowery habitats that used to be considered a scarce southern species but is now locally common over much of southern England (often alongside *L. malachurum*) and no longer warrants a rarity status. Common in the open areas of Wytham. Foraging occurs on a variety of flowers but perhaps especially Asteracae.

Lasioglossum puncticolle (Hymenoptera: Halictidae) graded Nationally Scarce (Falk, 1991a). A small bee of assorted flowery habitats that used to be considered a scarce southern, mostly coastal species but is now expanding into central England. It forages heavily on Asteraceae such as hawkbeards and ragworts, and nests in unshaded bare or sparsely-vegetated ground. First seen at Wytham in 2019 but fairly common and widespread by 2020. Only recently added to the Oxon list – the Wytham data may reflect a real-time colonisation event.

Linnaemyia comta (Diptera: Tachinidae) graded Near Threatened (Falk, Pont & Chandler, 2005). A fairly large tachinid fly recorded once during 2020. Known from scattered records in southern Britain and also some from the Scottish Highlands. The larvae have been reared from caterpillars of various noctuid moths. Adults like to visit the flowers of umbellifers.

Macronychia polyodon (Diptera: Sarcophagidae) graded Nationally Scarce (Falk & Pont, 2017). Larvae develop either as cleptoparasites or parasitoids of crabronid solitary wasps such as *Ectemnius* and *Pemphredon* species. Data to hand suggests it specialises in those that nest in dead wood. One from pan trap 10 in 2019.

Macropis europaea (Hymenoptera: Melittidae) graded Nationally Scarce (Falk, 1991a). One of only two British bees associated primarily with wetlands – obtaining pollen almost exclusively from Yellow Loosestrife. A good population was discovered in the reedbed of Marley Wood in 2020 with much nectaring from figwort observed. This colony seems to be right on the edge of its south-east-biased range. It is unclear if it is a new arrival at the site though the vegetation of the reedbed is so dense in places that it could have been overlooked during previous surveys.

Mallota cimbiciformis (Diptera: Syrphidae) graded Nationally Scarce (Ball & Morris, 2014). A scarce large hoverfly with scattered records as far north as Lanarkshire. The rat-tailed larvae develop in water-filled rot holes of mature broadleaved trees. Adults fly from June to September and visit flowers such as Hogweed, brambles, thistles and knapweeds. Both sexes can also be seen around rot holes. One male recorded resting beside a large rot hole of an old Sycamore at SP 46170 07931 in 2017. It has been reared in good numbers from larvae found at Wytham Woods in the past (C. Watkins - pers. comm.).

Meligramma euchromum (Diptera: Syrphidae) graded Nationally Scarce (Ball & Morris, 2014). A scarce and sporadic, southern-biased hoverfly usually found in woodland. Records extend north to Lancashire. The larvae are thought to be predators of tree and shrub-inhabiting aphids, though this is not confirmed. Adults

fly mainly in May and June have been recorded visiting spring blossoms such as Blackthorn and Hawthorn, also flowers such as Wood Spurge. One female recorded at Marley Wood in 2017 and another at Rough Common in 2020.

Merzomyia westermanni (Diptera: Tephritidae) graded Natioanally Scarce (Falk, 1991b). A localised southern species with larvae that develop in the flowerheads of Hoary Ragwort. Adults will often walk over the flowerheads of the host plant and are probably large enough to act as weak pollinators. Probably quite frequent at Wytham Woods but not initially recorded because tephritid flies were not considered likely pollinators at the start of the survey.

Miscordynerus exilis (Hymenoptera: Melittidae) graded Nationally Scarce (Falk, 1991a). Britain's smallest mason wasp. Traditionally a scarce southern species but it seems to be expanding northwards, probably in response to climate change. Nesting occurs in dead wood and hollow stems. Adults visit umbellifer flowers. The nest cells are stocked with small weevil larvae. One recorded in the arable plot in 2020.

Mydaea anicula (Diptera: Muscidae) graded Nationally Scarce (Falk, 1991b). A widely recorded but localised fly of woodland. Probably too frequent to deserve a rarity status. The larvae may develop in fungi. Recorded from Marley Wood in 2017.

Myolepta dubia (Diptera: Syrphidae) graded Nationally Scarce (Ball & Morris, 2014). A localised hoverfly mostly recorded from the southern half of England where it is associated with older woods and other locations with old trees. The larvae develop in water-filled rot holes and other cavities of broadleaved trees such as Beech and Horse Chestnut. Adults visit the flowers of umbellifers, brambles and spring-blossoming shrubs. Recorded from Rough Common in 2018.

Myopa pellucida (Diptera: Conopidae) graded Nationally Rare RDB3 (Falk 1991b). Formerly rare but increasing throughout southern England north to the Midlands and probably not warranting a rarity status now. Females inject eggs into the abdomen of spring-flying mining bees and the larvae develop as internal parasitoids, eventually killing the host. The main host seems to be *Andrena cineraria*. Recorded on several occasions including twice from the Cherry Laurel blossom in Marley Wood.

Nomada ferruginata (Hymenoptera: Apidae) graded Nationally Endangered RDB1 (Falk, 1991a) and Section 41 (2006 NERC Act). A cleptoparasite of the spring-flying mining bee *Andrena praecox* which gathers all its pollen form sallows and willows. *N. ferruginata* was formerly regarded as very rare but has turned up quite widely in southern England in recent years and may only merit a Nationally Scarce status now. Quite a good population here, often found in pan traps.

Nomada fucata (Hymenoptera: Apidae) graded Nationally Scarce (Falk, 1991a). The cleptoparasite of the mining bee *Andrena flavipes*. Both the nomad and its hosts have expanded their range and increased in frequency considerably over recent

decades and *N. fucata* no longer merits a rarity status though neither *N. fucata* or its host are common at Wytham.

Nomada lathburiana (Hymenoptera: Apidae) graded Nationally Rare RDB3 (Falk, 1991a). The cleptoparasite of the mining bee *Andrena cineraria*. Formerly regarded as scarce, but much increased in recent decades and no longer meriting a rarity status.

Osmia bicolor (Hymenoptera: Megachilidae) graded Nationally Scarce (Falk, 1991a). A bee primarily of calcareous grasslands with records extending as far north as the Midlands. During spring the distinctive black and red females create a nest in empty snail shells located on dry, short turf in warm and sunny locations. They eventually cover the shells with a 'wigwam' of grass leaves or other small stems. Assorted flowers and blossoms are used, though it is particularly keen on Ground-ivy and Bugle. Common in many of the grassland areas of Wytham.

Parasetigena silvestris (Diptera: Tachinidae) graded Data Deficient (Falk, Pont & Chandler, 2005). A fairly large parasitic tachinid fly of old woods. The hosts are the Gypsy Moth *Lymantria dispar* and Black Arches *L. monacha*. There appear to be very few recent records of this fly in Britain. One recorded in Wytham Great Wood in May 2018 and another in the clearing behind the chalet in 2019.

Pocota personata (Diptera: Syrphidae) graded Nationally Scarce (Ball & Morris, 2014). A spectacular bumblebee mimic with larvae that develop in water-filled rot holes and cavities of broadeaved trees, perhaps especially mature Beech. Adults visit spring-blossoming shrubs such as Hawthorn. One male recorded on the Cherry Laurel within Marley Wood in 2019. In 2020, several males were seen around rot holes of mature Beeches of the Dell Woodland SP 46361 08022 and those nearby at SP 46290 07879.

Priocnemis hyalinata (Hymenoptera: Apidae) graded Nationally Scarce (Falk, 1991a). A scarce southern-biased spider wasp most typically found on dry calcareous grassland. Nesting probably occurs in natural cavities in the ground and old mining bee burrows. Cells are stocked with paralysed spiders such as lycosids. Adults are likely to visit the flowers of umbellifers. Obtained from pan traps 2 and 4 in 2018 and 2019.

Sarcophaga albiceps (Diptera: Sarcophagidae) graded Nationally Scarce (Falk & Pont, 2017). A widespread but uncommon fleshfly with records extending north to Scotland. The larvae appear to be very catholic in their tastes, preying on or parasitising the larvae of a range of Lepidoptera and Coleoptera, and also breeding in carcasses, faeces and garbage. Plus there is a record of dermal myiasis in a bull. Adults are likely to visit the flowers of umbellifers. One male recorded in 2020 whilst gathering specimens for the Darwin Tree of Life project.

Sarcophaga subulata (Diptera: Sarcophagidae) graded Nationally Scarce (Falk & Pont, 2017). A scarce fleshfly of southern Britain north to the Midlands. Found in a

variety of habitats. The precise larval needs are unclear as on mainland Europe it is said to have been reared from caterpillars of the Gypsy Moth *Lymantria dispar* whilst in England it has been reared from the snail *Monacha cantiana*. Adults are likely to visit the flowers of umbellifers. Fairly frequent at Wytham.

Satyrium w-album (Lepidoptera: Lycaenidae) listed as Section 41 (2006 NERC Act). The White-letter Hairstreak butterfly. A somewhat declined species because of the impact of Dutch Elm Disease on its foodplant, elm, but capable of using elm regrowth and now stable or increasing in many pars of Britain. Recorded from the Chalet area in 2018 and near to Marley Wood in 2020.

Sphecodes crassus (Hymenoptera: Halictidae) graded Nationally Scarce (Falk, 1991a). A much increased, tiny blood bee that no longer requires a rarity status. It is a cleptoparasite of small *Lasioglossum* bee species.

Sphecodes niger (Hymenoptera: Halictidae) graded Nationally Rare (RDB3) (Falk, 1991a). A cleptoparasite of small halictid bees such as *Lasioglossim morio*. Formerly regarded as a scarce southern species but much increased in recent decades and possibly no longer requiring a rarity status, though not common in Oxfordshire. Recorded by Liam Crowley in Rough Common during 2020.

Sphecodes rubicundus (Hymenoptera: Halictidae) graded Nationally Scarce (Falk, 1991a). A cleptoparasite of the mining bee *Andrena labialis* in legume-rich grasslands and disturbed sites. Recorded from Upper Seeds in 2020. The host does not seem to be common at Wytham.

Subclytia rotundivenstris (Diptera: Tachinidae) graded Near Threatened (Falk, Pont & Chandler, 2005). A localised species of southern Britain, most often encountered in birch-rich habitats. The larvae are parasitoids of several species of shieldbug. One recorded on Angelica flowers in Marley Wood during 2020.

Thecla betulae (Lepidoptera: Lycaenidae), the Brown Hairstreak butterfly, listed as Section 41 (2006 NERC Act). A scarce and declined species with UK sites concentrated within south-west Wales, Devon/Somerset and Surrey/Sussex. Other smaller populations occur around Oxford and on Salisbury Plain. The caterpillars feed on the young growth of Blackthorn and Bullace. Adults visit flowers such as Bramble and Fleabane. Only seen once during the Falk survey but well-known from Wytham Woods.

Thecocarcelia acetangulata (Diptera: Tachinidae) graded Data Deficient (Falk, Pont & Chandler, 2005). A fairly large parasitic tachinid thought be be associated primarily with Essex Skipper *Thymelicus lineola*. Adults are likely to visit the flowers of umbellifers. One recorded in the small quarry in 2020.

Thecophora fulvipes (Diptera: Conopidae) graded Nationally Scarce (Falk 1991b). A small grey 'beegrabber' mostly recorded from dry grasslands and other flowery habitats in southern Britain. Females inject eggs into the abdomen of Lasioglossum

or *Halictus* furrow bees and the larvae develop as internal parasitoids, eventually killing the host. One recorded from the small quarry near the chalet in 2018.

Tiphia minuta (Hymenoptera: Tiphiidae) graded Nationally Scarce (Falk, 1991a). A small black wasp with larvae that are parasitoids of small dung beetle larvae, possibly those associated with rabbits and badgers. Adults are likely to visit the flowers of umbellifers. One swept from the small quarry near the Chalet in 2019.

Villa cingulata (Diptera: Bombyliidae) graded Least Concern/Nationally Rare (Drake, 2017). A scarce but increasing species mostly recorded on chalk and limestone grassland in southern England north to the Midlands. The larvae may develop as parasitoids of solitary bee larvae though this is not proven. Adults forage mainly on umbellifer flowers, notably Wild Parsnip. Quite common in open areas such as Upper Seeds, Dell, Arable plot and Rough Common, but it will also turn up in woodland rides and clearings.

Xylota xanthocnema (Diptera: Syrphidae) graded Nationally Scarce (Ball & Morris, 2014). Recorded sparingly across Britain, usually in old woodland. The larvae have been reared from rot holes of Oak and Yew. Unusually for a hoverfly, adults may not visit flowers at all, but it is listed here because all the other British Xylota species are known to visit flowers, if only very rarely.

In addition to the above, two further species that were added to the British list too late for inclusion in a published rarity review, but which would almost certainly qualify as of at least Nationally Scarce status, have been recorded:

Crossocerus congener (Hymenoptera: Crabronidae). Discovered in Britain in 1999 and currently known from a small number of sites in SE England (including nearby Shotover). Recorded from Rough Common in 2017 and Marley Wood (visiting Angelica flowers) in 2020. Nesting probably occurs in dead wood or hollow plant stems.

Nomada facilis (Hymenoptera: Apidae). Added to the British list in 2017 but with older museum specimens misplaced under the very similar *Nomada integra* dating back to the Victorian period which show it is not a recent British colonist. But clearly a very rare southern species with relatively few modern records. It is a cleptoparasite of the mining bee *Andrena fulvago* which has a small population at Wytham centred on the Upper Seeds area where it forages exclusively on yellow-flowered Asteraceae such as hawksbeards.

Appendix 2 – Summarised species list

This is a summarised list of the species and other taxa recorded during the 2017-20 survey. Information on dates, locations and survey technique is provided in the accompanying spreadsheet. Species/taxa in red were only recorded in the pan traps.

Coleoptera	Byturidae	Byturus tomentosus
Coleoptera	Cantharidae	Cantharis nigricans
Coleoptera	Cantharidae	Cantharis pellucida
Coleoptera	Cantharidae	Cantharis rustica
Coleoptera	Cantharidae	Cantharis sp.
Coleoptera	Cantharidae	Podabrus alpinus
Coleoptera	Cantharidae	Rhagonycha fulva
Coleoptera	Cantharidae	Rhagonycha lignosa
Coleoptera	Coccinellidae	Axyridis harmonia
Coleoptera	Coccinellidae	Coccinella septempunctata
Coleoptera	Cerambycidae	Agapanthea villosoviridescens
Coleoptera	Cerambycidae	Clytus arietus
Coleoptera	Cerambycidae	Grammoptera ruficornis
Coleoptera	Cerambycidae	Phytoecia cylindrica
Coleoptera	Cerambycidae	Pseudovadonia livida
Coleoptera	Cerambycidae	Rutpela maculata
Coleoptera	Cerambycidae	Stenocorus meridianus
Coleoptera	Melyridae	Malachius bipustulatus
Coleoptera	Mordellidae	Mordellid species
Coleoptera	Oedemeridae	Oedemera lurida
Coleoptera	Oedemeridae	Oedemera nobilis
Coleoptera	Pyrochroidae	Pyrochroa coccinea
Coleoptera	Pyrochroidae	Pyrochroa serraticornis
Coleoptera	Scarabaeidae	Hoplia philanthus
Diptera	Anthomyiidae	Adia cinerella
Diptera	Anthomyiidae	Alliopsis billbergi
Diptera	Anthomyiidae	Anthomyia liturata
Diptera	Anthomyiidae	Anthomyia procellaris
Diptera	Anthomyiidae	Anthomyia pluvialis
Diptera	Anthomyiidae	Botanophila fugax
Diptera	Anthomyiidae	Botanophila striolata
Diptera	Anthomyiidae	Botanophila trapezina
Diptera	Anthomyiidae	Calythea nigricans
Diptera	Anthomyiidae	Calythea pratincola
Diptera	Anthomyiidae	Delia criniventris
Diptera	Anthomyiidae	Delia florilega
Diptera	Anthomyiidae	Delia platura
Diptera	Anthomyiidae	Delia radicum
Diptera	Anthomyiidae	Egle ciliata
Diptera	Anthomyiidae	Emmesomyia grisea
Diptera	Anthomyiidae	Eustalomyia festiva

Diptera	Anthomyiidae	Eustalomyia hilaris
Diptera	Anthomyiidae	Eustalomyia histrio
Diptera	Anthomyiidae	Hydrophoria lancifer
Diptera	Anthomyiidae	Hydrophoria ruralis
Diptera	Anthomyiidae	Hylemya nigrimana
Diptera	Anthomyiidae	Hylemya urbica
Diptera	Anthomyiidae	Hylemya vagans
Diptera	Anthomyiidae	Hylemya variata
Diptera	Anthomyiidae	Hylemyza partita
Diptera	Anthomyiidae	Lasiomma seminitidum
Diptera	Anthomyiidae	Lasiomma strigilatum
Diptera	Anthomyiidae	Leucophora obtusa
Diptera	Anthomyiidae	Leucophora personata
Diptera	Anthomyiidae	Mycophaga testacea
Diptera	Anthomyiidae	Paradelia intersecta
Diptera	Anthomyiidae	Pegomya solennis
Diptera	Anthomyiidae	Pegoplata aestiva
Diptera	Anthomyiidae	Pegoplata infirma
Diptera	Anthomyiidae	Phorbia fumigata
Diptera	Anthomyiidae	anthomyiid indet
Diptera	Bibionidae	Bibio johannis
Diptera	Bibionidae	Bibio leucopterus
Diptera	Bibionidae	Bibio marci
Diptera	Bibionidae	Bibio varipes
Diptera	Bibionidae	Dilophus febrilis
Diptera	Bibionidae	Dilophus femoratus
Diptera	Bombyliidae	Bombylius discolor
Diptera	Bombyliidae	Bombylius major
Diptera	Bombyliidae	Villa cingulata
Diptera	Calliphoridae	Bellardia pandia
Diptera	Calliphoridae	Bellardia viarum
Diptera	Calliphoridae	Bellardia vulgaris
Diptera	Calliphoridae	Calliphora vicina
Diptera	Calliphoridae	Calliphora vomitoria
Diptera	Calliphoridae	Eurychaeta palpalis
Diptera	Calliphoridae	Lucilia ampullacea
Diptera	Calliphoridae	Lucilia caesar
Diptera	Calliphoridae	Lucilia richardsi
Diptera	Calliphoridae	Lucilia sericata
Diptera	Calliphoridae	Lucilia species
Diptera	Calliphoridae	Melanomyia nana
Diptera	Calliphoridae	Melinda gentilis
Diptera	Calliphoridae	Melinda viridicyanea
Diptera	Calliphoridae	Pollenia amentaria
Diptera	Calliphoridae	Pollenia angustigena
Diptera	Calliphoridae	Pollenia griseotomentosa

Diptera	Calliphoridae	Pollenia labialis
Diptera	Calliphoridae	Pollenia pediculata
Diptera	Calliphoridae	Pollenia rudis
Diptera	Calliphoridae	Pollenia viatica
Diptera	Calliphoridae	Protocalliphora azurea
Diptera	Conopidae	Conops quadrifasciatus
Diptera	Conopidae	Myopa pellucida
Diptera	Conopidae	Myopa testacea
Diptera	Conopidae	Myopa indet
Diptera	Conopidae	Physocephala rufipes
Diptera	Conopidae	Sicus ferrugineus
Diptera	Conopidae	Thecophora atra
Diptera	Conopidae	Thecophora fulvipes
Diptera	Dryomyzidae	Dryomyza anilis
Diptera	Empididae	Empis aestiva
Diptera	Empididae	Empis caudatula
Diptera	Empididae	Empis femorata
Diptera	Empididae	Empis grisea
Diptera	Empididae	Empis livida
Diptera	Empididae	Empis nigripes
Diptera	Empididae	Empis nuntia
Diptera	Empididae	Empis opaca
Diptera	Empididae	Empis pennipes
Diptera	Empididae	Empis praevia
Diptera	Empididae	Empis rufiventris
Diptera	Empididae	Empis tessellata
Diptera	Empididae	Empis trigramma
Diptera	Empididae	Rhamphomyia albohirta
Diptera	Empididae	Rhamphomyia cf curvula
Diptera	Empididae	Rhamphomyia dentipes
Diptera	Empididae	Rhamphomyia flava
Diptera	Empididae	Rhamphomyia laevipes
Diptera	Empididae	Rhamphomyia sulcata
Diptera	Empididae	Rhamphomyia sulcatella
Diptera	Empididae	Rhamphomyia tarsata
Diptera	Empididae	Rhamphomyia umbripennis
Diptera	Fanniidae	Fannia armata
Diptera	Fanniidae	Fannia coracina
Diptera	Fanniidae	Fannia cunicularius
Diptera	Fanniidae	Fannia fuscula
Diptera	Fanniidae	Fannia gotlandica
Diptera	Fanniidae	Fannia lustrator
Diptera	Fanniidae	Fannia mollissima
Diptera	Fanniidae	Fannia mutica
Diptera	Fanniidae	Fannia pallitibia
Diptera	Fanniidae	Fannia rondanii

Diptera	Fanniidae	Fannia serena
Diptera	Fanniidae	Fannia similis
Diptera	Fanniidae	Fannia subsimilis
Diptera	Fanniidae	Fannia sp. female indet
Diptera	Heleomyzidae	Tephrochlamys flavipes
Diptera	Hybotidae	Bicellaria vana
Diptera	Hybotidae	Hybos culiciformis
Diptera	Hybotidae	Hybos femoratus
Diptera	Muscidae	Azelia cilipes
Diptera	Muscidae	Azelia nebulosa
Diptera	Muscidae	Brontaea humilis
Diptera	Muscidae	Coenosia albicornis
Diptera	Muscidae	Coenosia agromyzina
Diptera	Muscidae	Coenosia infantula
Diptera	Muscidae	Coenosia tigrina
Diptera	Muscidae	Eudasyphora cyanella
Diptera	Muscidae	Eudasyphora cyanicolor
Diptera	Muscidae	Graphomya maculata
Diptera	Muscidae	Hebcnema fumosa
Diptera	Muscidae	Hebcnema nigra
Diptera	Muscidae	Hebecnema nigricolor
Diptera	Muscidae	Hebecnema umbratica
Diptera	Muscidae	Hebecnema vespertina
Diptera	Muscidae	Helina depuncta
Diptera	Muscidae	Helina evecta
Diptera	Muscidae	Helina latitarsis
Diptera	Muscidae	Helina impuncta
Diptera	Muscidae	Helina reversio
Diptera	Muscidae	Helina setiventris
Diptera	Muscidae	Hydrotaea cyrtoneurina
Diptera	Muscidae	Hydrotaea diabolus
Diptera	Muscidae	Hydrotaea irritans
Diptera	Muscidae	Hydrotaea militaris
Diptera	Muscidae	Limnophora triangula
Diptera	Muscidae	Lophosceles cinereiventris
Diptera	Muscidae	Mesembrina meridiana
Diptera	Muscidae	Morellia aenescens
Diptera	Muscidae	Morellia hortorum
Diptera	Muscidae	Morellia simplex
Diptera	Muscidae	Musca autumnalis
Diptera	Muscidae	Muscina levida
Diptera	Muscidae	Muscina prolapsa
Diptera	Muscidae	Mydaea ancilla
Diptera	Muscidae	Mydaea anicula
Diptera	Muscidae	Mydaea corni
Diptera	Muscidae	Mydaea nebulosa

Diptera	Muscidae	Mydaea urbana
Diptera	Muscidae	Myospila meditabunda
Diptera	Muscidae	Neomyia cornicina
Diptera	Muscidae	Neomyia viridescens
Diptera	Muscidae	Phaonia angelicae
Diptera	Muscidae	Phaonia errans
Diptera	Muscidae	Phaonia halterata
Diptera	Muscidae	Phaonia incana
Diptera	Muscidae	Phaonia pallida
Diptera	Muscidae	Phaonia palpata
Diptera	Muscidae	Phaonia rufiventris
Diptera	Muscidae	Phaonia serva
Diptera	Muscidae	Phaonia siebecki
Diptera	Muscidae	Phaonia subventa
Diptera	Muscidae	Phaonia trimaculata
Diptera	Muscidae	Phaonia tugurionum
Diptera	Muscidae	Phaonia valida
Diptera	Muscidae	Polietes domitor
Diptera	Muscidae	Polietes lardarius
Diptera	Muscidae	Polietes meridionalis
Diptera	Muscidae	Stomoxys calcitrans
Diptera	Muscidae	Thricops diaphana
Diptera	Muscidae	Thricops semicinereus
Diptera	Pallopteridae	Palloptera trimaculata
Diptera	Rhiniidae	Stomorhina lunata
Diptera	Rhinophoridae	Paykullia maculata
Diptera	Rhinophoridae	Phyto melanocephala
Diptera	Rhinophoridae	Rhinophora lepida
Diptera	Rhinophoridae	Stevenia atramentaria
Diptera	Rhinophoridae	Tricogena rubricosa
Diptera	Sarcophagidae	Blaesoxipha plumicornis
Diptera	Sarcophagidae	Brachicoma devia
Diptera	Sarcophagidae	Macronychia polyodon
Diptera	Sarcophagidae	Nyctia halterata
Diptera	Sarcophagidae	Ravinia pernix
Diptera	Sarcophagidae	Sarcophaga albiceps
Diptera	Sarcophagidae	Sarcophaga anaces
Diptera	Sarcophagidae	Sarcophaga caerulescens
Diptera	Sarcophagidae	Sarcophaga carnaria
Diptera	Sarcophagidae	Sarcophaga crassimargo
Diptera	Sarcophagidae	Sarcophaga depressifrons
Diptera	Sarcophagidae	Sarcophaga dissimilis
Diptera	Sarcophagidae	Sarcophaga haemorrhoa
Diptera	Sarcophagidae	Sarcophaga hirticrus
Diptera	Sarcophagidae	Sarcophaga incisilobata
Diptera	Sarcophagidae	Sarcophaga nigriventris

Diptera	Sarcophagidae	Sarcophaga pumila
Diptera	Sarcophagidae	Sarcophaga rosellei
Diptera	Sarcophagidae	Sarcophaga sexpunctata
Diptera	Sarcophagidae	Sarcophaga subulata
Diptera	Sarcophagidae	Sarcophaga subvicina
Diptera	Sarcophagidae	Sarcophaga vagans
Diptera	Sarcophagidae	Sarcophaga variegata
Diptera	Sarcophagidae	Sarcophaga indet.
Diptera	Scathophagidae	Norellia spinipes
Diptera	Scathophagidae	Norellisoma spinimanum
Diptera	Scathophagidae	Scathophaga furcata
Diptera	Scathophagidae	Scathophaga inquinata
Diptera	Scathophagidae	Scathophaga stercoraria
Diptera	Stratiomyidae	Beris chalybata
Diptera	Stratiomyidae	Beris vallata
Diptera	Stratiomyidae	Chloromyia formosa
Diptera	Stratiomyidae	Oplodontha viridula
Diptera	Stratiomyidae	Nemotelus pantherinus
Diptera	Stratiomyidae	Pachygaster atra
Diptera	Stratiomyidae	Sargus bipunctatus
Diptera	Stratiomyidae	Sargus iridatus
Diptera	Stratiomyidae	Stratiomys potamida
Diptera	Syrphidae	Baccha elongata
Diptera	Syrphidae	Brachyopa scutellaris
Diptera	Syrphidae	Brachypalpoides lentus
Diptera	Syrphidae	Chalcosyrphus nemorum
Diptera	Syrphidae	Cheilosia albitarsis
Diptera	Syrphidae	Cheilosia albitarsis agg. female
Diptera	Syrphidae	Cheilosia barbata
Diptera	Syrphidae	Cheilosia bergenstammi
Diptera	Syrphidae	Cheilosia illustrata
Diptera	Syrphidae	Cheilosia impressa
Diptera	Syrphidae	Cheilosia lasiopa
Diptera	Syrphidae	Cheilosia latifrons
Diptera	Syrphidae	Cheilosia pagana
Diptera	Syrphidae	Cheilosia proxima
Diptera	Syrphidae	Cheilosia ranunculi
Diptera	Syrphidae	Cheilosia scutellata
Diptera	Syrphidae	Cheilosia soror
Diptera	Syrphidae	Cheilosia variabilis
Diptera	Syrphidae	Cheilosia vernalis
Diptera	Syrphidae	Cheilosia urbana
Diptera	Syrphidae	Cheilosia vulpina
Diptera	Syrphidae	Chrysogaster cemeteriorum
Diptera	Syrphidae	Chrysogaster solstitialis
Diptera	Syrphidae	Chrysotoxum bicinctum

Diptera	Syrphidae	Chrysotoxum festivum
Diptera	Syrphidae	Chrysotoxum verralli
Diptera	Syrphidae	Criorhina asilica
Diptera	Syrphidae	Criorhina berberina
Diptera	Syrphidae	Criorhina floccosa
Diptera	Syrphidae	Criorhina ranunculi
Diptera	Syrphidae	Dasysyrphus albostriatus
Diptera	Syrphidae	Dasysyrphus tricinctus
Diptera	Syrphidae	Dasysyrphus venustus
Diptera	Syrphidae	Didea fasciata
Diptera	Syrphidae	Epistrophe eligans
Diptera	Syrphidae	Epistrophe grossulariae
Diptera	Syrphidae	Epistrophe melanostoma
Diptera	Syrphidae	Epistrophe nitidicollis
Diptera	Syrphidae	Episyrphus balteatus
Diptera	Syrphidae	Eriozona syrphoides
Diptera	Syrphidae	Eristalinus sepulchralis
Diptera	Syrphidae	Eristalis arbustorum
Diptera	Syrphidae	Eristalis horticola
Diptera	Syrphidae	Eristalis intricarius
Diptera	Syrphidae	Eristalis nemorum
Diptera	Syrphidae	Eristalis pertinax
Diptera	Syrphidae	Eristalis tenax
Diptera	Syrphidae	Eumerus funeralis
Diptera	Syrphidae	Eumerus ornatus
Diptera	Syrphidae	Eumerus strigatus
Diptera	Syrphidae	Eupeodes corollae
Diptera	Syrphidae	Eupeodes latifasciatus
Diptera	Syrphidae	Eupeodes luniger
Diptera	Syrphidae	Ferdinandea cuprea
Diptera	Syrphidae	Helophilus pendulus
Diptera	Syrphidae	Helophilus trivittatus
Diptera	Syrphidae	Leucozona glaucia
Diptera	Syrphidae	Leucozona laternaria
Diptera	Syrphidae	Leucozona lucorum
Diptera	Syrphidae	Mallota cimbiciformis
Diptera	Syrphidae	Melangyna labiatarum
Diptera	Syrphidae	Melangyna lasiophthalma
Diptera	Syrphidae	Melangyna umbellatarum
Diptera	Syrphidae	Melanogaster hirtella
Diptera	Syrphidae	Melanostona mellinum
Diptera	Syrphidae	Melanostoma scalare
Diptera	Syrphidae	Meligramma cincta
Diptera	Syrphidae	Meligramma euchromum
Diptera	Syrphidae	Meliscaeav auricollis
Diptera	Syrphidae	Meliscaeva cinctella

Diptera	Syrphidae	Merodon equestris
Diptera	Syrphidae	Myathropa florea
Diptera	Syrphidae	Myolepta dubia
Diptera	Syrphidae	Neoascia meticulosa
Diptera	Syrphidae	Neoascia podagrica
Diptera	Syrphidae	Neoascia tenur
Diptera	Syrphidae	Orthonevra nobilis
Diptera	Syrphidae	Paragus haemorrhous
Diptera	Syrphidae	Parasyrphus annulatus
Diptera	Syrphidae	Parasyrphus punctulatus
Diptera	Syrphidae	Parhelophilus frutetorum
Diptera	Syrphidae	Parhelophilus versicolor
Diptera	Syrphidae	Pipiza noctiluca
Diptera	Syrphidae	Pipizella viduata
Diptera	Syrphidae	Pipizella virens
Diptera	Syrphidae	Platycheirus albimanus
Diptera	Syrphidae	Platycheirus angustatus
Diptera	Syrphidae	Platycheirus clypeatus
Diptera	Syrphidae	Platycheirus fulviventris
Diptera	Syrphidae	Platycheirus manicatus
Diptera	Syrphidae	Platycheirus peltatus
Diptera	Syrphidae	Platycheirus rosarum
Diptera	Syrphidae	Platycheirus scutatus
Diptera	Syrphidae	Platycheirus scutatus agg. female
Diptera	Syrphidae	Platycheirus tarsalis
Diptera	Syrphidae	Pocota personata
Diptera	Syrphidae	Portevinia maculata
Diptera	Syrphidae	Rhingia campestris
Diptera	Syrphidae	Rhingia rostrata
Diptera	Syrphidae	Scaeva pyrastri
Diptera	Syrphidae	Sphaerophoria interrupta
Diptera	Syrphidae	Sphaerophoria scripta
Diptera	Syrphidae	Sphaerophoria taeniata
Diptera	Syrphidae	Sphaerophoria fem indet
Diptera	Syrphidae	Sphegina clunipes
Diptera	Syrphidae	Syritta pipiens
Diptera	Syrphidae	Syrphus ribessii
Diptera	Syrphidae	Syrphus torvus
Diptera	Syrphidae	Syrphus vitripennis
Diptera	Syrphidae	Tropidia scita
Diptera	Syrphidae	Volucella bombylans
Diptera	Syrphidae	Volucella inanis
Diptera	Syrphidae	Volucella inflata
Diptera	Syrphidae	Volucella pellucens
Diptera	Syrphidae	Xanthogramma pedisequum
Diptera	Syrphidae	Xylota segnis

Diptera	Syrphidae	Xylota sylvarum
Diptera	Syrphidae	Xylota xanthocnema
Diptera	Tabanidae	Chrysops caecutiens
Diptera	Tabanidae	Haematopota pluvialis
Diptera	Tabanidae	Hybomitra bimaculata
Diptera	Tabanidae	Tabanus bromius
Diptera	Tachinidae	Actia lamia
Diptera	Tachinidae	Aplomya confinis
Diptera	Tachinidae	Blepharomyia pagana
Diptera	Tachinidae	Blondelia nigripes
Diptera	Tachinidae	Cadurciella tritaeniata
Diptera	Tachinidae	Carcelia ?gnava
Diptera	Tachinidae	Carcelia lucorum
Diptera	Tachinidae	Cistogaster globosa
Diptera	Tachinidae	Cyrtophlebia ruricola
Diptera	Tachinidae	Dexiosoma canina
Diptera	Tachinidae	Eloceria delecta
Diptera	Tachinidae	Epicampocera succincta
Diptera	Tachinidae	Eriothrix rufomaculata
Diptera	Tachinidae	Ernestia rudis
Diptera	Tachinidae	Eumea linearicornis
Diptera	Tachinidae	Eurithia anthophila
Diptera	Tachinidae	Exorista larvarum
Diptera	Tachinidae	Exorista rustica
Diptera	Tachinidae	Freraea gagatea
Diptera	Tachinidae	Gonia picea
Diptera	Tachinidae	Gymnocheta viridis
Diptera	Tachinidae	Linnaemyia comta
Diptera	Tachinidae	Linnaemyia picta
Diptera	Tachinidae	Linnaemyia tessellans
Diptera	Tachinidae	Lydina aenea
Diptera	Tachinidae	Lypha dubia
Diptera	Tachinidae	Macquartia dispar
Diptera	Tachinidae	Macquartia grisea
Diptera	Tachinidae	Macquartia praefica
Diptera	Tachinidae	Macquartia tenebricosa
Diptera	Tachinidae	Medina collaris
Diptera	Tachinidae	Meigenia mutabilis
Diptera	Tachinidae	Nowickia ferox
Diptera	Tachinidae	Ocytata pallipes
Diptera	Tachinidae	Oswaldia muscaria
Diptera	Tachinidae	Pales pavida
Diptera	Tachinidae	Parasetigena silvestris
Diptera	Tachinidae	Phania funesta
Diptera	Tachinidae	Phasia barbifrons
Diptera	Tachinidae	Phasia hemiptera

Diptera	Tachinidae	Phasia obesa
Diptera	Tachinidae	Phasia pusilla
Diptera	Tachinidae	Phorocera assimilis
Diptera	Tachinidae	Phorocera obscura
Diptera	Tachinidae	Phryxe heraclei
Diptera	Tachinidae	Phryxe nemea
Diptera	Tachinidae	Phryxe vulgaris
Diptera	Tachinidae	Phryxe sp.
Diptera	Tachinidae	Platyma fimbriata
Diptera	Tachinidae	Ramonda spathulata
Diptera	Tachinidae	Siphona geniculata
Diptera	Tachinidae	Siphona sp.
Diptera	Tachinidae	Smidtia conspersa
Diptera	Tachinidae	Solieria pacifica
Diptera	Tachinidae	Sturmia bella
Diptera	Tachinidae	Subclytia rotundiventris
Diptera	Tachinidae	Tachina fera
Diptera	Tachinidae	Tachina lurida
Diptera	Tachinidae	Tachina ursina
Diptera	Tachinidae	Thecocarcelia acetangulata
Diptera	Tachinidae	Thelaira solivago
Diptera	Tachinidae	Triarthria setipennis
Diptera	Tachinidae	Trixa conspersa
Diptera	Tachinidae	Voria ruralis
Diptera	Tachinidae	Zaira cinerea
Diptera	Tephritidae	Merzomyia westermanni
Diptera	Tipulidae	Ctenophora pectinicornis
Diptera	Tipulidae	Tipula oleracea
Diptera	Ulidiidae	Herina germinationis
Diptera	Ulidiidae	Herina lugubris
Diptera	Ulidiidae	Otites guttata
Diptera	Ulidiidae	Physiphora alceae
Hymenoptera	Andrenidae	Andrena apicata
Hymenoptera	Andrenidae	Andrena bicolor
Hymenoptera	Andrenidae	Andrena bucephala
Hymenoptera	Andrenidae	Andrena chrysosceles
Hymenoptera	Andrenidae	Andrena cineraria
Hymenoptera	Andrenidae	Andrena clarkella
Hymenoptera	Andrenidae	Andrena dorsata
Hymenoptera	Andrenidae	Andrena flavipes
Hymenoptera	Andrenidae	Andrena fulva
Hymenoptera	Andrenidae	Andrena fulvago
Hymenoptera	Andrenidae	Andrena haemorrhoa
Hymenoptera	Andrenidae	Andrena hattorfiana
Hymenoptera	Andrenidae	Andrena helvola
Hymenoptera	Andrenidae	Andrena labialis

Hymenoptera	Andrenidae	Andrena minutula
Hymenoptera	Andrenidae	Andrena nigroaenea
Hymenoptera	Andrenidae	Andrena nitida
Hymenoptera	Andrenidae	Andrena praecox
Hymenoptera	Andrenidae	Andrena scotica
Hymenoptera	Andrenidae	Andrena semilaevia
Hymenoptera	Andrenidae	Andrena subopaca
Hymenoptera	Andrenidae	Andrena trimmerana
Hymenoptera	Andrenidae	Andrena wilkella
Hymenoptera	Apidae	Anthophora furcata
Hymenoptera	Apidae	Anthophora plumipes
Hymenoptera	Apidae	Apis mellifera
Hymenoptera	Apidae	Bombus barbutellus
Hymenoptera	Apidae	Bombus campestris
Hymenoptera	Apidae	Bombus hortorum
Hymenoptera	Apidae	Bombus humilis
Hymenoptera	Apidae	Bombus hypnorum
Hymenoptera	Apidae	Bombus jonellus
Hymenoptera	Apidae	Bombus lapidarius
Hymenoptera	Apidae	Bombus lucorum
Hymenoptera	Apidae	Bombus lucorum/terrestris
Hymenoptera	Apidae	Bombus pascuorum
Hymenoptera	Apidae	Bombus pratorum
Hymenoptera	Apidae	Bombus ruderatus
Hymenoptera	Apidae	Bombus rupestris
Hymenoptera	Apidae	Bombus sylvestris
Hymenoptera	Apidae	Bombus terrestris
Hymenoptera	Apidae	Bombus vestalis
Hymenoptera	Apidae	Nomada fabriciana
Hymenoptera	Apidae	Nomada facilis
Hymenoptera	Apidae	Nomada ferruginata
Hymenoptera	Apidae	Nomada flava
Hymenoptera	Apidae	Nomada flavoguttata
Hymenoptera	Apidae	Nomada fucata
Hymenoptera	Apidae	Nomada goodeniana
Hymenoptera	Apidae	Nomada lathburiana
Hymenoptera	Apidae	Nomada marshamella
Hymenoptera	Apidae	Nomada panzeri
Hymenoptera	Apidae	Nomada ruficornis
Hymenoptera	Apidae	Nomada zonata
Hymenoptera	Apidae	Arge cyanocrocea
Hymenoptera	Argidae	Arge fuscipes
Hymenoptera	Argidae	Arge melanochroa
Hymenoptera	Argidae	Arge ochropus
Hymenoptera	Argidae	Arge pagana
Hymenoptera	Argidae	Arge ustulata

Hymenoptera	Cephidae	Cephus pygmeus
Hymenoptera	Cephidae	Cephus spinipes
Hymenoptera	Cephidae	Cephus sp.
Hymenoptera	Cephidae	Hartigia linearis
Hymenoptera	Chrysididae	Chrysis sp.
Hymenoptera	Chrysididae	Pseudomalus auratus
Hymenoptera	Colletidae	Hylaeus brevicornis
Hymenoptera	Colletidae	Hylaeus communis
Hymenoptera	Colletidae	Hylaeus confusus
Hymenoptera	Colletidae	Hylaeus dilatatus
Hymenoptera	Crabronidae	Argogorytes mystaceus
Hymenoptera	Crabronidae	Crabro cribrarius
Hymenoptera	Crabronidae	Crossocerus annulipes
Hymenoptera	Crabronidae	Crossocerus congener
Hymenoptera	Crabronidae	Crossocerus distinguendus
Hymenoptera	Crabronidae	Crossocerus megacephalus
Hymenoptera	Crabronidae	Crossocerus podagrica
Hymenoptera	Crabronidae	Didineis lunicornis
Hymenoptera	Crabronidae	Ectemnius cavifrons
Hymenoptera	Crabronidae	Ectemnius cephalotes
Hymenoptera	Crabronidae	Ectemnius continuus
Hymenoptera	Crabronidae	Ectemnius lituratus
Hymenoptera	Crabronidae	Ectemnius rubicola
Hymenoptera	Crabronidae	Gorytes laticinctus
Hymenoptera	Crabronidae	Mellinus arvensis
Hymenoptera	Crabronidae	Mimumesa dahlbomi
Hymenoptera	Crabronidae	Nysson spinosus
Hymenoptera	Crabronidae	Passaloecus corniger
Hymenoptera	Crabronidae	Passaloecus gracilis
Hymenoptera	Crabronidae	Passaloecus insignis
Hymenoptera	Crabronidae	Pemphredon inornata
Hymenoptera	Crabronidae	Pemphredon lethifer
Hymenoptera	Crabronidae	Pemphredon lugubris
Hymenoptera	Crabronidae	Psenulus concolor
Hymenoptera	Crabronidae	Psenulus pallipes
Hymenoptera	Crabronidae	Rhopalum coarctatum
Hymenoptera	Crabronidae	Stigmus pendulus
Hymenoptera	Crabronidae	Trypoxylon attenuatum
Hymenoptera	Crabronidae	Trypoxylon clavicerum
Hymenoptera	Crabronidae	Trypoxylon figulus agg.
Hymenoptera	Gasteruptiidae	Gasteruptor jacula
Hymenoptera	Halictidae	Halictus rubicundus
Hymenoptera	Halictidae	Halictus tumulorum
Hymenoptera	Halictidae	Lasioglossum albipes
Hymenoptera	Halictidae	Lasioglossum calceatum
Hymenoptera	Halictidae	Lasioglossum fulvicorne

Hymenoptera	Halictidae	Lasioglossum lativentre
Hymenoptera	Halictidae	Lasioglossum leucopus
Hymenoptera	Halictidae	Lasioglossum leucozonium
Hymenoptera	Halictidae	Lasioglossum malachurum
Hymenoptera	Halictidae	Lasioglossum morio
Hymenoptera	Halictidae	Lasioglossum pauxillum
Hymenoptera	Halictidae	Lasioglossum puncticolle
Hymenoptera	Halictidae	Lasioglossum quadrinotatum
Hymenoptera	Halictidae	Lasioglossum villosulum
Hymenoptera	Halictidae	Sphecodes crassus
Hymenoptera	Halictidae	Sphecodes ephippius
Hymenoptera	Halictidae	Sphecodes geoffrellus
Hymenoptera	Halictidae	Sphecodes gibbus
Hymenoptera	Halictidae	Sphecodes hyalinatus
Hymenoptera	Halictidae	Sphecodes monilicornis
Hymenoptera	Halictidae	Sphecodes niger
Hymenoptera	Halictidae	Sphecodes puncticeps
Hymenoptera	Halictidae	Sphecodes rubicundus
Hymenoptera	Megachilidae	Chelostoma campanularum
Hymenoptera	Megachilidae	Chelostoma florisomne
Hymenoptera	Megachilidae	Coelioxys elongata
Hymenoptera	Megachilidae	Hoplitis claviventris
Hymenoptera	Megachilidae	Megachile ligniseca
Hymenoptera	Megachilidae	Megachile versicolor
Hymenoptera	Megachilidae	Megachile willughbiella
Hymenoptera	Megachilidae	Osmia bicolor
Hymenoptera	Megachilidae	Osmia bicornis
Hymenoptera	Megachilidae	Osmia caerulescens
Hymenoptera	Megachilidae	Osmia leaiana
Hymenoptera	Melittidae	Macropus europaea
Hymenoptera	Melittidae	Melitta haemorrhoidalis
Hymenoptera	Melittidae	Melitta leporina
Hymenoptera	Mutillidae	Myrmosa atra
Hymenoptera	Pamphiliidae	Pamphilius sylvaticus
Hymenoptera	Pompilidae	Anoplius nigerrimus
Hymenoptera	Pompilidae	Arachnospila anceps
Hymenoptera	Pompilidae	Arachnospila spissa
Hymenoptera	Pompilidae	Auplopus carbonarius
Hymenoptera	Pompilidae	Dipogon subintermedius
Hymenoptera	Pompilidae	Evagetes crassicornis
Hymenoptera	Pompilidae	Priocnemus fennica
Hymenoptera	Pompilidae	Priocnemus hyalinata
Hymenoptera	Pompilidae	Priocnemus parvula
Hymenoptera	Pompilidae	Priocnemis perturbator
Hymenoptera	Pompilidae	Priocnemis pusilla
Hymenoptera	Sapygidae	Sapyga quinquefasciata

Hymenoptera	Tenthredinidae	Aglaostigma aucuparia
Hymenoptera	Tenthredinidae	Aglaostigma fulvipes
Hymenoptera	Tenthredinidae	Athalia bicolor
Hymenoptera	Tenthredinidae	Athalia circularis
Hymenoptera	Tenthredinidae	Athalia cordata
Hymenoptera	Tenthredinidae	Athalia lugens
Hymenoptera	Tenthredinidae	Athalia rosae
Hymenoptera	Tenthredinidae	Athalia sp.
Hymenoptera	Tenthredinidae	Cladius pectinicornis
Hymenoptera	Tenthredinidae	Cytisogaster chambersi
Hymenoptera	Tenthredinidae	Dolerus aeneus
Hymenoptera	Tenthredinidae	Dolerus picipes
Hymenoptera	Tenthredinidae	Dolerus puncticollis
Hymenoptera	Tenthredinidae	Eutomostethus ephippium
Hymenoptera	Tenthredinidae	Macrophya albicincta
Hymenoptera	Tenthredinidae	Macrophya annulata
Hymenoptera	Tenthredinidae	Rhogogaster chlorosoma
Hymenoptera	Tenthredinidae	Rhogogaster scalaris
Hymenoptera	Tenthredinidae	Selandria serva
Hymenoptera	Tenthredinidae	Strongylogaster xanthocera
Hymenoptera	Tenthredinidae	Tenthredo amoena
Hymenoptera	Tenthredinidae	Tenthredo arcuata grp
Hymenoptera	Tenthredinidae	Tenthredo brevicornis
Hymenoptera	Tenthredinidae	Tenthredo distinguenda
Hymenoptera	Tenthredinidae	Tenthredo livida
Hymenoptera	Tenthredinidae	Tenthredo maculata
Hymenoptera	Tenthredinidae	Tenthredo mesomela
Hymenoptera	Tenthredinidae	Tenthredo notha
Hymenoptera	Tenthredinidae	Tenthredo scrophulariae
Hymenoptera	Tenthredinidae	Tenthredo temula
Hymenoptera	Tenthredinidae	Tenthredo zona
Hymenoptera	Tenthredinidae	Tenthredopsis litterata
Hymenoptera	Tenthredinidae	Tenthredopsis cf nassata
Hymenoptera	Tiphidae	Tiphia femorata
Hymenoptera	Tiphidae	Tiphia minuta
Hymenoptera	Vespidae	Ancistrocerus nigricornis
Hymenoptera	Vespidae	Ancistrocerus trifasciatus
Hymenoptera	Vespidae	Dolichovespula media
Hymenoptera	Vespidae	Dolichovespula norwegica
Hymenoptera	Vespidae	Dolichovespula saxonica
Hymenoptera	Vespidae	Dolichovespula sylvestris
Hymenoptera	Vespidae	Gymnomerus laevipes
Hymenoptera	Vespidae	Microdynerus exilis
Hymenoptera	Vespidae	Odynerus spinipes
Hymenoptera	Vespidae	Symmorphus gracilis
Hymenoptera	Vespidae	Vespa crabro

Hymenoptera	Vespidae	Vespula germanica
Hymenoptera	Vespidae	Vespula vulgaris
Lepidoptera	Adelidae	Nemophora metallica
Lepidoptera	Choreutidae	Anthophila fabriciana
Lepidoptera	Erebidae	Euclidia glyphica
Lepidoptera	Erebidae	Tyria jacobaeae
Lepidoptera	Hesperidae	Ochlodes sylvanus
Lepidoptera	Hesperidae	Pyrgus malvae
Lepidoptera	Hesperidae	Thymelicus lineola
Lepidoptera	Hesperidae	Thymelicus sylvestris
Lepidoptera	Lycaenidae	Aricia agestis
Lepidoptera	Lycaenidae	Celastrina argeolus
Lepidoptera	Lycaenidae	Callophrys rubi
Lepidoptera	Lycaenidae	Lycaena phlaeus
Lepidoptera	Lycaenidae	Polyommatus icarus
Lepidoptera	Lycaenidae	Satyrium w-album
Lepidoptera	Lycaenidae	Thecla betulae
Lepidoptera	Noctuidae	Autographa gamma
Lepidoptera	Nymphalidae	Aglais io
Lepidoptera	Nymphalidae	Aglais urticae
Lepidoptera	Nymphalidae	Apatura iris
Lepidoptera	Nymphalidae	Aphantopus hyperantus
Lepidoptera	Nymphalidae	Argynnis paphia
Lepidoptera	Nymphalidae	Maniola jurtina
Lepidoptera	Nymphalidae	Melanargia galathea
Lepidoptera	Nymphalidae	Pararge aegeria
Lepidoptera	Nymphalidae	Polygonia c-album
Lepidoptera	Nymphalidae	Pyronia tithonus
Lepidoptera	Nymphalidae	Speyeria aglaja
Lepidoptera	Nymphalidae	Vanessa atalanta
Lepidoptera	Nymphalidae	Vanessa cardui
Lepidoptera	Pieridae	Anthocharis cardamines
Lepidoptera	Pieridae	Colias croceus
Lepidoptera	Pieridae	Gonopteryx rhamni
Lepidoptera	Pieridae	Pieris brassicae
Lepidoptera	Pieridae	Pieris napi
Lepidoptera	Pieridae	Pieris rapae
Lepidoptera	Pyralidae	Pyrausta sp
Lepidoptera	Sesiidae	Bembecia ichneumoniformis
Lepidoptera	Zygaenidae	Zygaena filipendulae

Appendix 3 - Scientific names of plants mentioned in this report and spreadsheet

Agrimony *Agrimonia eupatoria*
Ash *Fraxinus excelsior*
Barren Strawberry *Potentilla sterilis*
Beaked Hawksbeard *Crepis vesicaria*
Beech *Fagus sylvatica*
Bird's-foot Trefoil (Common) *Lotus corniculatus*
Bittercress *Cardamine* species
Black-grass *Alopecurus myosuroides*
Black Medick *Medicago lupulina*
Blackthorn *Prunus spinosa*
Bluebell *Hyacinthoides non-scripta*
Bracken *Pteridium aquilinum*
Bramble(s) *Rubus fruticosus* agg.
Bristly Oxtongue *Helminthotheca echioides*
Broad-leaved Everlasting Pea *Lathyrus latifolius*
Bugle *Ajuga reptans*
Bullace *Prunus institia*
Burnet-saxifrage *Pimpinella saxifraga*
Bush Vetch *Vicia sepium*
Buttercups *Ranunculus* species
Catsear *Hypochoeris radicata*
Charlock *Sinapis arvensis*
Cherry Laurel *Prunus laurocerasus*
Cherry (Wild) *Prunus avium*
Cherry Plum *Prunus cerasifera*
Clovers *Trifolium* species
Common Lime *Tilia x europaea*
Common Mouse-ear *Cerastium fontanum*
Common Ragwort *Jacobaea vulgaris*
Common Reed *Phragmites australis*
Corn Sowthistle *Sonchus arvensis*
Cow Parsley *Anthriscus sylvestris*
Cowslip *Primula veris*
Crab Apple *Malus sylvestris*
Creeping Buttercup *Ranunculus repens*
Creeping Cinquefoil *Potentilla reptans*
Creeping Thistle *Cirsium arvense*
Crosswort *Cruciata laevipes*
Dandelion(s) *Taraxacum* species
Dog's Mercury *Mercurialis perennis*
Dog Violet Viola *riviniana*
Dwarf Mallow *Malva neglecta*
Dwarf Thistle *Cirsium acaule*

Elder *Sambucus nigra*
Elm(s) *Ulmus* species
Enchanter's Nightshade *Circaea lutetiana*
English Oak *Quercus robur*
Fairy Flax *Linum catharticum*
False Brome *Brachypodium sylvaticum*
False Oat-grass *Arrhenatherum elatius*
Field Bindweed *Convolvulus arvensis*
Field Maple *Acer campestre*
Field Scabious *Knautia arvensis*
Field Speedwell *Veronica arvensis*
Figwort (Common) *Scrophularia nodosa*
Fleabane *Pulicaria dyssenterica*
Fool's Parsley *Aethusa cynapium*
Garlic Mustard *Allaria petiolata*
Germander Speedwell *Veronica chamaedrys*
Goat Willow *Salix caprea*
Gorse (Common) *Ulex europaeus*
Greater Knapweed *Centaurea scabiosa*
Great Willowherb *Epilobium hirsutum*
Grey Willow (Sallow) *Salix cinerea*
Ground-ivy *Glechoma hederacea*
Harebell *Campanula rotundifolia*
Hawksbeard(s) *Crepis* species
Hawkbits *Leontodon* and *Scorzoneroides* species
Hawkweed Oxtongue *Picris hieracioides*
Hawthorn (Common) *Crataegus monogyna*
Hazel *Corylas avellana*
Hedge Bedstraw *Galium mollugo*
Hedge Bindweed *Calystegia sepium*
Hedge Woundwort *Stachys sylvatica*
Hemp-agrimony *Eupatorium cannabinum*
Herb-Robert *Geranium robertianum*
Hoary Ragwort *Jacobaea erucifolia*
Hogweed *Heracleum sphondylium*
Honey Garlic *Nectaroscordum siculum*
Hornbeam *Carpinus betulus*
Horse Chestnut *Aesculus hippocastanum*
Imperforate St John's-wort *Hypericum maculatum*
Ivy *Hedera helix*
Knapweed(s) *Centaurea* species
Lady's Bedstraw *Galium verum*
Lesser Celandine *Ficaria verna*
Marsh Thistle *Cirsium palustre*
Mayweeds – *Matricaria* and *Tripleurospermum* species
Meadow Thistle *Cirsium dissectum*
Meadow Vetchling *Lathyrus pratensis*

Michaelmas Daisy *Aster* species
Montbretia *Crocosmia x crocosmiiflora*
Mouse-ear Hawkeed *Hieracium pilosella*
Musk Mallow *Malva moschata*
Musk Thistle *Carduus nutans*
Nipplewort *Lapsana communis*
Oxeye Daisy *Leucanthemum vulgare*
Perforate St John's-wort *Hypericum perforata*
Pignut *Conopodium majus*
Poppies *Papaver* species here
Primrose *Primula vulgaris*
Pyramidal Orchid *Anacamptis pyramidalis*
Ragwort(s) *Jacobaea* species
Ramsons *Allium ursina*
Red Bartsia *Odontites verna*
Red Campion *Silene dioica*
Rockrose (Common) *Helianthemum nummularium*
Rose(s) *Rosa* species
Rough Hawkbit *Leontodon hispidus*
Rough Hawksbeard *Crepis biennis*
Sallow (Grey Willow) *Salix cinerea* (occasionally used more loosely for similar shrubby willows)
Scentless Mayweed *Tripleurospermum inodorum*
Self-heal *Prunella vulgaris*
Smooth Hawk's-beard *Crepis capillaris*
Spear Thistle *Cirsium vulgare*
Spindle *Euonymus europaea*
St John's-worts *Hypericum* species
Sycamore *Acer pseudoplatanus*
Tare – smaller *Vicia* species
Teasel *Dipsacus fullonum*
Thistles - typically *Cirsium* and *Carduus* species
Traveller's Joy *Clematic vitalba*
Tufted Vetch *Vicia cracca*
Umbellifers – family Apiaceae
Upright Hedge-parsley *Torilis japonica*
Vetches – *Vicia* species
Violets – *Viola* species
Water Mint *Mentha aquatica*
Wavy Bittercress *Cardamine flexuosa*
Welted Thistle *Carduus crispus*
White Bryony *Bryonia alba*
White Clover *Trifoilium repens*
White Dead-nettle *Lamium album*
Wild Angelica *Angelica sylvestris*
Wild Basil *Clinopodium vulgare*
Wild Liquorice *Astragalus glycyphyllos*

Wild Parsnip *Pastinaca sativa*
Wild Privet *Ligustrum vulgare*
Wild Thyme *Thymus polytrichus*
Willow(s) *Salix* species
Willowherb(s) *Chamerion* and *Epilobium* species
Wood Anemone *Anemone nemorosa*
Wood Avens *Geum urbanum*
Wood Spurge *Euphorbia amygdaloides*
Woolly Thistle *Cirsium eriophorum*
Yarrow *Achillea millefolium*
Yellow Archangel *Lamium galeobdolon*
Yellow Loosestrife *Lysimachia vulgaris*

Appendix 4 – Definitions of British conservation status categories

1. Status Categories and Criteria Version 1 (Shirt, 1987)

These status categories and criteria were introduced for British insects by Shirt (1987) and received some modifications by later authors (e.g. Falk, 1991a & b; Hyman and Parsons, 1992; Kirby, 1992).

Red Data Book category EXTINCT

Definition: Species which were formerly native to Britain but have not been recorded since 1900.

Red Data Book category 1 (RDB1), Endangered

Definition: Species in danger of extinction and whose survival is unlikely if causal factors continue to operate. Endangered species either (a) occur as only a single population within one 10-km square, or (b) only occur in especially vulnerable habitats, or (c) have been declining rapidly or continuously for twenty years or more to the point where they occur in five or fewer 10-km squares, or (d) may already have become extinct.

Red Data Book category 2 (RDB2), Vulnerable

Definition: Species which are likely to move into the Endangered category in the near future if causal factors continue to operate. Vulnerable species are declining throughout their range or occupy vulnerable habitats.

Red Data Book category 3 (RDB3), Rare

Definition: Species which occur in small populations and although not currently either Endangered or Vulnerable are at risk. Rare species exist in 15 or fewer 10-km squares, or are more widespread than this but dependent on small areas of especially vulnerable habitat.

Red Data Book category I (RDBi), Indeterminate

Definition: Species considered to be either Endangered, Vulnerable or Rare but with insufficient information to say which.

Red Data Book category K (RDBK), Insufficiently Known

Definition: Species suspected to merit either Endangered, Vulnerable, Rare or Indeterminate status but lacking sufficient information. Species included in this category may have only recently been discovered in Britain, or may be very poorly recorded for a variety of reasons.

Nationally Scarce (NS)

Definition: Species which do not fall within Red Data Book categories but which are nonetheless uncommon in Great Britain and thought to occur in between 16 and 100 10-km squares of the National Grid. In some reviews this category is divided into:

- **Category A (Na)** - thought to occur in between 16 and 30 10-km squares
- **Category B (Nb)** - thought to occur in between 31 and 100 10-km squares

2. Status Categories and Criteria Version 2 (IUCN, 2001)

These later status categories and criteria are based on IUCN Red List Categories and Criteria version 3.1 (IUCN, 2001) and have been applied to British butterflies, dragonflies, water beetles and a few other invertebrate groups.

Critically Endangered (CR)

Definition: A taxon is Critically Endangered when the best available evidence indicates that it is facing an **extremely high** risk of extinction in the wild.

Endangered (EN)

Definition: A taxon is Endangered when the best available evidence indicates that it is facing a **very high** risk of extinction in the wild.

Vulnerable (VU)

Definition: A taxon is Vulnerable when the best available evidence indicates that it is facing a **high** risk of extinction in the wild.

N.B.: Species belonging to the above three categories may be collectively referred to as 'Threatened'.

Data Deficient (DD)

Definition: A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate.

The DD category effectively replaces the Indeterminate (RDBi) and Insufficiently Known (RDBK) categories of the earlier version.

Near Threatened (NT)

Definition: A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

Least Concern (LC)

Definition: A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

Not Applicable (NA)

Definition: A taxon is Not Applicable when it is regarded as a non-native in Britain, or occurs solely as a natural vagrant.

3. Status Categories and Criteria Version 3 (GB Rarity Status)

These status categories and criteria operate in parallel with version 2 and are defined specifically for use in Britain where they provide some continuity with version 1, allowing the continued use of "rare and scarce" species for site assessment purposes.

Nationally Rare (NR)

Definition: Native species which have not been recorded from more than 15 British hectads in recent decades and where there is reasonable confidence that exhaustive recording would not find them in more than 15 hectads. This category includes species which are probably extinct.

Nationally Scarce (NS)

Definition: Native species which are not regarded as Nationally Rare AND which have not been recorded from more than 100 British hectads in recent decades and where

there is reasonable confidence that exhaustive recording would not find them in more than 100 hectads.

4. Section 41 species

Species of Principal Importance in England (i.e. conservation priority species) listed in Section 41 of The Natural Environment and Rural Communities Act 2006 (c 16), also referred to as the NERC Act (2006). The Section 41 list features a somewhat subjective choice of species in that it does not include many critically endangered species and also includes some species that are not especially rare and, in some cases, increasing. Nevertheless the Act requires local authorities, government departments, and others to have regard to the purposes of conserving biodiversity (especially S41 species) in a manner that is consistent with the exercise of their normal functions such as policy and decision-making. 'Conserving biodiversity' may include enhancing, restoring or protecting a population or a habitat.