A REVIEW OF THE POLLINATORS ASSOCIATED WITH DECAYING WOOD, OLD TREES AND TREE WOUNDS IN GREAT BRITAIN

Steven Falk 2021

A report for the Woodland Trust

Contents

Veteran beech trees at Wytham Woods, Oxfordshire. These rot-holes are used by scarce hoverflies such as *Pocota personata* and *Mallota cimbciformis*.

Summary

- This review identifies over 320 saproxylic insects that visit flowers on a regular or occasional basis in England, Wales and Scotland. That represents 16% of Britain's approximately 2000 saproxylic insects. However it does not cover saproxylic Hymenoptera Parasitica, the majority of fungus gnats or nocturnal flower-visiting by saproxylic moths, beetles and flies – due to such groups being either poorly studied or taxonomically challenging.
- That list comprises approximately 130 beetles, 85 flies, 35 bees and 75 wasps but it is not a sharply-defined list because species range from strongly saproxylic to weakly so, plus the flower-visiting credentials of some saproxylic insects are uncertain or presumed.
- The review highlights the tremendous variety of saproxylic microhabitats used by those species for larval development, including those associated with older living trees, as well as dead trees, detached dead wood, and wood-associated fungi.
- It also highlights the tremendous variety of flowers visited by saproxylic insects but shows the particularly high importance of common hawthorn, bramble and umbellifers such as hogweed, and stresses the need to promote suitable flowery habitat at sites with old trees or dead wood.
- The proportion of saproxylic flower-visitors with rarity grades or conservation statuses is shown to be unusually high for a habitat-based assemblage, reflecting the low coverage plus widespread decline and deterioration of habitats rich in dead wood and old trees.
- That, in turn, shows the great importance of ancient woodland, relict pasture-woodland and historic parkland for our scarcer saproxylic species and more exciting assemblages, some of which have international significance e.g. those of the New Forest and Windsor Forest/Great Park.
- Some recommendations for further work are suggested.

1 Introduction

1.1 Background and objectives

Pollinating insects and saproxylic insects are both huge and important ecological assemblages in Britain with perhaps approaching 6,000 species in the first category (Falk, unpublished) and over 2,000 in the second (Alexander, 2002 updated by the Ancient Tree Forum https://www.ancienttreeforum.co.uk/ancient-trees/ancient-tree-ecology-wildlife/invertebrates/). These categories are not mutually exclusive - some of the most stunning flower-visiting hoverflies and beetles are well-known as being associated with the old trees of ancient pasture-woodland and historic parkland. We also know that many rare and threatened species fall into that zone of overlap. However, it appears there has never been a thorough review of all the flower-visiting ***saproxylic pollinators*** in Britain, one that includes the smaller, less conspicuous or well-known taxa as well as the large and showy species, and considers the conservation issues that might be associated with saproxylic pollinators as a whole.

Such a review has two benefits. Firstly, it can allow us to assess the extent to which old trees, decaying wood, and associated microhabitats can help generate flower-visiting insects that can pollinate flowers in the immediate and wider landscape i.e. an aspect of the ***ecosystem services*** associated with those saproxylic pollinators. Secondly, it allows us to consider how we might design, manage and manipulate flowers in the landscape to serve the needs of saproxylic pollinator assemblages. Some of our rarest saproxylic insects have an obligate requirement for flowers to complete a lifecycle, and their floral requirements can be highly specific both in terms of flower species used, and the period in which foraging must take place. It is vital that we account for their foraging needs as well as their developmental ones, and ensure that ill-informed site management such as the casual removal of hawthorn or goat willow in a wood or hedge, or the strimming of hogweed in a woodland ride at its flowering peak, does not impact an important saproxylic pollinator population or assemblage.

The information this report assembles will hopefully assist landowners and conservation organisations to account for the full lifecycle needs of saproxylic pollinators and help the Woodland Trust furnish advice to others. Further, it can strengthen advocacy for better veteran tree and historic pasture-woodland protection and management, including the gaining of funding through Environmental Land Management schemes (ELMs) and other schemes. It is a working document and is not definite. We still have a lot to learn about saproxylic pollinators and their conservation. But hopefully, it helps reveal where some of the shortfalls of information lie and bring about the new research that is required to address this.

1.2 What is a pollinator?

This is an organism (typically an insect in Britain, but also a bird, bat or other animal elsewhere) that visits flowers regularly and is capable of transferring pollen between flowers of the same plant species in a manner that brings about ***pollination***

(fertilisation of a flower). That pollination can then initiate seed maturation including any associated fruit, nut or pod production (some of which can have commercial value). Some pollinators, such as bees, hoverflies and moths can be extremely efficient and effective because they often pick up quite a lot of pollen on their bodies as they visit flowers, and then move very actively between flowers. They don't behave like this to pollinate; they visit flowers either to eat (or in the case of a bee, collect) proteinaceous pollen or to drink sugar-rich nectar. Pollination is an evolution-driven consequence of this behaviour – one that has seen co-evolution of flowering plants and insects stretching back millions of years.

Other insects are less effective at pollination than bees, hoverflies and moths, maybe because they are less hairy and therefore pick up less pollen on their body, or because they are less active and therefore less efficient at pollen transfer. Some insects are probably only marginal pollinators, especially the smaller and less hairy flies and beetles. But if you undertake macrophotography of the last category, you can still often see the odd pollen grain attached to their body, so one has to assume they can still deliver pollination albeit at a low level of efficiency – and if they happen to be very abundant, lots of marginal pollinators may add up to quite a lot of pollination.

1.3 What is a saproxylic insect?

These are the insects that rely heavily on dead wood or tree wounds to complete a lifecycle. Such lifecycles cover a surprisingly diverse array of larval development locations that include the following:

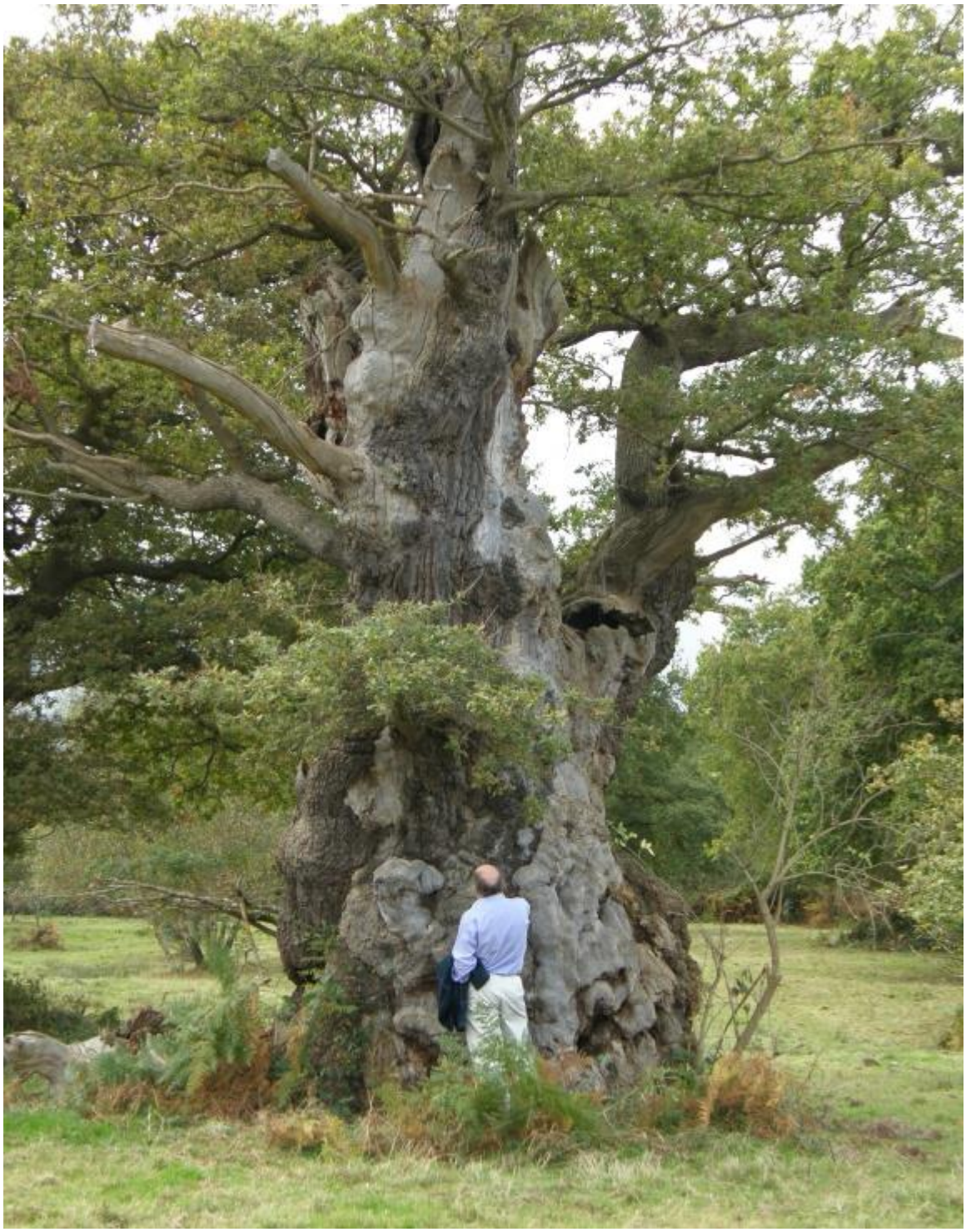
- The dead parts of living trees such as heart-rot, rot-holes, hollow trunks, dead limbs and dead roots.
- The wounds of living trees such as sap-runs.
- Dead standing or fallen trees.
- Stumps and detached dead wood such as fallen branches.
- The fungi, mosses and lichens associated with old trees, dead wood and tree wounds.
- Exposed root-plates of wind-blown trees.

The insect lifecycle types (or lifecycle requirement) associated with those saproxylic locations include:

- Xylophagous - eating wood.
- Saprophagous – eating some other decaying substance associated with saproxylic locations such as bat droppings, bird guano or accumulated leaves.
- Fungivorous – specifically eating fungi.
- Scavenging – eating the dead parts of other animals.
- Predatory – eating other living animals (typically other insects/invertebrates) as prey (as opposed to developmental hosts).
- Parasitoidal – eating other living insects/invertebrates as developmental hosts (as opposed to prey).
- Cleptoparasitic – stealing the nest or other developmental provisions (e.g. larval food) of another species to bring about its own development.
- Aquatic – requiring water e.g. water-filled tree rot-holes for development.

- A nesting location – for various bees and wasps that use old/dead trees, or detached dead wood, or the earth attached to an exposed root-plate, as a place to nest.

All the above nine categories contain flower-visiting species. A major objective of this review is to better understand the individual species involved and the conservation requirements and ecosystem services associated with them.



An ancient oak at Windsor Great Park. Windsor has the largest number of ancient trees for any site in Western Europe.

2 Methodology

2.1 Ascertaining lifecycles

For many groups of insects, saproxylic lifestyles (and often the details of these such as precise development locations) are well flagged in literature or on the internet. Just within Britain, the number of publications providing details for saproxylic insects runs into the thousands. It includes:

- Papers featuring saproxylic species in the various entomological journals and newsletters such as *British Journal of Entomology and Natural History*, *Entomologist's Monthly Magazine*, *The Entomologists Record and Journal of Variation*, *Dipterists Digest*, *The Coleopterist*, *Insect Conservation and Diversity*, *Bulletin of the Dipterists Forum*, and *BWARS Newsletter*.
- Useful papers in more local journals such as the *Worcestershire Record*, *Transactions of the Suffolk Naturalists' Society*, and the *Proceedings* of the *Cotteswold Naturalists' Field Club*.
- National and county atlases such as the *Provisional atlas of British hoverflies* (Ball & Morris, 2000), the various Bees, Wasps and Ants Recording Society (BWARS) atlases, *Hoverflies of Surrey* (Morris, 1998) and *An Atlas of Warwickshire* Beetles (Lane, Wright & Forsythe, 2002). These often contain useful and original information in their species accounts.
- Technical reports such as the very comprehensive checklist of saproxylic invertebrates provided by Alexander (2002), various national reviews of scarcer species published by statutory agencies (see section 2.5 for a list of relevant ones), autecological reports such as Rotheray (2004) for the hoverfly *Callicera spinolae*, and symposium/conference reports such as *Dead Wood Matters* (Kirby & Drake, 1992).
- The various books that compile and summarise much of the information above such as *British Hoverflies* (Stubbs & Falk, 2002), the *Beetles of Britain and Ireland* series (Duff, 2012, 2016, 2020), *A Dipterists Handbook* (Chandler, 2010), and various Royal Entomological Society handbooks (e.g. D'Assis Fonseca, 1968 and Smith, 1989).
- Popular articles such as the illustrated review of longhorn beetles (Duff, 2007) and an article on the ecology of the Noble Chafer in orchards (Alexander & Bowers, 2011) in *British Wildlife* magazine.
- Unpublished reports that have been circulated within the entomological community such as Stuart Ball's account of muscid flies (Ball, 2010).

These are augmented by much published abroad through journals, international symposium reports and key books.

British websites that furnish information on saproxylic species include:

- Hoverfly Recording Scheme http://sgbtest.me.uk/hrs/
- The Bees, Wasps and Ants Recording Society (BWARS), www.bwars.com
- UK Beetle Recording https://www.coleoptera.org.uk/,
- UK Beetles: https://www.ukbeetles.co.uk/
- Steven Falk Flickr:

https://www.flickr.com/photos/63075200@N07/collections/

The blog sites/websites of key entomologists such as Mark Telfer http://www.markgtelfer.co.uk/ and Graeme Lyons http://analternativenaturalhistoryofsussex.blogspot.com/ also contain useful and often original information. Online fact sheets for rare and iconic species such as Noble Chafer and Violet Click Beetle have been produced by organisations such as the People's Trust for Endangered Species, Buglife and the Woodland Trust.

It needs to be stressed that having assembled information, it is clear that there is a range of fidelity associated with saproxylic development. Whilst some species might have an obligate requirement for veteran trees or dead wood in very natural conditions, others can also use less natural dead wood items such as fence posts and building timbers, and may even use nesting locations that do not involve wood at all on occasion. This report attempts to include all flower-visiting species that have at least a partial reliance on the saproxylic conditions described in 1.3 i.e. more than just a minor or incidental association with them.

2.2 Ascertaining flowers visited

For many of the more frequent and readily-identifiable saproxylic insects such as the longhorn beetle *Rutpela maculata* or hoverfly *Myathropa florea*, flower-visiting is beyond dispute and can be easily observed in the field by an active naturalist. For other species it can be deduced by a quick check of images on the internet. Much of the formally and informally published information listed in 2.1 can also furnish flower-visiting data. In addition those sources, the author has carried out many surveys of pollinators in assorted habitats throughout Great Britain for over 40 years and has generated much species-level flower-visitation information in assorted technical reports, spreadsheets, hand-written lists, and in the form of photographic records. These have contributed substantially to the species accounts in this report.

Not infrequently, the flower-visiting information in literature is incomplete and might simply cite 'spring blossom and umbellifers' when in reality a much broader range of flowers is used, or otherwise masks a close association with hawthorn or hogweed specifically. This is where additional photographic information on the internet can be useful. However, using photos from the internet has to be done with great care. Photos are frequently misidentified, even those supplied by well-known stock libraries. An experienced photographer might not be such an experienced entomologist – a photo of a bee beetle labelled *Trichius fasciatus* taken in France might actually be *T. gallicus*, and photographs of the smaller flower-visiting beetles such as scaptiids or wasps of genera such as *Ancistrocerus* and *Chrysis* are likely to have very high error rates. Some mistakes can be even more fundamental than that such as hoverflies labelled as bees! Professional judgement has been exercised to ensure trustworthy images are used.

Interpreting the flowers involved can also be tricky, especially if the photo has a non-British source or only features a small part of a flower. The author is a fairly experienced botanist (author of a county flora for Warwickshire and with a very

extensive image library of flowers) which helps. But again, great care is needed. Even if the insect and flower species can be ascertained, an image may still be misleading. Many photographers will stage a sluggish but showy saproxylic insect such as a large longhorn (e.g. *Lamia textor* which is not a flower visitor as far as can be told) or chafer beetle on a flower for photographic effect. These photos can then end up in literature or on the internet and become quoted visitation records when the only reason they are on a flower is because the photographer put them there. With experience, it is often possible to spot posed images. In other instances, an insect may genuinely be on a flower, but for non-feeding, incidental reasons e.g a *Trichius fasciatus* beetle sitting on a harebell flower having been crawling about.

Extrapolating flower-visiting for species within a genus is another activity requiring care. It is easy to assume that a scarce species with no flower-visiting data probably is a flower-visitor if other members of its genus are. This can be unsafe. Within the saproxylic hoverfly genus *Xylota* for example, only one species (*X. jakutorum*) is a regular flower visitor. The other six British *Xylota* species are rarely found on flowers and *X. xanthocnema* seemingly has no flower-visiting data. With this in mind, the author has exercised a degree of professional judgement in arriving at the species list in Table 1. Given time, it is likely that additional saproxylic flower-visitors will come to light or that some of those tentatively listed as flower visitors will prove not to be. The same also applies to lifecycles. A genus, subfamily or family dominated by saproxylic species may contain some species that are non-saproxylic (e.g. the wood ant-associated chafer *Protaetia metallica* within the mostly saproxylic chafer subfamily Cetoniinae). Conversely, a genus that is mostly non-saproxylic, such as the hoverfly genus *Volucella*, may contain a species that is (the sap run-associated *Volucella inflata*).

The final cautionary note relates to the range and variety of flowers visited by a saproxylic species. The commoner species with more records will tend to have accumulated longer lists of visited flowers. Take a more common and widespread, spring-active saproxylic insect that likes shrub and trees blossoms for example. It might have records for hawthorn, blackthorn, wild cherry, bird cherry, cherry laurel and rowan. However, a closely related but much rarer species using a similar range of blossoms might have only accumulated records for hawthorn, simply as a result of fewer observations.

2.3 Taxonomic scope

This review has concentrated on Coleoptera (beetles), Diptera (flies) and aculeate Hymenoptera (bees and aculeate wasps). Some of the saproxylic moths listed in Alexander (2002) may be nocturnal flower visitors though it appears that many are not. For those few moths that might be (e.g. the Waved Black *Parascotia fuliginaria*) there seem to be no published information for flower visitations which is hardly surprising for a night-active insect that is difficult to observe. Lepidoptera have therefore not been covered in this review.

Hymenoptera Parasitica (e.g. ichneumon wasps) are briefly covered in section 6.7 but no detailed species-level information has been provided because of the poor

state of knowledge associated with these insects. The same as applies to fungus gnats of the family Mycetophilidae.

2.4 Geographic scope
This review has covered England, Wales and Scotland, as this coincides with the major statutory agency status reviews of scarcer species. These reviews do not cover Ireland.

2.5 Ascertaining conservation statuses
National conservation statuses include Red Data Book (RDB) Categories 1, 2, 3 and K, IUCN threat statuses, Nationally Scarce or Notable statuses, or anything listed in Section 41 of the 2006 Natural Environment and Rural Communities (NERC) Act as a conservation priority species. Definitions for these categories are given in Appendix 2 at the end of this report. The following taxonomic status reviews were used for checking the conservation statuses of species recorded:

- **Coleoptera:** Alexander (2014, 2017, 2019), Alexander, Dodd & Denton (2014), Hyman & Parsons (1992, 1994).

- **Diptera:** Ball & Morris (2014), Drake (2017, 2018), Falk (1991b), Falk, Pont & Chandler (2005), Falk & Crossley (2005), Falk, Ismay & Chandler (2016), Falk & Pont (2017).

- **Hymenoptera aculeata:** Falk (1991a)

It should be noted that some of the Nature Conservancy Council 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 though these are gradually being replaced by more up-to-date JNCC and Natural England ones.

2.6 Checking national distributions
This has been done using the latest information to hand. This tends to be online, constantly-updated websites such as the

- National Biodiversity Network (NBN) https://species.nbnatlas.org/
- Hoverfly Recording Scheme http://sgbtest.me.uk/hrs/
- Bees, Wasps and Ants Recording Society (BWARS) https://www.bwars.com/
- Soldierflies & allies Recording Scheme https://www.brc.ac.uk/soldierflies-and-allies/

It should be noted that NBN maps can be very incomplete for some species and often contain spurious and unverified data that fails to correlate with literature or other maps of a more reliable nature such as those of BWARS. Maps can also fail to give information on precise locations for some of our rarest saproxylic flower-visitors, so the distributional information available from those sources listed in 2.1 has also been used for rarer species.

2.7 Format of species accounts

Two forms of species account are included in this review. For the better-known species with strong saproxylic and flower-visiting credentials such as longhorn beetles, chafers, cardinal beetles and hoverflies, relatively detailed species accounts have been produced. These comprise:

- A general statement – a sort of high-level strapline for a species.
- Lifecycle and habitat requirements – a summary of what is known of the larval habits and habitat needs.
- Flowers visited – a list of flowers known to be visited.
- Status and distribution – a summary of the frequency and range with a note of any conservation status(es) and a hyperlink to any up-to-date online map.
- Conservation requirements – a simple summary of the main action required to conserve a species based on what we know of its ecology.
- Key references – a few of the most important references for a given species (including any key autecological papers); also a hyperlink to my Flickr site for some of the species covered (as this furnishes a trustworthy photo gallery and species account) or any key online species accounts, such as those provided by UK Beetles: https://www.ukbeetles.co.uk/.

Less detailed, often aggregate accounts have been produced for less well understood species or those with weaker saproxylic or flower-visiting credentials such as mordellid and nitidulid beetles, fanniid and muscid flies, and most aerial nesting bees and wasps.

2.8 Nomenclature and naming conventions

Scientific names generally follow those of the NBN which in turn usually accord with the latest literature. However, these names can vary from names used in older publications such as Hyman & Parson (1992, 1994) or some of the older Royal Entomological Society handbooks. In some instances both genus and species name may have changed over time. Another issue is species splits and species mergers. Name changes and taxonomic revisions have been accounted for wherever possible to ensure that the species information presented is as accurate and up-to-date as possible.

Any English (vernacular) names for insects in popular usage (notably those for longhorn beetles, chafer beetles, some of the rare click beetles and bees) have been cited at the top or start of any species accounts. A couple of the names are my inventions for species in popular families that did not appear to have a name e.g. Attenuated Longhorn for *Strangalia attenuata* and Heart-marked Longhorn for *Stictoleptura cordigera*.

Plant scientific names have been placed in a separate Appendix at the end of this review rather than embedded in the main text to make report production easier. The normal convention for using a capital at the start of a species-level English plant name (i.e treating it as a proper noun) has been deliberately dropped. This is because it is unclear much of the time whether the source information is truly species-specific. A reference to ‘hawthorn’ for example might be referring to

Common Hawthorn or more loosely to any hawthorn (Common, Midland or even a continental species). A similar situation applies to 'oak', 'maple', 'lime', 'willow', 'dogwood' and many of the flowers mentioned, and whilst Aspen probably refers strictly to *Populus tremula*, and Sycamore to *Acer pseudoplatanus*, one could end up with a confusing and subjective application of capitals within the text. So to avoid a messy mix of capitalised and non-capitalised names, and any chance of misrepresenting information, I have totally removed capitals from English plant names.

2.9 Limitations

As alluded to earlier, this review has some limitations in scope. It does not cover four categories of saproxylic flower-visitors:

- nocturnal pollinators
- species of the Hymenoptera Parasitica (e.g ichneumon wasps)
- fungus gnats of the family Mycetophilidae
- non-established introductions/adventives/vagrants
- species only known from the fossil or archaeological record

For the categories covered, the review does not claim to represent an exhaustive trawl for information but is certainly an extensive one. To have checked runs of all the British and foreign entomological journals and other literature for information on lifecycles or flower visits, or to have contacted every entomologist in the UK likely to hold data on saproxylic pollinators would have been a massive undertaking. However, a first draft of the report was sent to a number of Britain's leading dipterists, coleopterists and pollinator experts (see Acknowledgements). This has corrected or refined a good number of species accounts and added quite a few species to the list. There is little doubt that further correspondence would have continued to extend the list of species and flower-visitations by individual species. Inevitably a level of pragmatism needs to be exercised. It should be noted that, having gathered lots of information, there can appear contradictions concerning details of the lifecycle (sometimes even within the work of a single author). This has been negotiated using professional judgement and the author takes full responsibility for what appears here.

3 Results

3.1 A provisional list of Britain's flower-visiting saproxylics

This is provided in Table 1. The table uses conventions and abbreviations that are explained below

Conventions

- An asterix (*) after the scientific name indicates a species that is facultatively rather than obligately saproxylic.
- A question mark after a scientific name means that flower visiting is suspected but not proven.

Abbreviations (ecological)

Ash, Aspen, Beech, Oak, Pine, OrchardTrees – special reliance on 1-2 of these trees
Conif – associated with conifers
Conif(Cal) – characteristic Caledonian pine forest species
Fungi – specific or strong association with fungal fruiting bodies
NestPara – a cleptoparasite or parasitoid using wood/tree-nesting wasps & bees
NestSite – using dead wood/trees as a nest site
RedRot – specific or strong association with red-rotted decay
RotHole – specific or strong association with rot-holes
RootPlate –using root-plates of wind-blown for nesting
Sap – specific or strong association with sap-runs
Subm – able to use semi-submerged dead wood
WhiteRot – specific or strong association with white-rotted decay

The larval requirement column picks out specific, known associations with a tree species, type of decay, or other microhabitat. Most fields in this column are left empty, reflecting that most species develop under bark, in decaying sapwood or heartwood, in standing or lying dead wood of assorted tree species.

Abbreviations (conservation statuses) – see Appendix 2 for definitions

Old rarity grades:

- RDB1 – Nationally Endangered
- RDB2 – Nationally Vulnerable
- RDB3 – Nationally Rare (old version)
- RRBK/RDBI – Rare, Insufficiently known/Indeterminate
- NS(Na) – Nationally Scarce (Notable A)
- NS(Nb) – Nationally Scarce (Notable B)
- Ext - Extinct

IUCN threat levels:

- CR - Critically Endangered
- EN - Endangered
- VU - Vulnerable
- DD – Data Deficient
- NT – Near Threatened
- LC – Least Concern

- NA – Not Applicable
- RE – Regionally Extinct

Modern rarity grades:

- NR – Nationally Rare (new version)
- NS – Nationally Scarce

Conservation priority status

- S41 – Section 41 conservation priority species
- Scot – Scotland Priority Species

Table 1. A list of British saproxylic insects that are known or suspected to visit flowers

Species	Larval requirement	BL v Conif	Status
COLEOPTERA			
Aderidae			
Aderus populneus	RedRot	BL	LC/NS
Euglenes oculatus	Oak, RedRot	BL	LC/NS
Buprestidae			
Anthaxia nitidula		BL	Ext
Agrilus sulcicollis			-
Cantharidae			
Malthinus flaveolus		BL	
Malthinus seriepunctatus		BL	
Malthodes fuscus		BL	
Malthodes marginatus		BL	
Malthodes minimus		BL	
*Malthodes pumilus**		BL	LC/NS
Cerambycidae			
Alosterna tabacicolor		BL & Conif	
Anaglyptus mysticus		BL	
Anastrangalia sanguinolenta	Pine	Conif(Cal)	CR/NR
Anoplodera sexguttata		BL	NT/NR
Aromia moschata		BL	
Clytus arietus		BL & Conif	
Dinoptera collaris		BL	RE/Ext
Glaphyra umbellatarum		BL	LC/NS
Grammoptera abdominalis		BL	LC/NS
Grammoptera ruficornis		BL	
Grammoptera ustulata		BL	LC/NR
Judolia sexmaculata	Pine	Conif(Cal)	VU/NR
Leptura aurulenta	Oak	BL	LC/NS
Leptura quadrifasciata		BL	
Lepturobosca virens		Conif	NA
Molorchus minor		Conif	
Pachytodes cerambyciformis		BL & Conif	
Paracorymbia fulva		BL	LC/NS

Pedostrangalia revestita	Oak, RedRot	BL	EN/NR
Pogonocherus hispidulus		BL	
Pogonocherus hispidus		BL	
Rhagium bifasciatum		BL & Conif	
Rhagium inquisitor	Pine	Conif(Cal)	LC/NS
Rhagium mordax		BL	
Rutpela maculata		BL & Conif	
Stenocorus meridianus		BL	
Stenurella melanura		BL & Conif	
Stenurella nigra		BL	LC/NS
Stictoleptura cordigera		BL	
Stictoleptura rubra		Conif	
Stictoleptura scutellata	Beech	BL	LC/NS
Strangalia attenuata		BL	NA
Tetrops praeustus	OrchardTrees	BL	
Tetrops starkii		BL	NA
Cleridae			
*Korynetes caeruleus**		BL	LS/NS
Tilloidea unifasciata		BL	Ext
Tillus elongatus		BL	LC/NS
Cryptophagidae			
Cryptophagus scanicus			
Some *Micrambe* species	Fungi		-
Cucujidae			
Pediacus dermestoides		BL	
Dermestidae			
Globicornis rufitarsis (= nigripes)	Oak	BL	VU/NR
*Megatoma undata**		BL	LC/NS
*Trinodes hirtus**		BL	NT/NR
Elateridae			
Ampedus balteatus	RedRot	BL & Conif	
Ampedus elongantulus	RedRot	BL & conif	NS(Na)
Ampedus nigerrimus	Oak, RedRot	BL & Conif	RDB1, S41
Ampedus quercicola	RedRot	BL	NS(Nb)
Ampedus sanguinolentus		BL	NS(Na)
Calambus bipustulatus		BL	NS(Nb)
*Hemicrepidius hirtus**			
Limoniscus violaceus	Beech, Ash	BL	RDB1, S41
Megapenthes lugens	Beech	BL	RDB1, S41
Procraerus tibialis		BL	RDB3
Eucinetidae			
Nycteus meridionalis	Pine	Conif	
Lycidae			
Dictyoptera aurora	Pine	Conif (Cal)	VU/NR
Erotides cosnardi?	Beech	BL	EN/NR, S41
Platycis minutus	WhiteRot	BL	
Pyropterus nigroruber?	WhiteRot	BL & Conif	LC/NS
Melandryidae			
Anisoxya fuscula		BL	

Orchesia undulata	Oak, Fungi	BL	
Osphya bipunctata		BL	LC/NS
Melyridae			
*Anthocomus fasciatus**		BL	LC/NS
Aplocnemus impressus		BL	LC/NS
Aplocnemus nigricornis		BL	LC/NS
Dasytes aeratus		BL	
Dasytes niger		BL & Conif	LC/NR
Dasytes plumbeus		BL	LC/NS
Dasytes virens		BL	NT/NR
*Malachius aeneus**			NT/NR
*Malachius bipustulatus**			
Mordellidae			
Mordella holomelaena			VU/NR
Mordella leucaspis?			VU/NR
Mordellistena humeralis		BL	LC/NS
Mordellistena neuwaldeggiana		BL	LC/NS
Mordellistena variegata		BL	LC/NS
Mordellochroa abdominalis		BL	
Tomoxia bucephala		BL	LC/NS
Variimorda villosa		BL	LC/NS
Nitidulidae			
Epuraea biguttata			
Epuraea longula		BL	Nb
Epuraea marseuli		BL?	
Epuraea melanocephala		BL?	
Epuraea melina		BL?	
Epuraea pallescens		BL?	
Epuraea rufomarginata		BL?	
Epuraea silacea	Birch	BL	RDB3
Soronia grisea	Sap	BL	
Oedemeridae			
Chrysanthia nigricornis	Pine	Conif(Cal)	VU/NR
Ischnomera caerulea		BL	LC/NS
Ischnomera cinerascens		BL	LC/NS
Ischnomera cyanea	WhiteRot	BL	
Ischnomera sanguinollis		BL	LC/NS
Ptinidae			
Hedobia imperialis		BL	
Pyrochroidae			
Pyrochroa coccinea		BL	
Pyrochroa serraticornis		BL	
Scarabaeidae			
*Cetonia aurata**		BL	
Gnorimus nobilis	Oak, Beech, OrchardTrees	BL	VU/NS, S41
Gnorimus variabilis	Oak, Beech, RedRot	BL	EN/NR, S41
Trichius fasciatus	Birch	BL	

Trichius gallicus		BL	
Valgus hemipterus		BL	
Scraptiidae			
Anaspis bohemica	Pine	Conif(Cal)	VU/NR
Anaspis costai		BL?	LC/NS
Anaspis fasciata		BL	
Anaspis frontalis		BL?	
Anaspis garneysi		BL?	
Anaspis lurida		BL	
Anaspis maculata		BL	
Anaspis pulicaria		BL?	
Anaspis regimbarti		BL	
Anaspis rufilabris		BL	
Anaspis thoracica		BL	LC/NS
Scraptia dubia		?	RE/Ext
Scraptia fuscula	Oak	BL	VU/NR
Scraptia testacea	Oak, RedRot	BL	LC/NS
Staphylinidae			
Dropephylla ioptera		BL	
Hapalaraea pygmaea		BL	
Phyllodrepa nigra		BL	RDBI
Tenebrionidae			
Gonodera luperus		BL	LC/NS
Pseudocistela ceramboides	Oak	BL	LC/NS
DIPTERA			
Anthomyiidae			
Pegomya transversa?*	Fungi		
Bombyliidae			
*Anthrax anthrax**	NestPara		
Bombylius species*	RootPlate, NestPara		
Calliphoridae			
*Bellardia bayeri**		BL?	
Empididae			
Dryodromia testacea	Beech?	BL	LR/NS
Fanniidae			
Fannia aequilineata		BL	NS
Fannia gotlandica?		BL	NS
Hybotidae			
Anthalia beatricella		BL	LR/NT
Euthyneura albipennis	Beech?	BL	VU
Euthyneura gyllenhali		BL & Conif	
Euthyneura halidayi		BL & Conif?	
Euthyneura inermis		BL	LR/NS
Euthyneura myrtilli		BL	
Oedalea apicalis		BL	LR/NS
Keroplatidae			
Macrorrhyncha flava		BL?	
Macrorrhyncha hugoi?		BL?	VU
Lonchaeidae			

Lonchaea peregrina		BL	
Lonchaea subneatosa		BL	
Muscidae			
Helina abdominalis?	RotHole	BL	NS
Helina pertusa?		BL	
Hydrotaea lundbecki?	Beech	BL	DD
Mydaea maculiventris?	Fungi	BL?	NS
Phaonia bitincta?		BL	NT
Phaonia canescens?		BL	NT
Phaonia cincta?	SapRun, RotHole	BL	NS
Phaonia exoleta?	RotHole	BL	NS
Phaonia goberti?		BL	
Phaonia laeta?	SapRun, RotHole	BL	NS
Phaonia mystica?		BL	NS
Phaonia palpata?		BL & Conif?	
Phaonia pratensis?	RotHole	BL	NS
*Phaonia rufiventris**		BL & Conif?	
Phaonia tiefii?		BL	
Potamia setifemur?	RotHol	NL	DD
Mycetophilidae			
Potentially dozens of species		BL & Conif	-
Sarcophagidae			
*Amobia signata**	NestPara		
*Macronychia agrestis**	NestPara		
*Macronychia dolini**	NestPara		NS
*Macronychia polyodon**	NestPara		NS
*Macronychia striginervis**	NestPara		
Oebalea (2 species)?*	NestPara		-
Stratiomyidae			
Chorisops tibialis?*			
Syrphidae			
Blera fallax	Pine, RotHole	Conif(Cal)	CR, Scot
Brachyopa bicolor	SapRun	BL	NS
Brachyopa insensilis	SapRun	BL	
Brachyopa pilosa	SapRun?	BL	NS
Brachyopa scutellaris	SapRun	BL	
Brachypalpoides lentus		BL	
Brachypalpus laphriformis	Oak	BL	
Caliprobola speciosa	Beech	BL	NT
Callicera aurata	RotHole	BL	NS
Callicera rufa	Pine, RotHole	Conif(Cal)	NS
Callicera spinolae	RotHole	BL	VU, S41
Chalcosyrphus eunotus	Subm	BL	NS
Chalcosyrphus nemorum	Subm	BL	
Criorhina asilica		BL	
Criorhina berberina		BL	
Criorhina floccosa		BL	
Criorhina ranunculi		BL	
Ferdinandea cuprea	SapRun	BL	

Ferdinandea ruficornis	Oak, SapRun	BL	NS
Hammerschmidtia ferruginea	Aspen	BL	EN, Scot
Mallota cimbiciformis	RotHole	BL	NS
Myathropa florea	RotHole	BL & Conif	
Myolepta dubia	RotHole	BL	NS
Myolepta potens	RotHole	BL	CR, S41
Pocota personata	RotHole	BL	NS
Psilota anthracina	SapRun	BL	NS
Sphegina clunipes	SapRun, RotHole, Subm	BL & Conif	
Sphegina elegans	Subm	BL	
Sphegina sibirica		Conif	
Sphegina verecunda	SapRun	BL	
Xylota abiens		BL & Conif	NS
Xylota florum	Subm	BL & Conif	
Xylota jakutorum		Conif(Cal)	
*Xylota segnis**		BL & Conif	
Xylota sylvarum		BL & Conif	
Xylota tarda	Aspen	BL	NS
Xylota xanthocnema?	Rothole	BL & Conif	
Volucella inflata	SapRun	BL	
Tachinidae			
Admontia maculisquama?*		BL	
Admontia seria?		BL	NT
Billaea irrorata		BL	NT
Elodia ambulatoria?	Fungi	?	NT
Leskia aurea		BL	DD
Xylotachina diluta?	Oak	BL	DD
Tipulidae			
Ctenophora flaveolata		BL	RDB2
Ctenophora pectinicornis		BL	NS
HYMENOPTERA			
Apidae			
Andrena species*	RootPlate, NestSite		-
*Anthidium manicatum**	NestSite		
*Anthophora furcata**	NestSite		
*Anthophora plumipes**	RootPlate, NestSite		
*Apis mellifera**	NestSite		
*Bombus hypnorum etc.**	NestSite		-
*Cholostoma campanularum**	NestSite		
*Chelostoma florisomne**	NestSite		
*Coelioxys elongata**	NestPara		
*Coelioxys inermis**	NestPara		
*Coelioxys quadridentata**	NestPara		
*Coelioxys rufescens**	NestPara		RDB3
*Heriades truncorum**	NestSite		
Halictus species*	RootPlate, NestSite		
*Hoplitis adunca**	NestSite		

*Hoplitis claviventris**	NestSite		
*Hylaeus communis**	NestSite		
*Hylaeus confusus**	NestSite		
*Hylaeus hyalinatus**	NestSite		
*Hylaeus incongruus**	NestSite		RDB3
*Lasioglossum species**	RootPlate, NestSite		
*Megachile centuncularis**	NestSite		
*Megachile ligniseca**	NestSite		
*Megachile versicolor**	NestSite		
*Megachile willughbiella**	NestSite		
*Melecta albifrons**	NestPara		
*Nomada species**	RootPlate, NestPara		-
*Osmia bicornis**	NestSite		
*Osmia caerulescens**	NestSite		
*Osmia cornuta**	NestSite		
*Osmia leaiana**	NestSite		
*Osmia niveata**	NestSite		
Osmia pilicornis	NestSite		NS(Na)
Osmia uncinata	Pine, NestSite	Conif(Cal)	RDB2, Scot
Sphecodes species*	RootPlate/NestPara		-
*Stelis breviuscula**	NestPara		
*Stelis phaeoptera**	NestPara		
*Stelis punctulatissima**	NestPara		
*Xylocopa violacea**	NestSite		
Chrysididae			
*Chrysis angustula**	NestPara		
*Chrysis fulgida**	NestPara		RDB1, S41
*Chrysis gracillima**	NestPara		RDB2
*Chrysis ignita**	NestPara		
*Chrysis impressa**	NestPara		
*Chrysis longula**	NestPara		RDB3, S41
*Chrysis pseudobrevitarsis**	NestPara		RDB2
*Chrysis terminata**	NestPara		
*Chrysis viridula**	RootPlate, NestPara		
*Chrysura hirsuta**	NestPara	Conif(Cal)	RDB3
*Chrysura radians**	NestPara		NS(Na)
*Omalus aeneus**	NestPara		
*Omalus puncticollis**	NestPara		NS(Na)
*Pseudomalus auratus**	NestPara		
*Pseudomalus violaceus**	NestPara		
*Trichrysis cyanea**	NestPara		
Crabronidae			
*Crossocerus annulipes**	NestSite		
*Crossocerus binotatus**	NestSite		NS(Nb)
*Crossocerus cetratus**	NestSite		
*Crossocerus dimidiatus**	NestSite		
Crossocerus leucostomus	NestSite	Conif(Cal)	NS(Na)
Crossocerus megacephalus	NestSite		

Crossocerus nigritus	NestSite		
*Crossocerus podagricus**	NestSite		
Crossocerus vagabundus	NestSite		RDB1
Crossocerus walkeri	NestSite		NS(Nb)
*Ectemnius borealis**	NestSite		RDB3
*Ectemnius cavifrons**	NestSite		
*Ectemnius cephalotes**	NestSite		
*Ectemnius continuus**	NestSite		
*Ectemnius dives**	NestSite		
*Ectemnius lapidarius**	NestSite		
*Ectemnius lituratus**	NestSite		
*Ectemnius ruficornis**	NestSite		NS(Nb)
*Ectemnius sexcinctus**	NestSite		NS(Nb)
*Lestica clypeata**	NestSite		Ext
*Mimumesa dahlbomi**	NestSite		
Nitela species?*	NestSite		-
Passaloecus species?*	NestSite		-
*Pemphredon inornata**	NestSite		
*Pemphredon lethifer**	NestSite		
*Pemphredon lugubris**	NestSite		
*Pemphredon morio**	NestSite		NS(Nb)
*Pemphredon rugifera**	NestSite	BL & Conif	RDB3
*Rhopalum coarctatum**	NestSite		
*Psenulus chevrieri**	NestSite		
*Psenulus concolor**	NestSite		
*Psenulus pallipes**	NestSite		
*Psenulus schencki**	NestSite		NS(Nb)
*Spilomena beata**			
*Spilomena curruca**	NestSite		-
*Spilomena differens**	NestSite		
*Spilomena enslini**	NestSite		
*Spilomena troglodytes**	NestSite		
*Stigmus species?**	NestSite		-
Trypoxylon species?*	NestSite		-
Pompilidae			
*Auplopus carbonarius**	NestSite		NS(Nb)
Dipogon bifasciatus?*	NestSite		RDB3
Dipogon subintermedius?*	NestSite		
Dipogon variegatus?*	NestSite		
Ground-nesting Arachnospila, Priocnems species etc.*	RootPlate, NestSite		-
Sapygidae			
*Monosapyga clavicornis**	NestSite		NS(Nb)
*Sapyga qunquepunctata**	NestSite		
Vespidae			
*Ancistrocerus antilope**	NestSite		RDB3
*Ancistrocerus gazella**	NestSite		
*Ancisrocerus nigricornis**	NestSite		

*Ancistrocerus parietum**	NestSite		
*Ancistrocerus parietinus**	NestSite		
*Ancistrocerus trifasciatus**	NestSite		
*Microdynerus exilis**	NestSite		NS(Nb)
*Odynerus spinipes**	RootPlate, NestSite		
*Symmorphus bifasciatus**	NestSite (Willow for prey)		
*Symmorphus connexs**	NestSite (Aspen for prey)		RDB3
*Symmorphus crassicornis**	NestSite (Aspen for prey)		RDB3
*Symmorphus gracilis**	NestSite		
*Vespa crabro**	NestSite		
Vespula/Dolichovespula species*	NestSite		-

3.2 General diversity

Table 1 identifies over 320 species that can be considered proven or probable saproxylic species (at least to a significant extent) that are also proven/probable/possible flower visitors. This is by necessity vague because a proportion of this total is represented by poorly-understood species or species that are on the cusp of being significantly saproxylic or only partially so. A fair amount of subjective professional judgement has been exercised but as we improve our understanding of these species it may be possible to refine this list. The list is made up of approximately 130 beetles, 85 flies, 35 bees and 75 wasps. In terms of key insect groups, longhorns are represented by 34 species, click beetles by 10 species, chafers by 6 species, hoverflies by 38 species and bees by 32 species (excluding those occasionally using root-plates). The list represents about 16% of the UK's saproxylic species.

3.3 Ecological assemblages

The vast majority of species are totally or predominantly associated with broadleaved trees/wood. 15 species are wholly associated with conifer trees/wood, of which 14 are totally, substantially or regularly found in ancient Caledonian pine forest. At least 20 species (excluding wood-nesting wasps and bees) can use both broadleaved and coniferous trees/wood for larval development. That figure is complicated by the fact that some species that only seem to use broadleaved trees in Britain, seem to also use conifers on the Continent. Table 1 has attempted to flag species associated with rot-holes, sap-runs, red rot, fungi, semi-submerged dead wood, and individual tree species. Again this is complicated by the fact that many species straddle two or more categories, the existence of contradictory information within literature, and mistrust of some of what has been published. Nevertheless it does flush out at least 11 species very strongly associated with veteran oaks (especially those with red-rot or Goat Moth activity), 10 species associated with old beech, and 4 species requiring aspen-rich woodland, and about 10 species associated with Caledonian pine forest.

3.4 Rare and threatened species

135 species (42% of the listed species) have conservation statuses and a further 5 species are considered extinct. Three species are classified as Critically Endangered (sensu IUCN), the beetle *Anastrangalia sanguinolenta* and the hoverflies *Blera fallax* and *Myolepta potens*. Four species are classified as Endangered (sensu IUCN), the beetles *Erotides cosnardi*, *Gnorimus variabilis* and *Pedostrangalia revestita* and the hoverfly *Hammerschmidtia ferruginea*. Four species are classified as Nationally Endangered (Red Data Book Category 1) using old grading criteria, the click beetles *Ampedus nigerrimus*, *Limoniscus violaceus* and *Megapenthes lugens*, and the wasps *Chrysis fulgida* and *Crossocerus vagabundus*.

There are 9 Section 41 England conservation priority species, the beetles *Ampedus nigerrimus*, *Erotides cosnardi*, *Gnorimus nobilis*, *Gnorimus variabilis*, *Limoniscus violaceus* and *Megapenthes lugens*, the wasp *Chrysis fulgida*, and the flies *Callicera spinolae* and *Myolepta potens*. It should be noted that the Section 41 list only partially covers the most threatened species, and *Gnorimus nobilis*, despite its Section 41 status, is only a Nationally Scarce species and fails to attain an IUCN threat grade (Lane & Mann, 2016).

4 A Review of the Coleoptera (beetles)

Britain's beetle fauna contains about 700 saproxylic species ranging from small and inconspicuous to large and stunning. One of the most interesting aspects of beetles at sites where collections of old trees are present, is their value in providing an independent indication of site quality, condition and character - one that can complement other values obtained from the size, number and age of veteran trees or values obtained from other assemblages such as lichens. Saproxylic beetles are divided into 3 classes according to fidelity with veteran trees and the scores obtained can be used to rank sites using an ***Index of Ecological Continuity*** (Alexander, 2002, 2008; Harding & Alexander, 1994; Harding & Rose, 1986). This has enabled British coleopterists to identify veteran tree sites of high national or even international importance. The surveying, assessing and ranking of pasture-woodland has continued ever since as data for sites and species has improved (e.g. Alexander & Abrahams, 2006; Alexander, 2004). The New Forest (Hampshire), Windsor Great Park and Forest (Berkshire), Bredon Hill (Worcs) and Langley Park (Bucks) are amongst the best sites. A regularly updated list of rankings can be viewed online: https://khepri.uk/main/. Saproxylic beetles have been subject of two European Red list reviews, Nieto & Alexander (2010) updated by Cálix et. al. (2018).

The following is a list of the British flower-visiting, saproxylic beetle species identified, arranged alphabetically within alphabetically-arranged families.

4.1 Aderidae (ant leaf beetles)

Represented in Britain by three very small (1.5 -2.5 mm) beetles which are covered on the UK Beetles website https://www.ukbeetles.co.uk/aderidae and Mark Telfer's website: http://www.markgtelfer.co.uk/beetles/aderidae/. Conservation statuses are provided by Alexander, Dodd & Denton (2014). Only two of the species seem to have been recorded visiting flowers. Information is from the above sources plus Alexander (2002), Hyman & Parsons (1992) and UK Beetles: https://www.ukbeetles.co.uk/aderidae.

Aderus populneus A local species of southern Britain (graded Least Concern/Nationally Scarce). Larvae probably develop in decaying heartwood (including red rot) of assorted broadleaved trees e.g oak, lime, plane and willow. Found in woodland, pasture-woodland, hedged farmland and sometimes gardens and other urban situations. Visits hawthorn and willow flowers in spring.

Euglenes oculatus A local species of southern Britain (graded Least Concern/Nationally Scarce). Typically develops in moist, crumbly red-rot of old hollowing, stag-horned oaks in ancient parks and pasture-woodland. Very much attracted to elder blossom – it is important this is not cleared from sites where it occurs.

4.2 Buprestidae (jewel beetles)

Represented in Britain by 20 species, most of which are saproxylic, but sometimes specialising in the twigs of shrubs rather than trees. The family is covered by Duff

(2020) and conservation statuses for the scarcer species are provided by Alexander (2014). Buprestids are well-known flower visitors abroad but the situation in Britain is rather unclear.

Anthaxia nitidula Considered extinct in Britain. Reported to visit hawthorn, guelder-rose, hawthorn, bramble, rose and buttercup (Alexander, 2002, Brock, 2019) and it is clearly a keen flower-visitor. Its larvae develop in the wood of rosaceous species such as blackthorn.

***Agrilus* species** Stated to be flower visitors by Duff (2020) but this seems to be rare in the 10 British species. The only flower-visiting record obtained is for *A. sulcicollis* on spindle (M. Telfer – pers. comm.). Abroad, some *Agrilus species* clearly are regular flower visitors.

4.3 Cantharidae (soldier beetles)
Represented in Britain by about 40 species which are covered by Duff (2020). Conservation statuses are provided by Alexander (2014). Non-saproxylic *Cantharis* species and *Rhagonycha fulva* can be abundant on flowers but flower-visiting by saproxylic species seems to be confined to some *Malthinus* and *Malthodes* species and is poorly documented (all the following records are from just one coleopterist, Mark Telfer).

Malthinus flaveolus A widespread species of woods, hedgerows etc. Recorded visiting wild privet.

Malthinus seriepunctatus Widespread in southern woodlands. Recorded visiting dogwood and privet.

Malthodes fuscus Widespread but most frequent in acidic oak and birch woods of the north and west. Recorded visiting rose and holly.

Malthodes marginatus Widespread in woodland. Recorded visiting hawthorn, field maple, bird cherry and cherry laurel.

Malthodes minimus Common and widespread in the south and east. Recorded visiting colt's-foot.

Malthodes pumilus Widespread but local (graded Least Concern/Nationally Scarce) Seems to be partially associated with large and open-grown trees such as oak and willow but can also turn up in open habitats away from trees or dead wood, so considered facultatively saproxylic. Recorded visiting holly, mayweed and meadow vetchling.

4.4 Cerambycidae (longhorn beetles)
About 75 British species, the majority of which have saproxylic lifecycles. This includes some very rare and restricted species of ancient woodland, parkland and pasture-woodland. 34 of these saproxylic species are also flower visitors, some very

regularly, others more reluctantly. Spring-blossoming shrubs (especially hawthorn), umbellifers (e.g. cow parsley and hogweed) and composites (e.g. creeping thistle and oxeye daisy) are especially well used by longhorns. All the British species (except a few recent additions) are covered by Duff (2016) and a nicely illustrated guide to all but the rarest species is furnished in *British Wildlife* (Duff, 2007). Photographs of many are also provided by Brock (2019) and Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/collections/72157634836644146/. Conservation grades are provided in Alexander (2019). This also gives an excellent overview of longhorn conservation requirements and detailed species accounts for our most endangered species. There is a national Longhorn Beetle Recording Scheme which collates records of the British species: https://www.coleoptera.org.uk/cerambycidae/home.

***Alosterna tabacicolor* Tobacco-coloured Longhorn**

General: A rather small (6-9.5 mm), narrowly-built longhorn with a dark-grey head and thorax, tawny elytra and brownish legs. Lifecycle and habitat requirements: The larvae feed for 2 years in the damp, rotten stumps and branches of various broadleaved and coniferous trees but especially oak. Most frequent in damp woodland. Flowers visited: Umbellifers (e.g. hogweed, hemlock water-dropwort), hawthorn, dogwood, dog rose, bramble, rowan, oxeye daisy, buttercups, preferring these in damper, shady places. Status and distribution: Widespread in the southern half of Britain, scarcer in the north with records extending to the Inverness area. Map: https://species.nbnatlas.org/species/NHMSYS0020151177. Conservation requirements: Promote the presence of post-mature trees and associated dead wood; also suitable flowers for adult foraging. Key references: Alexander (2002), Duff (2007, 2016), UK Beetles: https://www.ukbeetles.co.uk/alosterna-tabacicolor.

***Anaglyptus mysticus* Rufous-shouldered Longhorn**

General: A medium-sized (6-14 mm) longhorn with an attractive pattern of red, black, grey and white on the elytra. Lifecycle and habitat requirements: The larvae feed for 2 years in very dry (including fire-scorched) dead wood of various broadleaved trees but perhaps especially hawthorn. Young larvae feed under the bark but eventually move into the sapwood or heartwood. It can be found in various habitats including woods, old parkland and along hedgerows. Flowers visited: hawthorn, bird cherry (and probably other *Prunus*), umbellifers, yarrow, possibly dogwood. Status and distribution: Widespread in the southern half of Britain, scarcer in the north and very rare in Scotland. Map: https://species.nbnatlas.org/species/NBNSYS0000011047. Conservation requirements: Promote the presence of post-mature trees and associated dead wood; also suitable flowers for adult foraging. Key references: Alexander (2002), Duff (2007, 2016), UK Beetles: https://www.ukbeetles.co.uk/anaglyptus-mysticus.

***Anastrangalia sanguinolenta* Blood-red Longhorn**

General: A medium-sized (8.5-13 mm) longhorn with the elytra red in the larger female but buff with a black tip in the male. Lifecycle and habitat requirements: The larvae feed for 2-3 years in the dead wood of coniferous trees, typically Scots pine within open-structured Caledonian pine woodland. It favours the wood of sun-

exposed, standing or fallen stems of large-girth pine without bark. Flowers visited: Umbellifers (e.g. hogweed), rowan, yarrow, oxeye daisy, thistles, knapweeds, scabiouses, bramble, rosebay willowherb. Status and distribution: Very local in the Scottish Highlands (mostly the Cairngorms) with a few English records (notably from the East Anglian Brecks) that are not thought to represent established populations. Graded Critically Endangered/Nationally Rare by Alexander (2019). Map: https://species.nbnatlas.org/species/NHMSYS0020151246. Conservation requirements: Promote the presence of mature, open-grown pine trees, fallen pines and large detached branches in sunny locations; also suitable flowers for adult foraging. Key references: Alexander (2002, 2019), Duff (2007), Duff (2016).

***Anoplodera sexguttata* Six-spotted Longhorn**

General: A small to medium-sized (7-12 mm) longhorn with six yellow spots on the black elytra - the posterior two pairs sometimes fused to create a long bar on each side. Lifecycle and habitat requirements: The larvae feed for 2-3 years in the dead wood of various broadleaved trees, especially oak and beech. It seems to particularly like large items of seasoned oak being decayed by the heartwood-decay fungus *Hymenochaete rubiginosa*. Mostly found in old medieval forest and pasture-woodland remnants, both in lowland and upland areas (the North Yorks Moors). Flowers visited: Hawthorn, umbellifers, valerian, roses, bramble, buttercups, meadowsweet, scabiouses, oxeye daisy, meadow-rue. Status and distribution: Recorded very sparingly in Britain north to Yorkshire with numerous records from the New Forest. Graded Near Threatened/Nationally Rare by Alexander (2019). Map: https://species.nbnatlas.org/species/NHMSYS0020151259. Conservation requirements: Promote the presence of post-mature trees and associated dead wood; also suitable flowers for adult foraging. Key references: Alexander (2019), Duff (2007, 2016).

***Aromia moschata* Musk Beetle**

General: A medium to very large (13-34 mm), metallic green, bronze or turquoise longhorn that is readily distinguishable by its shape and size. Lifecycle and habitat requirements: The larvae feed for 3 or more years in the young and healthy wood of broadleaved trees – usually willows and sallows, and can endure prolonged flooding. Predominantly found in wetlands (especially old fens and mires) and damp woods. Flowers visited: Primarily umbellifers. Status and distribution: Local in the southern half of England, rare in Wales, northern England and SW Scotland. Hotspots occur in the Cambridgeshire Fens and New Forest. Map: https://species.nbnatlas.org/species/NBNSYS0000011038. Conservation requirements: Promote the presence of mature willows and sallows; also suitable flowers for adult foraging. Key references: Alexander (2002), Duff (2007, 2016), UK Beetles: https://www.ukbeetles.co.uk/aromia-moschata.

***Clytus arietus* Wasp Beetle**

General: A medium-sized (6-15 mm), long-legged longhorn with a characteristic black and yellow pattern and very active habits. Lifecycle and habitat requirements: The larvae feed for 2 or more years in the dead wood of various broadleaved and coniferous trees plus timber products. The young larvae feed under the bark but

eventually move into the sapwood. Adults sometimes emerge from stored firewood. Found in a variety of habitats including woodland, hedged farmland, wetlands and urban greenspace. Flowers visited: Umbellifers (e.g. hogweed and cow parsley), bramble, thistles, hawthorn, oxeye daisy, buttercups, spurges. Status and distribution: Common over much of southern Britain, scarcer in northern England and Scotland. Map: https://species.nbnatlas.org/species/NBNSYS0000011045. Conservation requirements: Promote the presence of mature trees and associated dead wood; also suitable flowers for adult foraging. Key references: Duff (2007, 2016), UK Beetles: https://www.ukbeetles.co.uk/clytus-arietis.

***Dinoptera collaris* Red-collared Longhorn**
General: A rather small (6.5-9 mm), blue-black longhorn with a bright red pronotum. Lifecycle and habitat requirements: The larvae feed for 2 years in the disused galleries of other wood-boring insects (e.g. scolytine and other longhorn beetles) under the loose bark of various broadleaved trees, but especially oak. Warm ground seems to be preferred, so freshly-coppiced areas on south-facing woodland slopes with lighter soils are important. The larvae are unusually active and mobile for a longhorn beetle and can use more than one item of dead wood. Flowers visited: Umbellifers such as cow parsley, roses, hawthorn, apple, guelder-rose, meadowsweet, yarrow and oxeye daisy – preferring flowers in warm, sunny spots. Status and distribution: Scattered old records in the southern half of England (especially North Kent) but not recorded since 1949 (single sites in Kent and Worcestershire). This is thought to result from the post-war demise of coppicing (which impacted many woodland insects). Graded Regionally Extinct by Alexander (2019). Map: https://species.nbnatlas.org/species/NHMSYS0020152020. Conservation requirements: Promote the presence of post-mature trees and associated dead wood within open structured/actively coppiced woodland where plentiful sun reaches the ground; also suitable flowers for adult foraging. Key references: Alexander (2019), Duff (2007, 2016).

***Glaphyra umbellatarum* Pear Shortwing Beetle**
General: A rather small (5-8.5 mm), slender longhorn with very short elytra – resembling a small *Molorchis minor* but with less swollen femora. Lifecycle and habitat requirements: The larvae feed for 2 years in the dead wood of the crown of various broadleaved trees and shrubs, but especially members of the Rosaceae including roses and cultivated pears. It will also use the old stems of bramble. Flowers visited: Umbellifers, hawthorn. Status and distribution: Local in the southern half of England, rare in Wales and northern England. Graded Least Concern/Nationally Scarce by Alexander (2019). Map: https://species.nbnatlas.org/species/NHMSYS0020152185. Conservation requirements: Promote the presence of mature rosaceous trees; also suitable flowers for adult foraging. Key references: Alexander (2019), Duff (2007, 2016).

***Grammoptera abdominalis* Black Grammoptera**
General: A smallish (5-10 mm), dark-grey longhorn resembling a large version of the common *G. ruficornis* but with a shorter 2nd antennal segment. Lifecycle and habitat requirements: The larvae feed for 1-2 years in the lower lateral branches of open-

grown oaks in ancient pasture-woodland, woodland edge and parkland. They also use pear and sweet chestnut. Flowers visited: Hawthorn and umbellifers. Status and distribution: Very local in the southern half of England and South Wales. Graded Least Concern/Nationally Scarce by Alexander (2019). Map: https://species.nbnatlas.org/species/MM0001Z1V30791ZB. Conservation requirements: Promote the presence of old open-grown oaks; also suitable flowers for adult foraging. Key references: Alexander (2002, 2019), Duff (2007, 2016).

***Grammoptera ruficornis* Common Grammoptera**
General: A small (3-7 mm), dark-grey longhorn with reddish femoral bases. Lifecycle and habitat requirements: The larvae feed for 1 year in fungus-infected small branches of various broadleaved trees (especially oak) and more rarely pine. Adults can be found in a variety of habitats including woodland and hedged farmland. Flowers visited: Hawthorn, rowan, umbellifers (e.g. cow parsley, hogweed, cowbane, hemlock water-dropwort), rose, bramble, blackthorn, cherry laurel, elder, apple, dogwood, buttercups, oxeye daisy, scentless mayweed, wild mignonette, marsh valerian, pyracantha, *Spiraea*. Status and distribution: Common over much of England and Wales but scarce in Scotland. Map: https://species.nbnatlas.org/species/NHMSYS0020152218. Conservation requirements: Promote the presence of post-mature trees and associated dead wood; also suitable flowers for adult foraging. Key references: Duff (2007, 2016), UK Beetles: https://www.ukbeetles.co.uk/grammoptera-ruficornis.

***Grammoptera ustulata* Burnt-tip Grammoptera**
General: A smallish (5-9 mm), grey-brown longhorn with a black tip to the elytra and reddish legs. Lifecycle and habitat requirements: The larvae feed for 1-2 years in the fungus-infested rotten branches of broadleaved trees such as oak, especially those of the crown. Mostly found in pasture-woodland. Flowers visited: Hawthorn and umbellifers. Status and distribution: Very scarce in the south with most records for Surrey, the New Forest and Welsh Marches. Graded Least Concern/Nationally Rare by Alexander (2019). Map: https://species.nbnatlas.org/species/NBNSYS0000011009. Conservation requirements: Promote the presence of post-mature trees and associated dead wood in open-structured woodland; also suitable flowers for adult foraging. Key references: Alexander (2019), Duff (2007, 2016).

***Judolia sexmaculata* Three-banded Longhorn**
General: A medium-sized (8-14 mm) black longhorn with three wavy transverse yellow bands narrowly interrupted by the elytral suture. Lifecycle and habitat requirements: The larvae feed for 2-3 years under the basal bark and underlying wood of dead standing and recently fallen pine and spruce, often feeding in the decaying sapwood below ground level; also in rotting stumps. It can also use other conifers abroad and some broadleaved trees such as alder. It is primarily associated with Caledonian pine forest. Flowers visited: Umbellifers such as hogweed, rowan, hawthorn, oxeye daisy, yarrow. Status and distribution: Very local in Scotland (mostly within the east Highlands), with additional records in northern England and South Wales. Graded Vulnerable/Nationally Rare by Alexander (2019). Map:

https://species.nbnatlas.org/species/NBNSYS0000011021. Conservation requirements: Promote the presence of mature conifers and associated dead wood; also suitable flowers for adult foraging. Key references: Alexander (2002, 2019), Duff (2007, 2016).

***Leptura aurulenta* Golden-haired or Hornet Longhorn Beetle**
General: A medium to fairly large (12-23 mm), black species resembling the more common *L. quadrifasciata* but elytra markings often orange and pronotum with yellow hairs on the fore and hind margin. Lifecycle and habitat requirements: The larvae feed for 2-4 years in the dead wood of various broadleaved trees, especially oak. It prefers old woodland and pasture-woodland in heathland districts such as found in the New Forest and the Weald. Flowers visited: Umbellifers. Status and distribution: Records concentrated within the New Forest, West Sussex, Cornwall and South Devon with additional records from South Wales, Somerset, Hertfordshire and the Manchester area. Graded Least Concern/Nationally Scarce by Alexander (2019). Map: https://species.nbnatlas.org/species/NHMSYS0020152406. Conservation requirements: Promote the presence of mature trees and associated dead wood; also suitable flowers for adult foraging. Key references: Alexander (2019), Duff (2007, 2016).

***Leptura quadrifasciata* Four-banded Longhorn**
General: A medium to fairly large (11-20 mm) black species with eight large yellow spots on the elytra. Lifecycle and habitat requirements: The larvae bore meandering galleries in the outer sapwood of dead or decaying wood of fallen/felled trees and large branches (even those in flood debris), stumps and the lower parts of dead standing trees. It can use both wet and dry wood, and development usually takes 2 years. Numerous trees species can be used including birch (the preferred host), alder, aspen, beech, oak, hazel, poplar, willow, elder and hazel. It has also been recorded from spruce wood. A variety of habitats are used including woodland, old parkland, also wetland and heathland with mature trees. Flowers visited: Umbellifers (e.g. hogweed, wild angelica), thistles, yarrow, hemp agrimony, bramble, devil's-bit scabious, meadowsweet, common valerian, woody nightshade. Status and distribution: Widespread but local throughout Britain. Map: https://species.nbnatlas.org/species/NHMSYS0020152407. Conservation requirements: Promote the presence of mature trees and associated dead wood; also suitable flowers for adult foraging. Key references: Duff (2007, 2016), UK Beetles: https://www.ukbeetles.co.uk/leptura-quadrifasciata.

Lepturobosca virens
General: A medium to fairly large (14-22 mm), greyish longhorn with cream-banded antennae. Lifecycle and habitat requirements: The larvae develop in decaying fallen branches and dead stumps of conifers such as spruce, pine and fir; also recorded from birch. Larvae feed in the sapwood, avoiding the outer soft and decaying wood and take several years to mature. Flowers visited: On the Continent umbellifers and composites (e.g. yarrow and thistles). Status and distribution: Only known from two 19th century records in the Forest of Dean and doubtfully from Scotland. Presumed extinct and possibly never a native. Not covered by Alexander (2019). Map:

https://www.coleoptera.org.uk/species/lepturobosca-virens. Conservation requirements: Promote the presence of over-mature coniferous trees and dead wood; also suitable flowers for adult foraging. Key references: Duff (2016), West Palaearctic Longhorns: http://www.cerambycidae.info/subfamily/lepturinae/lepturini/lepturobosca-virens-linnaeus-1758/.

***Molorchus minor* Spruce Shortwing Beetle**
General: A small to medium-sized (6-16 mm), slender, long-legged longhorn with strikingly swollen femoral tips and a red, black and cream-patterned elytra that does not extend to the tip of the abdomen. Lifecycle and habitat requirements: The larvae feed for 1-2 years in the dead wood of various coniferous trees such as spruce and fir. It prefers recently cut or damaged thin tree branches, trunks and roots, with larvae developing initially under the bark, later in the underlying wood. Usually found in conifer plantations. Flowers visited: Umbellifers (e.g. hogweed), hawthorn, *Prunus* species (possibly bird cherry), pyracantha. Status and distribution: Local in the southern half of England, rare in Wales. A naturalised introduction. Map: https://species.nbnatlas.org/species/NBNSYS0000011036. Conservation requirements: Promote the presence of mature coniferous trees and associated dead wood; also suitable flowers for adult foraging. Key references: Duff (2007, 2016).

***Pachytodes cerambyciformis* Speckled Longhorn**
General: A small to medium-sized (6.5-12 mm), compactly-built longhorn with a variable number of black spots on the yellow elytra. Lifecycle and habitat requirements: The larvae feed for 2 years in the dead wood of various broadleaved and coniferous trees, especially in the exposed roots of recently fallen trees. Found in woodland plus a variety of more open habitats. Flowers visited: Umbellifers (e.g. hogweed, hemlock water-dropwort), roses, bramble, yarrow, buttercups, oxeye daisy. Status and distribution: Fairly frequent in SW England, the Surrey-West Sussex region, and Wales. More local in northern England and Scotland. Map: https://species.nbnatlas.org/species/NHMSYS0020152978. Conservation requirements: Promote the presence of post-mature trees and associated dead wood; also suitable flowers for adult foraging. Key references: Duff (2007, 2016).

***Paracorymbia fulva* Tawny Longhorn**
General: A medium-sized (9.5-14 mm) longhorn resembling the male of *Anastrangalia sanguinolenta* but with a different-shaped pronotum. Lifecycle and habitat requirements: The larvae develop in decaying timber and cut logs of aspen and beech, including railway sleepers. Adults turn up in a variety of habitats including woodland but also in more open habitats such as farmland, coastal grazing marsh and suburban greenspace. Flowers visited: Umbellifers, bramble, creeping thistle. oxeye daisy, scabiouses. Status and distribution: Local but increasing in southern Britain with records extending north to Yorkshire. Rare in Wales. Graded Least Concern/Nationally Scarce by Alexander (2019). Map: https://species.nbnatlas.org/species/NHMSYS0020152984. Conservation requirements Promote the presence of mature trees and associated dead wood; also

suitable flowers for adult foraging. Key references: Alexander (2002, 2019), Duff (2007, 2016).

***Pedostrangalia revestita* Black-and-Red Longhorn Beetle**
General: A medium-sized (7.5-15 mm) longhorn that can be entirely reddish (except for black antennae) or with the elytra entirely blue-black. Lifecycle and habitat requirements: The larvae develop in dead, red-rotten parts of living broadleaved trees such as decaying wound scars, and at the base of dead branches. They feed at the interface of decaying and healthy wood over a period of 2-3 years. Oak is preferred in Britain and it shows a preference for old stunted trees with plenty of wounds and dead branches still attached to the living trees. It specifically needs such trees in warm, sunny locations such as open-structured woodland edge and south-facing slopes and cannot cope with a closed canopy. Most records are from pasture-woodland (e.g. the New Forest) or old boundary trees of ancient broadleaved woodland. Flowers visited: Duff (2016) states that it does not visit flowers and Aleander (2019) states that it hardly ever visits flowers but foreign images clearly show it visits umbellifers and hawthorn but possibly only on very warm days. Status and distribution: Rare in SE and central England with modern records from just four locations. Graded Endangered/Nationally Rare by Alexander (2019). The IUCN Red List of European Saproxylic Beetles (Dodelin *et al.*, 2017) has assessed this beetle as Vulnerable across its whole European range. Map: https://species.nbnatlas.org/species/NHMSYS0020152996. Conservation requirements: Promote the presence of over-mature broadleaved trees; also suitable flowers for adult foraging. Key references: Alexander (2019), Duff (2016); West Palaearctic Longhorns: http://cerambyx.uochb.cz/pedostrangalia_revestita.php.

***Pogonocherus hispidulus* Greater Thorn-tipped Longhorn**
General: A small (5-8 mm), lichen-camouflaged, grey and dark-brown longhorn. Lifecycle and habitat requirements: The larvae develop over 2 years in the twigs of a variety of tree and shrub species in woodland and more open habitats. Flowers visited: Hawthorn and crab apple (Lane et. al, 2002). Status and distribution: Widespread and frequent. Map: https://species.nbnatlas.org/species/NBNSYS0000011053. Conservation requirements: Promote the presence of mature trees and associated dead wood; also suitable flowers for adult foraging. Key references: Duff (2007, 2016).

***Pogonocherus hispidus* Lesser Thorn-tipped Longhorn**
General: A small (4-6 mm), lichen-camouflaged, grey and dark-brown longhorn. Lifecycle and habitat requirements: The larvae develop under the bark of thin dead branches of assorted broadleaved trees and shrubs, especially in old hedgerows. Flowers visited: Dogwood (M. Telfer - pers. comm). Status and distribution: Widespread and frequent in southern Britain, scarcer in the north and rare in Scotland. Map: https://species.nbnatlas.org/species/NBNSYS0000011054. Conservation requirements: Promote the presence of mature trees and associated dead wood; also suitable flowers for adult foraging. Key references: Duff (2007, 2016), UK Beetles: https://www.ukbeetles.co.uk/pogonocherus-hispidus.

***Rhagium bifasciatum* Two-banded Longhorn**
General: A medium to fairly large (13-22 mm), robust longhorn usually with four pale marks on a dark-grey or grey and red elytra. Lifecycle and habitat requirements: The larvae feed for 2-5 years underground in dead roots of various broadleaved and coniferous trees. Young larvae bore galleries beneath bark but as they grow they penetrate the heartwood, producing long meandering tunnels loosely packed with wood dust and frass. This species favours damp deciduous, coniferous or mixed woodland with plenty of timber in various stages of decay. Flowers visited: Occasionally visits umbellifers, elder, hawthorn. Status and distribution: Recorded throughout Britain and common in some well-wooded districts, especially in the north snd west. Map: https://species.nbnatlas.org/species/NBNSYS0000011002. Conservation requirements: Promote the presence of post-mature trees and associated dead wood; also suitable flowers for adult foraging. Key references: Duff (2007, 2016), UK Beetles: https://www.ukbeetles.co.uk/rhagium-bifasciatum.

***Rhagium inquisitor* Ribbed Pine Borer**
General: A medium to fairly large (10-21 mm), robust, grey longhorn marked with darker and paler blotches, and longitudinally-ridged elytra. Lifecycle and habitat requirements: The larvae feed for 2-3 years under the bark of Scots pine, especially fungus-infected stumps and fallen trunks. Other conifers such as spruce, larch and fir are used abroad. It will occasionally attack weakened living trees. Found in Caledonian pine forest and mature pine plantations with plentiful dead wood. Flowers visited: No flower-visiting seems to have been recorded though there is a strong likelihood that blossoming shrubs such as rowan and hawthorn are used. Status and distribution: Mostly recorded from the Scottish Highlands but with scattered records in England and Wales that probably represent introductions. Graded Least Concern/Nationally Scarce by Alexander (2019). Map: https://species.nbnatlas.org/species/NBNSYS0000011003. Conservation requirements: Promote the presence of post-mature pine trees and associated dead wood; also suitable flowers for adult foraging. Key references: Alexander (209), Duff (2007, 2016), UK Beetles: https://www.ukbeetles.co.uk/rhagium-inquisitor.

***Rhagium mordax* Black-spotted Longhorn**
General: A medium to fairly large (13-22 mm), robust, grey-buff longhorn with four orange blotches and usually four blackish blotches on the elytra. Lifecycle and habitat requirements: The larvae feed for 2-3 years in the cambium and outer sapwood of rotting stumps of various broadleaved trees, especially oak. Typically found in old broadleaved woodland and parkland with plentiful dead wood. Flowers visited: Occasionally visits umbellifers, hawthorn, elder, bramble and rose. Status and distribution: Widespread and locally frequent in many parts of England, Wales and northern Scotland but scarce in East Anglia and southern Scotland. Map: https://species.nbnatlas.org/species/NBNSYS0000011004. Conservation requirements: Promote the presence of post-mature trees and associated dead wood; also suitable flowers for adult foraging. Key references: Duff (2007, 2016), UK Beetles: https://www.ukbeetles.co.uk/rhagium-mordax.

***Rutpela maculata* Black-and-yellow Longhorn**
General: A medium to fairly large (13-20 mm), black and yellow longhorn that can be a familiar sight in woods over much of southern Britain during summer. Lifecycle and habitat requirements: The larvae feed for 2-3 years in the damp rotting wood of various broadleaved trees (but especially birch) or conifers such as pine. It will use stumps, roots and fallen branches, especially white-rotten branches lying on wet ground. It can be found in a variety of habitats including woodland (even quite young woodland), parkland, hedged farmland, road verges and urban greenspace. Flowers visited: Umbellifers (especially hogweed and wild angelica; also water-dropworts), bramble, thistles, hawthorn, dogwood, hemp-agrimony, valerian, rose, oxeye daisy – often flying very actively between flowers. Status and distribution: Common over much of England and Wales but scarce in Scotland. Map: https://species.nbnatlas.org/species/NHMSYS0020109270. Conservation requirements: Promote the presence of post-mature trees and associated dead wood; also suitable flowers for adult foraging. Key references: Duff (2007, 2016), UK Beetles: https://www.ukbeetles.co.uk/rutpela-maculata.

***Stenocorus meridianus* Variable Longhorn**
General: A medium to large (15-25 mm), robust longhorn that can be mostly blackish ranging through to individuals with the legs and elytra entirely reddish. Lifecycle and habitat requirements: The larvae feed for 2-3 years underground in the dead roots of various broadleaved trees including fruit trees in gardens and orchards. It can be found in a variety of habitats including woodland (even quite young woodland), parkland, hedged farmland, gardens and urban greenspace. Flowers visited: Umbellifers (e.g. hogweed, hemlock water-dropwort), bramble, roses, meadowsweet, wild privet. Status and distribution: Frequent over much of England, scarcer in Wales and not recorded from Scotland. Map: https://species.nbnatlas.org/species/NHMSYS0020153502. Conservation requirements: Promote the presence of post-mature trees and associated dead wood; also suitable flowers for adult foraging. Key references: Duff (2007, 2016), UK Beetles: https://www.ukbeetles.co.uk/stenocorus-meridianus.

***Stenurella melanura* Black-striped Longhorn**
General: A medium-small (6-10 mm) longhorn with the elytra red at the sides but usually broadly black down the midline and at the tip. Lifecycle and habitat requirements: The larvae feed for 2 years in moist, decaying wood such as partly buried fallen branches, shallow roots and the base of stumps. It will use a wide range of both broadleaved and coniferous trees but the most popular seem to be oak, beech, willow, maple, hawthorn, pine and juniper. The smaller larvae feed under bark while larger larvae tend to penetrate the underlying wood. Like *Rutpela maculata*, it can be found in a variety of habitats including woodland, parkland, hedged farmland and along road verges. Flowers visited: Umbellifers (e.g. hogweed, rough chervil), bramble, roses, oxeye daisy, yarrow, thistles, scabiouses, cranesbills, spurges, privet, St John's worts. Status and distribution: Widespread and fairly frequent in southern England, scarcer in Wales and northen England, rare in Scotland. Map: https://species.nbnatlas.org/species/NHMSYS0020109272. Conservation requirements: Promote the presence of post-mature trees and

associated dead wood; also suitable flowers for adult foraging. Key references: Duff (2007, 2016), UK Beetles: https://www.ukbeetles.co.uk/stenurella-melanura.

***Stenurella nigra* Small Black Longhorn**
General: A rather small (6-9 mm) and slim, black longhorn with the underside of the abdomen orange. Lifecycle and habitat requirements: Larvae develop in dead branches within the crown of open-grown broadleaved trees. Usually found in older woods and parkland. Flowers visited: Umbellifers (e.g. hogweed), bramble, roses, yarrow, scabiouses, stitchwort, buttercups, oxeye daisy. Status and distribution: Very local in southern and central England, rare in South Wales. Graded Least Concern/Nationally Rare by Alexander (2019). Map: https://species.nbnatlas.org/species/NHMSYS0020153515. Conservation requirements: Promote the presence of post-mature trees and associated dead wood; also suitable flowers for adult foraging. Key references: Alexander (2019), Duff (2007, 2016).

***Stictoleptura cordigera* Heart-marked Longhorn**
General: A medium to fairly large (14-20 mm), red and black longhorn with a conspicuous triangular or heart-shaped black mark on the red elytra that makes it unmistakable. Lifecycle and habitat requirements: The larvae develop in the dead wood of broadleaved trees. Flowers visited: In Britain reported visiting yarrow, wild carrot and creeping thistle. On the Continent it will visit assorted umbellifers, thistles, scabiouses, bramble and yarrow. Status and distribution: A recent addition to the British list seemingly established in the Hackney area of NE London. Map: https://species.nbnatlas.org/species/NHMSYS0020153529. Conservation requirements: Promote the presence of mature trees and associated dead wood; also suitable flowers for adult foraging. Key references: Duff (2016).

***Stictoleptura rubra* Red Longhorn**
General: A medium to fairly large (12-20 mm) longhorn with the elytra red in the larger female but buff in the male, closely resembling *Anastrangalia sanguinolenta*. Lifecycle and habitat requirements: The larvae feed for 2-3 years in the dead wood such as stumps, roots and fallen trunks of various coniferous trees, especially pines Mostly found in coniferous plantations. Flowers visited: Umbellifers and thistles. Status and distribution: A naturalised immigrant that is local but increasing in the eastern side of England and South Wales but with additional records extending north to Central Scotland. Map: https://species.nbnatlas.org/species/NHMSYS0020153529. Conservation requirements: Promote the presence of mature pine trees and associated dead wood; also suitable flowers for adult foraging. Key references: Alexander (2002), Duff (2007, 2016).

***Stictoleptura scutellata* Large Black Longhorn**
General: A medium to fairly large (12-20 mm), black longhorn with a small, bright-yellow scutellum at the base of the elytra. Lifecycle and habitat requirements: The larvae feed for 2-3 years in the dead stumps and trunks of various broadleaved trees but especially beech. Most records are from old woods and pasture-woodland. Flowers visited: Hawthorn, bramble, various umbellifers. Status and distribution:

Very local in the southern half of England, especially the Home Counties and New Forest. Graded Least Concern/Nationally Scarce by Alexander (2019). Map: https://species.nbnatlas.org/species/NHMSYS0020153530. Conservation requirements: Promote the presence of mature trees (especially beech) and associated dead wood; also suitable flowers for adult foraging. Key references: Alexander (2002, 2019), Duff (2007, 2016).

***Strangalia attenuata* Attenuated Longhorn**

General: A medium-sized (9-17 mm), black and yellow longhorn resembling a slim version of the common *Rutpela maculata*. Lifecycle and habitat requirements: The larvae feed for 2-3 years in broadleaved tree stumps and branches at the interface between decaying sapwood but hard and undecayed heartwood. Host trees abroad include hazel, oak, lime and birch. Most records are for old woodland. Flowers visited: Internet photos from abroad feature umbellifers, yarrow, bramble, bindweed, scabious. Status and distribution: Very rare with old records from Salisbury, Southend-on-Sea, Windsor Forest and possibly a 1982 record from West Sussex. Alexander (2019) questions whether it was ever resident and does not assign it a conservation status. Map: https://species.nbnatlas.org/species/NHMSYS0020151177. Conservation requirements: Promote the presence of post-mature trees and dead wood; also suitable flowers for adult foraging. Key references: Alexander (2019), Duff (2016), West Palaearctic Longhorns: http://www.cerambyx.uochb.cz/strangalia_attenuata.php.

***Tetrops praeustus* Plum Longhorn**

General: A very small (3-6 mm), hairy longhorn with a black head and pronotum but a buff or tan-coloured elytra that has a black tip. Lifecycle and habitat requirements: The larvae develop over 1-2 years in the dead and dying twigs and branches of assorted broadleaved trees and shrubs, including rosaceous fruit trees such as plum. Flowers visited: Apple and hawthorn. Status and distribution: Widespread and frequent in the southern half of Britain, scarcer in the north. Map: https://species.nbnatlas.org/species/NHMSYS0020153614. Conservation requirements: Promote the presence of mature trees/shrubs; also suitable flowers for adult foraging. Key references: Alexander (2002), Duff (2007, 2016).

***Tetrops starkii* Ash Longhorn**

General: Closely resembling *T. praeustus* but lacking the dense short pubescence on the sides of the pronotum. Lifecycle and habitat requirements: The larvae develop over 1-2 years, primarily in the dead and dying twigs and branches of native ash. Also claimed to use oak (Alexander, 2002) and non-native ashes such as narrow-leaved ash, which is common in municipal planting. Flowers visited: Hawthorn. Status and distribution: Discovered in Britain in the early 1990s and presumed to be a recent introduction or colonist. Currently only known from a few sites in southern England. Map: https://species.nbnatlas.org/species/NBNSYS0000036960. Conservation requirements: Promote the presence of mature ash trees; also hawthorn blossom for adult foraging. Key references: Alexander (2002), Duff (2007, 2016).

4.5 Cleridae (chequered beetles)

Represented in Britain by 13 species that are covered by Duff (2020). Conservation grades are provided by Alexander (2014). The extinct *Tilloidea unifasciata*, which is a predator of immature stages of *Lycus* beetles in old oak and beech trees, is recorded as visiting shrub blossom by Alexander (2002). The internet features foreign photos of it on assorted composites such as yarrow, a thistle and a daisy-type flower. The only extant British species that seem to visit flowers are the following:

Korynetes caeruleus

General: A 5-6.5 mm long, metallic blue-black beetle with slightly clubbed antennae. Lifecycle and habitat requirements: The larvae develop as predators in dry dead wood infested with wood-boring beetles such scolytids and ptinids. They have been studied as a potential biological control for woodworm *Anobius punctatum*. Old and dry wood of assorted broadleaved trees in preferred but it may use conifers. occasionally and it can also occur in building timbers infested with woodworm. However, it is mostly found in dry broadleaved or coniferous woodland, woodland borders and parkland/pasture-woodland. Flowers visited: Various flowers apparently though no specific information has been obtained and flower-visiting seems to be uncommon. Status and distribution: Widespread but local in the southern half of England, rare in Wales. Graded Least Concern/Nationally Scarce by Alexander (2014). Map: https://species.nbnatlas.org/species/NHMSYS0001718644. Conservation requirements: Promote the presence of old dry timber and trunks. Key references: Alexander (2014), Hyman & Parsons (1992), Duff (2020), UK Beetles: https://www.ukbeetles.co.uk/korynetes-caeruleus.

Tillus elongatus

General: A 6-10 mm long, slim black beetle that can have the narrow pronotum red or black. Lifecycle and habitat requirements: The larvae develop as predators in wood infested with wood-boring beetles such as *Ptilinus pectinicornis* in old and dry trunks devoid of bark and exposed to the sun. Assorted broadleaved trees are used, especially beech but also oak, maple, lime, hazel, black poplar and ivy. It is usually recorded in old woodland and pasture-woodland. Flowers visited: Elder, hawthorn and lime but not a particularly regular flower-visitor. Status and distribution: Widespread but local with most records for the southern half of England excluding the SW. Graded Least Concern/Nationally Scarce by Alexander (2014). Map: https://species.nbnatlas.org/species/NBNSYS0000024370. Conservation requirements: Promote the presence of old, barkless timber and tree trunks in sunny locations; also suitable flowers for adult foraging. Key references: Alexander (2014), Hyman & Parsons (1992), Duff (2020), UK Beetles: https://www.ukbeetles.co.uk/tillus-elongatus.

4.6 Cryptophagidae (silken fungus beetles)

Represented in Britain by about 100 small or very small beetle species, most of which develop in fungi. The British species are covered by Duff (2020). Conservation statuses are provided by Hyman & Parsons (1994).

Cryptophagus scanicus This widespread species has been recorded on cherry laurel

(Mark Telfer –pers. comm.).

***Micrambe* species** These have been reported visiting flowers but very little hard data is available for which flowers are used by individual species.

4.7 Cucujidae (flat bark beetles)
Represented in Britain by 2 *Pediastus* species, which are 3.5-4.5 mm long flattish brown and black beetles that live under the fungus-ridden bark of decaying trees. The family is covered by Duff (2020). The commoner of the two, *P. dermestoides* has been recorded visiting hawthorn blossom (K. Alexander – pers. comm.).

4.8 Dermestidae (hide beetles)
Represented in Britain by about 40 mostly non-saproxylic species. The British species are covered by Duff (2020). Conservation statuses are provided by Alexander (2017). Three fully or semi-saproxylic species have been reported visiting flowers:

Globicornis rufitarsis
General: A 2.3-3 mm long, black beetle with pubescent uppersides. Lifecycle and habitat requirements: The larvae develop under loose bark and in old decayed wood where they feed on the dry larval and pupal remains of other insects. At Windsor it is associated with old oaks in ancient pasture-woodland. In the Worcestershire/Gloucestershire area it uses old willow pollards in ancient field boundaries. Flowers visited: Hogweed, cow parsley and 'spiraea' (=meadowsweet?). Status and distribution Known in Britain from four distinct areas across England: Windsor Forest & Great Park and surrounding area; Severn Vale - Bredon Hill-Croome Park-Forthampton Oaks; Wyre Forest; High Park, Blenheim. Graded Vulnerable/Nationally Rare by Alexander (2017). Map: https://species.nbnatlas.org/species/NHMSYS0001718231 (as *G. nigripes*). Conservation requirements: Promote the presence of old hollow trees; also suitable flowers for adult foraging. Key references: Alexander (2002, 2017), Hyman & Parsons (1992), Duff (2020).

Megatoma undata
General: A 3.6-5 mm long rather rectangular dark beetle with patches of white scales on the pronotum and elytra. Lifecycle and habitat requirements: Facultatively saproxylic with larvae that scavenge in the nests and burrows of other insects, and in spider webs. This can be under the bark and in the decaying wood of old trees (including conifers) at woodland margins and in pasture-woodland. However, it can also occur in non-saproxylic locations such as bee hives, rabbit burrows, the nests of Red Mason Bee *Osmia bicornis* and occasionally in old timber-framed buildings. Flowers visited: Hawthorn and crab apple. Status and distribution: Widespread but very local in the southern half of England; rare in the SW, N. England and Wales. Graded Least Concern/Nationally Scarce by Alexander (2017). Map: https://species.nbnatlas.org/species/NBNSYS0000024292. Conservation requirements: Promote the presence of old hollow trees; also suitable flowers for adult foraging. Key references: Hyman & Parsons (1992), Alexander (2002), Duff (2020), UK Beetles: https://www.ukbeetles.co.uk/megatoma-undata.

Flower-visiting longhorn beetles

Rutpela maculata

Stenocorus meridianus

Clytus arietus

Stictopleura scutellata

Stenurella melanura

Leptura quadrifaciata

Trinodes hirtus

General: A tiny (1.5-2.5 mm), oval-shaped black beetle covered with long bristly hairs. Lifecycle and habitat requirements: The larvae and adults live as scavengers amongst the webs of tube and sheet web-inhabiting spiders (e.g. 'house spiders') in old and ancient trees, especially oaks. It can also occur associated with such spiders in buildings and may be under-recorded in such locations. Flowers visited: Flower-visiting is stated in literature but no specific details have been located. Status and distribution: Known from a few records in England north to Cheshire. Graded Near Threatened/Nationally Rare by Alexander (2017). Map: https://species.nbnatlas.org/species/NHMSYS0001720444. Conservation requirements: Promote the presence of old hollow trees. Key references: Alexander (2002, 2017), Hyman & Parsons (1992), Duff (2020), UK Beetles: https://www.ukbeetles.co.uk/trinodes-hirtus.

4.9 Elateridae (click beetles)

Represented in Britain by about 75 species, some of which are iconic saproxylic ones associated with some of the finest ancient tree sites. Flower-visiting data has only been found for the 10 saproxylic species though quite a few of the non-saproxylic click beetles are regular flower visitors. The British species are covered by Duff (2020). Conservation statuses for the scarcer species are provided by Hyman & Parsons (1992) but require updating.

Ampedus balteatus

General: A 7.5-10 mm long, red and black click beetle with the red elytra black on the posterior two-fifths. Lifecycle and habitat requirements: The larvae are predatory under bark and in soft, decaying wood (often red-rotten) of dead and dying trees, stumps and detached wood fragments. Host trees include pine (including that in pure plantations), birch and oak, the latter two seemingly only when pine is present. Development probably takes 2-3 years. As well as coniferous and mixed woodland, it can also use isolated trees on moorland and within bogs. Flowers visited: Hawthorn, rowan and umbellifers. Status and distribution: Widespread but local in England, Wales and Scotland. Map: https://species.nbnatlas.org/species/NBNSYS0000010910. Conservation requirements: Promote the presence of old trees and associated dead wood, especially pines; also suitable flowers for adult foraging. Key references: Alexander (2002), Duff (2020), UK Beetles: https://www.ukbeetles.co.uk/ampedus-balteatus.

Ampedus elongantulus

General: A 7-9.5 mm long red and black click beetle that is difficult to distinguish from certain other *Ampedus* species. Lifecycle and habitat requirements: The larvae are predatory in red-rotten wood of oak, beech and pine. The favoured habitat is ancient woodland and pasture-woodland. Flowers visited: Hawthorn. Status and distribution: Widespread but local in southern England; rare in Wales. Graded Nationally Scarce (Notable A) by Hyman & Parsons (1992). Map: https://species.nbnatlas.org/species/NHMSYS0001716779. Conservation requirements: Promote the presence of old trees and associated dead wood,

especially pines; also suitable flowers for adult foraging. Key references: Hyman & Parsons (1992), Alexander (2002), Duff (2020).

Ampedus nigerrimus
General: A 6-8.5mm long, entirely black click beetle that is very rare but difficult to distinguish from other black click beetles. Lifecycle and habitat requirements: The larvae develop exclusively in large, decayed oak trunks, boughs, logs and especially stumps – typically red-rotten ones. The known British site is ancient woodland with numerous very old oaks. Flowers visited: Hawthorn. Status and distribution: Only known from Windsor Forest, Berkshire. Graded Endangered by Hyman & Parsons (1992) and a Section 41 conservation priority species. Map: https://species.nbnatlas.org/species/NBNSYS0000010914. Conservation requirements: Promote the presence of old red-rotten oak trees and associated dead wood; also suitable flowers for adult foraging. Key references: Hyman & Parsons (1992), Alexander (2002), Duff (2020).

Ampedus quercicola
General: A 9-11 mm long, red and black click beetle that is difficult to distinguish from certain other *Ampedus* species. Lifecycle and habitat requirements: The larvae develop in decayed heart-rot (including red-rotten wood) of birch, beech, hawthorn and other broadleaved trees. Can be found in ancient woodland, pasture-woodland and the wet birch woodland of fens. Flowers visited: Hawthorn. Status and distribution: Very local in southern England with records concentrated within the New Forest, Cambridgeshire and Norfolk. Graded Nationally Scarce (Notable B) by Hyman & Parsons (1992). Map: https://species.nbnatlas.org/species/NBNSYS0000010916. Conservation requirements: Promote the presence of old trees and associated dead wood; also suitable flowers for adult foraging. Key references: Hyman & Parsons (1992), Alexander (2002), Duff (2020).

Ampedus sanguinolentus
General: A 10-12 mm long black and red click beetle with a characteristic dark patch of variable size along the midline of the elytra. Lifecycle and habitat requirements: The larvae are predatory in decaying damp wood of broadleaved stumps, trunks, fallen/felled trunks, log piles and exposed roots. Host trees in Britain include birch and oak, possibly also pine and sallow. Development takes 3-4 years. The typical habitat is ancient broadleaved woodland and pasture-woodland with plentiful old trees in heathland districts. Flowers visited: Hawthorn and umbellifers. Status and distribution: Southern England with most records for the New Forest, West Sussex and Surrey. Graded Nationally Scarce (Notable A) by Hyman & Parsons (1992). Map: https://species.nbnatlas.org/species/NBNSYS0000010922. Conservation requirements: Promote the presence of old trees and associated dead wood; also suitable flowers for adult foraging. Key references: Hyman & Parsons (1992), Alexander (2002), Duff (2020), UK Beetles: https://www.ukbeetles.co.uk/ampedus-sanguinolentus.

It is possible that some other *Ampedus* species visit flowers too but no information

has been obtained.

Calambus bipustulatus
General: A 6.5-9 mm long, shiny-black click beetle with red 'shoulders' to the elytra. Lifecycle and habitat requirements: The larvae are predatory in fairly soft, rotten wood including the stumps and fallen trunks of oak and other broadleaved trees. A species of broadleaved woodland and pasture-woodland. Flowers visited: Blackthorn and hogweed. Status and distribution: Very local with scattered records across the southern half of Britain. Graded Nationally Scarce (Notable B) by Hyman & Parsons (1992 – as *Selatosomus bipustulatus*). Map: https://species.nbnatlas.org/species/NBNSYS0000010961. Conservation requirements: Promote the presence of old trees and associated dead wood; also suitable flowers for adult foraging. Key references: Hyman & Parsons (1992), Alexander (2002), Duff (2020).

Hemicrepidius hirtus
General: A fairly large (9-14 mm long) black click beetle with yellow pubescence on the elytra. Lifecycle and habitat requirements: The larvae can develop both in dead wood and decaying vegetation. Flowers visited: Umbellifers and common lime. Status and distribution: Widespread in southern Britain, scarcer in the north. Map: https://species.nbnatlas.org/species/NBNSYS0000010952. Conservation requirements: Promote the presence of old trees and associated dead wood; also suitable flowers for adult foraging. Key references: Alexander (2002), UK Beetles: https://www.ukbeetles.co.uk/hemicrepidius-hirtus.

***Limoniscus violaceus* Violet Click Beetle**
General: A 12 mm long, black click beetle with a slight blue and violet sheen. Lifecycle and habitat requirements: The larvae develop over a period of 2 years within a soot-like wood mould and associated leaf mould of old, hollow trees. At Windsor Forest, it seems restricted to old beech trees within ancient woodland. At Bredon Hill and Dixton Wood it uses old ash pollards in more open settings. Abroad it can use further broadleaved species including Turkey oak (a potential host tree of the future in Britain). Alexander (2002) suggests that it might require the presence of birds nest material above the larval habitat to raise the nitrogen level of the substrate. Flowers visited: Occasionally recorded on hawthorn. Alexander (pers. comm.) suggests that flower-visiting could be important in fuelling long flights to find new suitable trees. Status and distribution: Very rare with records confined to Windsor Forest (Berkshire), Bredon Hill (Worcestershire) and Dixton Wood (Gloucestershire). At all three sites, the number of suitable trees seems to be very small. Graded Endangered by Hyman & Parsons (1992) and a Section 41 conservation priority species; also listed in Annex II of the EC Habitats Directive and Schedule 5 of the UK's Wildlife and Countryside Act 1981. Map: https://species.nbnatlas.org/species/NHMSYS0001718842. Conservation requirements: Promote the presence of old beech or ash trees with heart-rot; also hawthorn flowers for adult foraging. Key references: Alexander (2002), Hyman & Parsons (1992), Duff (2020), Woodland Trust fact sheet: https://www.woodlandtrust.org.uk/trees-woods-and-

wildlife/animals/beetles/violet-click-beetle/.

***Megapenthes lugens* The Queen's Executioner**
General: A 7.5-11 mm long, dull-black click beetle not easily distinguished from others in the field but very rare. Lifecycle and habitat requirements: The larvae feed on weevil larvae in relatively dry rotten wood of old, hollow broadleaved trees. It seems to rely primarily on beech trees at Windsor but has also been reared from elm there. Flowers visited: Hawthorn. Status and distribution: Historically known from Hampshire, Surrey, Essex, Berkshire, Norfolk and Gloucestershire. Today it seems to be confined to Windsor Forest, Berkshire. Graded Endangered by Hyman & Parsons (1992) and a Section 41 conservation priority species. Map: https://species.nbnatlas.org/species/NBNSYS0000010926. Conservation requirements: Promote the presence of old trees and associated dead wood; also suitable flowers for adult foraging. Key references: Alexander (2002), Hyman & Parsons (1992), Duff (2020).

Procraerus tibialis
General: A 6-8 mm long, dull-black click beetle not easy to distinguish from others in the field. Lifecycle and habitat requirements: The larvae develop in the dead wood of hollow and decayed oak, beech and hornbeam; also in dead wood from hedgerow ash. They seem to be predators of the larvae of certain weevils. Most records are from ancient broadleaved woodland and pasture-woodland. Flowers visited: Flowering shrubs including hawthorn. Status and distribution: Very localised with scattered records in southern and central England. Graded Rare by Hyman & Parsons (1992). Map: https://species.nbnatlas.org/species/NBNSYS0000010925. Conservation requirements: Promote the presence of old trees and associated dead wood; also blossoming shrubs for adult foraging. Key references: Alexander (2002), Hyman & Parsons (1992), Duff (2020).

4.10 Eucinetidae (plate-thighed beetles)
Represented in Britain by the 3.3-3.7 mm long beetle *Nycteus meridionalis* which develops under the bark of fungus-infested pine wood and apparently sometimes visits flowers, (Duff, 2020; UK Beetles: https://www.ukbeetles.co.uk/eucinetidae) though there seems to be no information on its floral preferences and flower-visiting may be very rare (Steve Lane – pers. comm.). Very local in southern England within coniferised settings and probably a recent introduction (first recorded as British in 1968).

4.11 Lycidae (net-winged beetle)
Represented in Britain by 4 species which rather resemble small, heavily-textured cardinal beetles (Pyrochroidae). All develop in decaying wood. Flower-visiting has been noted for all but the very rare *Erotides cosnardi* but it cannot be ruled out for this species. The British species are covered by Duff (2020). Conservation statuses for the scarcer species are provided by Alexander (2014).

***Erotides cosnardi* Cosnard's Net-winged Beetle**
A very rare species (graded Endangered/Nationally Rare by Alexander, 2014 and a

Section 41 conservation priority species – as *Platycis cosnardi*) only known from the Wye Gorge, Monmouthshire and a woodland site in Sussex. It is associated with veteran Beech trees. No records of flower-visiting appear to exist.

Dictyoptera aurora
General: Resembling *Platycis minuta* but larger (7-13 mm) with red margins to the pronotum. Lifecycle and habitat requirements: The larvae develop in white-rotten fallen pine trunks and stumps within ancient Caledonian pine woodland. It can also use firs and spruces abroad. Flowers visited: There are foreign internet images of it on an umbellifer, yarrow, willow catkin and a plantain species. Status and distribution: Confined to the Scottish Highland where it is scarce. Graded Vulnerable by Alexander (2014). Map: https://species.nbnatlas.org/species/NBNSYS0000024267. Conservation requirements: Promote the presence of dead standing and fallen Scots pine. Key references: Alexander (2014), Duff (2020), Hyman & Parson (1992), UK Beetles: https://www.ukbeetles.co.uk/dictyoptera-aurora.

Platycis minutus
General: A 5-8 mm long beetle with a dull-red, flattened and ridged elytra contrasting with a black pronotum, head and appendages – our most frequent lycid. Lifecycle and habitat requirements: The larvae develop as predators in damp, white-rotted wood of assorted broadleaved species including beech, birch, oak and possibly ash in shaded locations. Adults will swarm over dead wood, nettles, bramble and recently cut stumps of Scots pine though it is not known if it can develop in the last. It is mostly recorded in ancient woodland and parkland. Flowers visited: Umbellifers and *Rubus* species (bramble etc.). Status and distribution: Local in the southern half of Britain, scarcer in the north and rare in Scotland. Map: https://species.nbnatlas.org/species/NHMSYS0001719616. Conservation requirements: Promote the presence of plentiful rotting wood in shaded locations; also suitable flowers for adult foraging. Key references: Hyman & Parson (1992), Duff (2020), UK Beetles: https://www.ukbeetles.co.uk/platycis-minutus.

Pyropterus nigroruber
General: Resembling *Platycis minuta* but usually larger (7.5-10 mm) with longer antennae and more obvious cross-ridges on the elytra. Lifecycle and habitat requirements: The larvae develop among soft white-rotted heartwood of a range of broadleaved and coniferous trees, especially birch and beech in Britain but also commonly using decaying pine stumps abroad. It likes open-structured but damp woodland with plentiful moss-covered dead wood. Flowers visited: Claimed to visit a variety of flowers in hot weather but no specific information obtained. Status and distribution: A strangely disjunct distribution with a high proportion of records within the Nottinghamshire, Lincolnshire and Yorkshire region and a smaller hotspot in the Scottish Highlands. Graded Least Concern/Nationally Scarce by Alexander (2014). Map: https://species.nbnatlas.org/species/NHMSYS0001719896. Conservation requirements: Promote the presence of old trees with damp heart-rot, also damp, moss-covered stumps and lying dead wood. Key references: Hyman & Parson (1992), Duff (2020), UK Beetles: https://www.ukbeetles.co.uk/pyropterus-

nigroruber.

4.12 Melandryidae (false darkling beetles)

Represented in Britain by 17 species, all of which either develop in rotting wood or in bracket fungi on trees. Only one species appears to be a regular flower-visitor. The British species are covered by Duff (2020). Conservation statuses for the scarcer species are provided by Alexander, Dodd & Denton (2014).

Anisoxya fuscula

General: A 2.5-4 mm long, torpedo-shaped brown beetle. Lifecycle and habitat requirements: The larvae develop in the dead twigs of assorted broadleaved trees including ash, willow, beech, field maple, lilac, grey poplar. Has been recorded from ancient woodland, fairly open woodland in the Brecks, and suburban gardens. Flowers visited: Meadowsweet but it does not seem to be a very regular flower visitor. Status and distribution: Widespread but local in the southern half of Britain. Graded Least Concern/Nationally Scarce by Alexander, Dodd & Denton (2014). Map: https://species.nbnatlas.org/species/NBNSYS0000024887. Conservation requirements: Promote the presence of older trees with dead twigs in the canopy; also suitable flowers for adult foraging. Key references: Alexander (2002), Hyman & Parsons (1992), Duff (2020).

Orchesia undulata

General: A 4-5 mm long, brown and black, chequer-patterned beetle. Lifecycle and habitat requirements: The larvae develop in decaying dead branches of oak, where it is possibly associated with the fungus *Exidia glandulosa*; also recorded from some other broadleaved species. Found in woods, pasture-woodland and along hedges with mature trees. Flowers visited: Occasionally visits hawthorn and umbellifers but this seems to be very infrequent. Status and distribution: Widespread but local in England and Wales; very scarce in Scotland. Map: https://species.nbnatlas.org/species/NBNSYS0000024886. Conservation requirements: Promote the presence of old trees; also suitable flowers for adult foraging. Key references: Alexander (2002), Duff (2020).

Osphya bipunctata

General: A 5-11 mm beetle with females and smaller males that can resemble a red and brown soldier beetle whilst large males have greatly swollen and modified hind legs and look very different. Lifecycle and habitat requirements: The larvae are presumed to develop in dead wood within ancient broadleaved woodland. Flowers visited: Flowering shrubs, especially hawthorn but also dog rose, wayfaring Tree, guelder-rose, dogwood and field maple. Status and distribution: Widespread but very local in England north to Yorkshire. Graded Least Concern/Nationally Scarce by Alexander, Dodd & Denton (2014). Map: https://species.nbnatlas.org/species/NHMSYS0020152917. Conservation requirements: Promote the presence of old trees and dead wood; also spring-blossoming shrubs for adult foraging. Key references: Duff (2020), Hyman & Parsons (1992).

4.13 Melyridae (soft-bodied flower beetles)

Represented in Britain by 26 species which have frequently been treated as two families (Dasytidae and Malachiidae). The British species are covered by Duff (2020). Conservation statuses for the scarcer species are provided by Alexander (2014).

Anthocomus fasciatus

General: A 3-3.5 mm long, black beetle with a pair of red lateral spots on the elytra and a red tip. Lifecycle and habitat requirements: The larvae are predatory in the borings of anobiid beetles. It can occur in a variety of habitats and can also develop in compost. Flowers visited: Hawthorn and umbellifers. Status and distribution: Widespread but local in the southern half of Britain. Graded Least Concern/Nationally Scarce by Alexander (2014). Map: https://species.nbnatlas.org/species/NBNSYS0000024407. Conservation requirements: Promote the presence of old trees and associated dead wood; also suitable flowers for adult foraging. Key references: Alexander (2002, 2014), Duff (2020), UK Beetles: https://www.ukbeetles.co.uk/anthocomus-fasciatus.

Aplocnemus impressus

General: A small (4-5 mm), elongate-oval, heavily-punctured black beetle with a sparse covering of erect hairs. Lifecycle and habitat requirements: The larvae develop in decaying wood pf various broadleaved trees including oak, birch, pear, sycamore and occasionally pine. Most records are for broadleaved and mixed woodland and parkland with plenty of over-mature trees. Flowers visited: Tree blossoms; also conifer flowers. Status and distribution: Sparingly recorded in southern and central England. Graded Least Concern/Nationally Scarce by Alexander (2014). Map: https://species.nbnatlas.org/species/NHMSYS0001717020. Conservation requirements: Promote the presence of old trees and associated dead wood; also suitable flowers for adult foraging. Key references: Alexander (2002, 2014), Duff (2020), UK Beetles: https://www.ukbeetles.co.uk/aplocnemus-impressus.

Aplocnemus nigricornis

General: A small (4-5 mm), elongate-oval, heavily-punctured black beetle closely resembling *A. impressus*. Lifecycle and habitat requirements: Found in ancient broadleaved woodland and parkland with hollow oaks; also mixed and coniferous woodland. The larvae develop in decaying wood. Flowers visited: No data obtained but there is a purported internet photo which seems to feature a large oxeye daisy-type composite. Status and distribution: Sparingly recorded in the southern half of Britain north to Yorkshire. Rare in Scotland. Graded Least Concern/Nationally Scarce by Alexander (2014). Map: https://species.nbnatlas.org/species/NHMSYS0001717021. Conservation requirements: Promote the presence of old trees and associated dead wood; also suitable flowers for adult foraging. Key references: Alexander (2002), Hyman & Parsons (1992), Duff (2020).

Dasytes aeratus

General: A small (4-5 mm), rather slim, semi-shiny-black beetle with a sparse

covering of erect hairs, distinguishable from other *Dasytes* species by the entirely dark legs. Lifecycle and habitat requirements: The larvae develop as predators under bark or in decaying wood of a variety of broadleaved trees including oak, lime, beech and willow. They will use living trees, stumps and detached wood. Typically recorded in broadleaved woodland, parkland and along hedges but it can disperse some distance from breeding habitat. Flowers visited: Hawthorn, roses, apple, dogwood, cherry, sallow, *Viburnum* species. Foreign internet images purporting to be this species feature an umbellifer and white bryony. Status and distribution: Locally common in the southern half of Britain but rare in the SW and north. Very rare in Scotland. Map: https://species.nbnatlas.org/species/NBNSYS0000024387. Conservation requirements: Promote the presence of old trees and associated dead wood; also suitable flowers for adult foraging. Key references: Alexander (2002), UK Beetles: https://www.ukbeetles.co.uk/dasytes-aeratus.

Dasytes niger

General: A small (3.5-4.5 mm), rather slim shiny-black beetle with a sparse covering of erect hairs. Lifecycle and habitat requirements: The larvae develop as predators under bark or in decaying wood of smaller branches and fallen timber up to 40 cm in diameter. They will use wood of a variety of broadleaved trees including birch, rowan, aspen, willow and oak. Pine and spruce are also used on the Continent. This species likes open broadleaved woodland and parkland with plenty of dead wood but there are also records from downland and railway embankments. Adults will swarm over dead logs in sunshine. Flowers visited: Umbellifers, 'blossom' and Common Rockrose. Foreign internet images purporting to be this species feature strawberry, spurge and oxeye daisy. Status and distribution: Most records are from central Southern England within Hampshire and West Sussex. Graded Least Concern/Nationally Rare by Alexander (2014). Map: https://species.nbnatlas.org/species/NBNSYS0000024389. Conservation requirements: Promote the presence of old trees and associated dead wood; also suitable flowers for adult foraging. Key references: Alexander (2002), Hyman & Parsons (1992), UK Beetles: https://www.ukbeetles.co.uk/dasytes-niger.

Dasytes plumbeus

General: A small (3.5-4.5 mm), rather slim, slightly metallic black beetle with a sparse covering of erect hairs but not easily distinguishable from some related species. Lifecycle and habitat requirements: The larvae develop as predators in the decaying wood of trunks and thicker branches of broadleaved trees. It can turn up in a variety of habitats including woodland, scrub, hedgerows and sometimes gardens. Flowers visited: Hawthorn, hogweed and elder in Britain. Foreign internet images purporting to be this species also feature roses and buttercups. Status and distribution: Very local in the southern half of Britain but the precise distribution unclear due to past confusion with other species such as *D. virens*. Graded Least Concern/Nationally Scarce by Alexander (2014).Map: https://species.nbnatlas.org/species/NHMSYS0001717842. Conservation requirements: Promote the presence of old trees and associated dead wood; also suitable flowers for adult foraging. Key references: Alexander (2002), Hyman & Parsons (1992), UK Beetles: https://www.ukbeetles.co.uk/dasytes-plumbeus.

Dasytes virens
General: A small (3.5-4.5 mm), rather slim, blackish beetle with a sparse covering of erect hairs but not easily distinguishable from some related species. Lifecycle and habitat requirements: Biology probably similar to other members of the genus. Flowers visited: Purported photos on the internet feature umbellifers and what appears to be a rose. Status and distribution: Very scarce with scattered records in SE England, East Anglia, also a site in Warwickshire. Graded Near Threatened/Nationally Rare by Alexander (2014). Map: https://species.nbnatlas.org/species/NHMSYS0001717844. Conservation requirements: Promote the presence of old trees and associated dead wood; also suitable flowers for adult foraging. Key references: Alexander (2002, 2014), Hyman & Parsons (1992 – as *D. puncticollis*).

Dasytes cyaneus Only known as British from a single record which is not believed to represent an established population (Alexander, 2014).

Malachius bipustulatus The familiar Common Malachite beetle is facultatively saproxylic with larvae that can develop as predators and scavengers in the holes of wood-borers but also in various non-saproxylic locations. Adults feed on a large variety of flowers but especially umbellifers, buttercups and oxeye daisy; also grass flowers.

Malachius aeneus A very rare southern species graded Near Threatened/Nationally Rare by Alexander (2014) and a Section 41 conservation priority species. Larvae of have been found under the bark of logs in Devon (Alexander, 2014) and under bark and in tree rot-holes abroad (UK Beetles: https://www.ukbeetles.co.uk/malachius-aeneus) but it is also suspected of using roofing thatch in places such as the New Forest so, again, may not be an obligate saproxylic. Adults visit a variety of flowers including buttercups and umbellifers (e.g. ground-elder); also the flowers of grasses such as cock's-foot and meadow foxtail, and some garden flowers such as a yellow-flowered *Centaurea*.

4.14 Mordellidae (tumbling flower beetles)
Currently represented in Britain by 17 species, some of which are saproxylic and appear to visit flowers. The British species are covered by Duff (2020). The taxonomy of some species is unstable and Identification can be difficult which means that it can be hard to assign flower visits to particular species. Umbellifers and composites seem to be most visited. Conservation statuses for the scarcer species are provided by Alexander, Dodd & Denton (2014). The following summarises the British species thought to be saproxylic flower-visitors based on information in Alexander, Dodd & Denton (2014), Duff (2020), Hyman & Parsons (1992), Jones (1992) and the UK Beetles website.

Mordella holomelaena Graded Vulnerable/Nationally Rare. A species of old broadleaved woodland in the southern part of Britain. Possibly saproxylic but seemingly not proven. Visits a variety of flowers including buttercups, wood spurge, bramble, wild carrot, guelder-rose and possibly yarrow.

Mordella leucaspis Extremely rare and poorly known (graded Critically Endangered/Nationally Rare). It could be a flower visitor as it is closely related to the previous species.

Mordellistena humeralis Very scarce in the southern half of Britain (graded Least Concern/Nationally Scarce). Larvae develop in decaying white wood of old broadleaved trees such as oak, hornbeam, alder and hazel in ancient woodland, parkland and old hedges. Adults visit umbellifers (e.g. hogweed, wild angelica), meadowsweet, bedstraws, hawthorn and elder.

Mordellistena neuwaldeggiana Local in the southern half of Britain (graded Least Concern/Nationally Scarce). The ecology seems to be similar to that of the very similar *M. humeralis*. Adults visit umbellifers (e.g. hogweed, wild angelica), guelder-rose, mugwort.

Mordellistena variegata Graded Nationally Scarce. The ecology seems to be similar to that of *M. humeralis*. Known to visit umbellifers such as hogweed, wild parsnip and wild angelica.

Mordellochroa abdominalis Local in southern Britain. The larvae develop under bark or in dry sapwood of various broadleaved trees including ash in England, also goat willow, beech, hazel and willows on the Continent. Adults visit hawthorn, rowan, umbellifers (e.g. hogweed), rose, apple, pyracantha, dogweed and guelder-rose. Typical habitats are woodland borders, hedgerows, wooded parkland, gardens and wasteland.

Tomoxia bucephala Local in southern Britain (graded Least Concern/Nationally Scarce). The larvae develop in the well-decayed, fungus-infested wood of decaying beech, horse chestnut, hornbeam, oak and poplar in old broadleaved woodland and pasture-woodland. Adults visit umbellifers.

Variimorda villosa Local in southern Britain (graded Least Concern/Nationally Scarce). Strongly associated with willows in riparian situations; also recorded from ancient broadleaved woodland. Visits hogweed, pyracantha, scentless mayweed and great mullein.

4.15 Nitidulidae (pollen and sap beetles)

Represented in Britain by over 90 species of small to very small, oval beetles with varied biology but including some species associated with sap-runs, tunnels of other saproxylic beetles, and fungi associated with trees or dead wood. Members of the non-saproxylic genus *Meligethes* can be the most abundant insects on flowers such as oil-seed rape and oxeye daisy. The British species are covered by Duff (2020). Conservation statuses for the scarcer species are provided by Hyman & Parsons (1994). The saproxylic species reported to visit flowers are summarised here (information based mainly on Alexander, 2002; Duff, 2020; Lane et. al., 2002). *Epuraea* species seem to be associated variously with sap-runs, bracket fungi and other saproxylic habitats but these are tiny and relatively poorly studied beetles and

it is possible that more of Britain's 21 *Epuraea* species will prove to be flower-visiting saproxylics.

(***Epuraea aestiva*** – listed as possibly saproxylic in Alexander (2002) but rejected based on current information)

Epuraea biguttata A widespread species that develops under sappy bark of dead timber and in bracket fungi. Visits sallow catkins and apple.

Epuraea longula Very local in England and Wales (Graded Nationally Scarce (Notable B)). Usually recorded in woodland. Adults have been found at Goat Moth *Cossus cossus* burrows and will visit flowers such as hogweed, wild angelica, meadowsweet, cherry laurel and scabious (Hyman & Parsons, 1994).

Epuraea marseuli Widespread and fairly frequent. At flowers but no specific information found.

Epuraea melanocephala A widespread species that visits the flowers of hawthorn, field maple, wild parsnip, bramble, gorse, common ragwort, buddleia, cherry laurel, rose, *Clematis*, elder and wild privet.

Epuraea melina Will visit cherry laurel, wild angelica, apple and bird cherry.

Epuraea pallescens Widespread but local. At flowers but no specific information found.

Epuraea rufomarginata A very local species that visits woodland flowers but no specific information found.

Epuraea silacea Widespread but local (graded Nationally Rare in Hyman & Parsons, 1994) but now regarded as more frequent. Has been found in sap and dead wood of birch, also associated with fungi such as *Cerioporus squamosus*, *Fomes fomentarius* and *Fomitopsis betulina*.

Soronia grisea. A widespread but local species that develops in sap-runs. Adults will visit flowering shrubs (Duff, 2020).

4.16 Oedemeridae (false blister beetles)

Represented in Britain by 10 species, several of which are very active flower visitors (notably non-saproxylic *Oedemera* species). The British species are covered by Duff (2020). Conservation statuses for the scarcer species are provided by Alexander, Dodd & Denton (2014). The species known or suspected to visit flowers are as follows:

Chrysanthia nigricornis

General: A small, slim beetle with an iridescent green or copper body plus orange and black legs that is associated with ancient pine woods. Lifecycle and habitat

requirements: The larvae develop in rotting fallen pine branches lying amongst heather and moss. The only known British site is ancient Caledonian pine woodland. Flowers visited: It apparently favours composites. Internet photos from abroad feature what appears to be native goldenrod, yarrow and tansy plus other flowers unlikely to occur in pinewoods. Status and distribution: Only known from Glen Tanar, Aberdeenshire where it was first discovered in 1971. Graded Vulnerable/Nationally Rare by Alexander, Dodd & Denton (2014). No NBN map. Conservation requirements: Promote the presence of rotting pine branches on the ground; also suitable flowers for adult foraging. Key references: Alexander, Dodd & Denton (2014), Duff (2020).

Ischnomera caerulea

General: Resembling the commoner *A. cyanea* but more sparsely and finely punctured. Lifecycle and habitat requirements: Recorded from soft, white-rotted heartwood of a dead elm and rotten wood removed from a rot-hole. Associated with oak on the Continent. Occurs mainly in old broadleaved woodland and pasture-woodland. Flowers visited: Hawthorn. Status and distribution: Very scarce in the southern half of England and east Wales. Graded Least Concern/Nationally Rare by Alexander, Dodd & Denton (2014). Map: https://species.nbnatlas.org/species/NBNSYS0000024939. Conservation requirements: Promote the presence of older trees with heart-rot; also suitable flowers for adult foraging. Key references: Alaxander (2002), Hyman & Parsons (1992), Duff (2020).

Ischnomera cineracens

General: Resembling *A. cyanea* and *A. caerulea* but with longer, paler hairs on the elytra. Lifecycle and habitat requirements: Develops in white-rotted heartwood of large wych elms and perhaps other broadleaved species. Recorded from ancient and secondary broadleaved woodland plus pasture-woodland. Flowers visited: Hawthorn (S. Lane – pers. comm). Status and distribution: Very rare with a few records in the South Midlands, Cumbria and Yorkshire. Graded Least Concern/Nationally Rare by Alexander, Dodd & Denton (2014). Map: https://species.nbnatlas.org/species/NHMSYS0020152587. Conservation requirements: Promote the presence of older trees with heart-rot; also suitable flowers for adult foraging. Key references: Alexander (2002), Hyman & Parsons (1992), Duff (2020).

Ischnomera cyanea

General: A slim 8-10 mm long, iridescent blue-green beetle. Lifecycle and habitat requirements: The larvae develop in relatively soft white-rotted heartwood of various broadleaved trees in woodland and more open habitats. Flowers visited: Hawthorn, roses, umbellifers (e.g. hogweed), *Sorbus* species, pyracantha. Status and distribution: Local in the southern half of Britain but rare in SW England, Wales and northern England. Not recorded in Scotland. Map: https://species.nbnatlas.org/species/NHMSYS0020152589. Conservation requirements: Promote the presence of older trees with heart-rot; also suitable flowers for adult foraging. Key references: Alexander (2002), Watford Coleoptera

Group: http://www.thewcg.org.uk/Oedemeridae/0127.htm, Duff (2020).

Ischnomera sanguinicollis
General: A slim 8-12 mm long beetle with a bright red pronotum that contrasts with the dark-grey elytra and black head and appendages. Lifecycle and habitat requirements: The larvae develop in the decaying wood of various broadleaved trees including maples, alder, beech and elm. Found in old broadleaved woodland with plenty of dead wood in various stages of decay but it also associated with more isolated mature trees in old parkland, pasture-woodland etc. Flowers visited: Hawthorn, field maple, sycamore, lime, guelder-rose, pyracantha, elder, broom with foreign reports for false acacia and *Sorbus* species. Status and distribution: Scarce and localised with records concentrated within the western side of Central England, West Sussex and the New Forest. Rare in Wales and unrecorded in East Anglia and northern Britain. Graded Least Concern/Nationally Scarce by Alexander, Dodd & Denton (2014). Map: https://species.nbnatlas.org/species/NHMSYS0020152591. Conservation requirements: Promote the presence of old trees and dead wood; also suitable flowers for adult foraging. Key references: Alexander (2002), Hyman & Parsons (1992), UK Beetles: https://www.ukbeetles.co.uk/ischnomera-sanguinicollis, Watford Coleoptera Group: http://thewcg.org.uk/Oedemeridae/0128.htm, Duff (2020).

4.17 Ptinidae (spider and furniture beetles)
Represented in Britain by nearly 60 species of mostly small or very small beetles. Many are associated with dead wood or fungi. The British species are covered by Duff (2020). Conservation statuses are provided by Alexander (2017). Only one saproxylic species seems to be a regular flower visitor.

Hedobia imperialis
General: A 3-6 mm long, woodworm-like beetle strongly patterned black, brown and cream by small scales. Lifecycle and habitat requirements: The larvae develop under the bark and in the xylem of decaying timber of stumps, logs, fallen branches and standing dead trees, especially where there is luxuriant ivy growth. Many species of broadleaved tree are used, including hawthorn, hornbeam, hazel, elm and lime; also dead stems of rose. The favoured habitats are woodland, pasture-woodland and old hawthorn hedges. Flowers visited: Spring-flowering shrubs such as blackthorn, hawthorn and guelder-rose, also umbellifers. Status and distribution: Widespread but local extending north to southern Scotland. Map: https://species.nbnatlas.org/species/NBNSYS0000148202. Conservation requirements: Promote the presence of post-mature trees and associated dead wood; also suitable flowers for adult foraging. Key references: Alexander 2002), Hyman & Parsons (1992 – as *Ptinomorphus imperialis*), Duff (2020), UK Beetles: https://www.ukbeetles.co.uk/ptinomorphus-imperialis.

4.18 Pyrochroidae (cardinal beetles)
Represented in Britain by three species which are covered by Duff (2020). All three are saproxylic but only the two *Pyrochroa* species seem to visit flowers. Conservation statuses are provided by Alexander, Dodd & Denton (2014).

***Pyrochroa coccinea* Black-headed Cardinal Beetle**
General: A 10-18 mm long, bright red beetle with a black head and pectinate antennae in males, serrate antennae in females. Lifecycle and habitat requirements: The larvae develop under the bark of stumps, logs, fallen trunks and branches of assorted broadleaved trees, especially in damp, shaded places. They feed upon decaying bark, insect excrement, plus living and dead other insects, and can be cannibalistic when at high densities. Development takes 2 years or more. Usually found in older broadleaved woods. Flowers visited: Cow parsley. As well as feeding on pollen, they will also predate other insects on flowers. Status and distribution: Local but not rare in SE and central England plus East Wales. Scarce in SW England, East Anglia and northern England. Not recorded from Scotland. Regarded as an introduction that is expanding. Map: https://species.nbnatlas.org/species/NBNSYS0000024880. Conservation requirements: Promote plentiful lying dead wood; also umbellifers for adult foraging. Key references: Alexander (2002), Duff (2020), UK Beetles: https://www.ukbeetles.co.uk/pyrochroa-coccinea

***Pyrochroa serraticornis* Red-headed Cardinal Beetle**
General: Resembling *C. coccinea* but duller red and with a red head. Lifecycle and habitat requirements: Biology and habitat requirements similar to *P. coccinea* and sometimes found at the same sites. Flowers visited: Cow parsley, hawthorn, dogwood, dandelion. As well as feeding on pollen, they will also predate other insects on flowers. Status and distribution: Fairly frequent in woodlands within the southern half of Britain but scarce in SW England and northern England. Not recorded in Scotland. The commonest British cardinal beetle but said to be declining on the Continent. Map: https://species.nbnatlas.org/species/NBNSYS0000024881. Conservation requirements: Promote plentiful lying dead wood; also umbellifers for adult foraging. Key references: Duff (2020),
UK Beetles: https://www.ukbeetles.co.uk/pyrochroa-serraticirnis

4.19 Scarabaeidae (dung beetles, chafers etc.)
About 85 species occur in Britain, most of which are associated with dung or soil. Saproxylic lifecycles are found in *Cetonia*, *Gnorimus, Trichius* and *Valgus* species, all of which are flower visitors. These saproxylic species are some of our most spectacular beetles. The British species are covered by Duff (2020). Conservation statuses for the scarcer species are provided by Lane & Mann (2016). There is a British Scarabs Recording Scheme https://britishscarabs.org/.

***Cetonia aurata* Rose Chafer**
General: A large (up to 21 mm long) shiny, metallic-green chafer with a variable number of white streaks on the elytra which has sinuately-indented wing tips (unlike the similar *Protaetia metallica*). Lifecycle and habitat requirements: The larvae feed for two years in rotting wood such as stumps but can also use compost, leaf mould and manure. Brock (2019) has found larvae associated with dead wood colonised by Southern Wood Ant *Formica rufa* but this is not a strong association as the beetle occurs in many places where the ant is absent. Flowers visited: Mann & Mann (2020) lists British records for garden privet, *Viburnum*, hoary cress, assorted umbellifers

(wild carrot, cow parsley, hogweed, hemlock, *Oenanthe*), creeping thistle, ragwort, arum lily, elder, pyracantha, rose, hemp-agrimony, hawthorn, ivy, thrift, wild thyme and bramble. Further records also exist for gorse, and 'honeysuckle'. Status and distribution: Local and patchily distributed in southern England and West Wales; very rare in northern England and West Scotland. Hotspots include the New Forest, West Sussex, the Home Counties, the South Devon coast and Pembrokeshire. Map: https://species.nbnatlas.org/species/NBNSYS0000011544. Conservation requirements: Promote the presence of decaying dead wood such as stumps; also suitable flowers for adult foraging. Key references: Duff (2020), Mann & Mann (2020), UK Beetles: https://www.ukbeetles.co.uk/cetonia-aurata.

***Gnorimus nobilis* Noble Chafer**

General: A large (up to 20 mm long) shiny, metallic-green chafer that resembles *Cetonia aurata* but is somewhat duller with longer legs and a narrower body shape. Lifecycle and habitat requirements: The larvae develop in the wood mould of hollow trunks and boughs of assorted broadleaved trees. In places such as the New Forest it primarily uses old oak and beech but in the Severn basin there is a strong association with old orchards where it uses cherry, plum, damson and apple. It will also use willow. Flowers visited: Mann & Mann (2020) lists British records for elder (which it seems to really favour), guelder-rose, box honeysuckle and *Aruncus* and there are further records here and abroad for hogweed, hawthorn, roses, bramble, wild privet, meadowsweet and yarrow. Status and distribution: Local and largely restricted to SE England, the New Forest, and with a major hotspot in the Severn basin area of Gloucestershire, Worcestershire and Herefordshire. Graded Vulnerable/Nationally Scarce by Lane & Mann (2016) and a Section 41 conservation priority species. Map: https://species.nbnatlas.org/species/NBNSYS0000011549. Conservation requirements: Promote the presence of post-mature trees such as cherry, plum, damson and apple in the Severn Basin; oak and beech in areas such as the New Forest; also suitable flowers for adult foraging. Key references: Alexander (2002), Alexander & Bowers (2011), Hyman & Parsons (1992), Duff (2020), Mann & Mann (2020), Schenke (2012), Jessop (1986), PTES Fact Sheet: https://ptes.org/campaigns/noble-chafer-beetles/noble-chafer-beetles-facts/.

***Gnorimus variabilis* Variable Chafer**

General: A large (up to 22 mm long) black chafer with a variable number of pale flecks on the elytra. Lifecycle and habitat requirements: The larvae develop in damp wood mould and red-rotted heartwood of veteran oak and beech trees. Other broadleaved trees such as sweet chestnut can be used abroad. This beetle is very much associated with old woodland and parkland that offers a long continuity of veteran trees. Flowers visited: Stated to be a flower visitor though no specific information has been found. It is likely to visit a similar selection of flowers to *G. nobilis*. Status and distribution: Very rare. Historically known from a number of locations (mainly commons) in Kent and Surrey but recent records come from just two modern locations, the Windsor Forest/Great Park area of Berkshire and Parham Park, West Sussex. Graded Endangered/Nationally Rare by Lane & Mann (2016) and a Section 41 conservation priority species. The IUCN Red List of European Saproxylic Beetles (Dodelin*et al.*, 2017) has assessed this beetle as Vulnerable across its whole

A Noble Chafer apple tree at Croft Castle, Herefordshire.

European range. Map: https://species.nbnatlas.org/species/NBNSYS0000011550. Conservation requirements: Promote the presence of very old oak and beech with red heart-rot. Key references: Duff (2020), Lane & Mann (2016), UK Beetles: https://www.ukbeetles.co.uk/cetonia-aurata.

***Trichius fasciatus* Bee Beetle/Bee Chafer**

General: A very striking 9-12 mm long chafer with a brown-furred pronotum and black and beige-patterned elytra that can render it somewhat bee-like when sitting on flowers. Lifecycle and habitat requirements: The larvae feed in large birch stumps containing wood mould. It is associated with birch woodland and other birch-rich habitats. Flowers visited: Mann & Mann (2020) lists British records for assorted umbellifers (ground elder, hogweed, wild angelica), assorted thistles (spear, marsh, melancholy, meadow), bramble, garden privet, *Allium*, bluebell, buddleia, foxglove, meadowsweet, pyramidal orchid, *Hosta*, oxeye daisy, Siberian iris, peony, rose, common ragwort, devil's-bit scabious, field scabious, wild thyme, cornsalad, knapweed and white clover. Further records exist for Scot's lovage, yarrow and, from internet photos, possibly for cranesbills and bridewort though foreign photos claiming to be *T. fasciatus* could be other similar *Trichius* species. Status and distribution: Records almost entirely confined to the Scottish Highlands and Wales where it can be locally frequent. Very rare in England. Map: https://species.nbnatlas.org/species/NBNSYS0000011551. Conservation requirements: Promote the presence of decaying wood such as birch stumps; also suitable flowers for adult foraging. Key references: Alexander (2002), Duff (2020), Mann & Mann (2020).

Trichius gallicus
A recent colonist that closely resembles *T. fasciatus* but averages slightly larger and has slightly different markings on the elytra. It is mostly recorded from the Norfolk and London areas. Mann & Mann (2020) list British flower visits for *Convolvulus*, bramble, peony, ground elder, hogweed, daisy, Astrantia, buddleia and elder. Foreign internet photos (if accurate) add roses, scabiouses and a variety of composites (e.g. oxeye daisy, yarrow, thistles).

Valgus hemipterus
Another recent colonist which was considered as naturalised in the London area in 2019 (Telfer, 2020) following older isolated records. Females have a saw-like ovipositor to create an egg-laying site in moist, rotting wood of trees such as birch. Internet photos show a broad range of flowers are visited abroad including hawthorn, roses, umbellifers, oxeye daisy and thistles. In Britain it has been found feeding on hoary cress and hemlock.

4.20 Scraptiidae (false flower beetles)
Represented in Britain by 14 small saproxylic beetles that resemble mordellid beetles. Some use bracket fungi rather than rotting wood. All probably visit flowers, although they are so small (2-4 mm long) that they are unlikely to be very effective pollinators and difficulties with field identification make it hard to assign some species to specific flowers. The British species are covered by Duff (2020). Conservation statuses for the scarcer species are provided by Alexander, Dodd & Denton (2014).

***Anaspis* species** These are particularly keen on the flowers of umbellifers and spring-blossoming shrubs but will visit composites and flowers of various other families though identifying the beetles to species level in the field or from a photograph is not always easy. The following is a summary of the British species based on Information on from Duff (2020), UK Beetles website, Alexander (2002), Alexander, Dodd & Denton (2014), Hyman & Parsons (1992), Lane et al. (2002), Nature Spot etc.

Anaspis bohemica Only known from a small number of ancient Caledonian pine forest sites in Scotland. Graded Vulnerable/Nationally Rare. Larvae are presumed to develop in dead branches of pine. Adults have been beaten from Broom blossom and are also said to visit the male flowers of Scots pine. Rowan (the main rosaceous blossom of the pinewoods) could also be important.

Anaspis costai Local in the southern half of Britain (graded Least Concern Nationally Scarce). Recorded visiting hogweed and wild angelica, and an Internet photo purporting to be this species features oxeye daisy.

Anaspis fasciata Fairly frequent in wooded areas of the southern half of Britain but scarce in the north. Has been reared from dead oak branches. Visits blossoms such as hawthorn, blackthorn, dogwood, bramble and apple.

Anaspis frontalis Fairly common in wooded areas of the southern half of Britain but

More flower-visiting saproxylic beetles

Pyrochroa serraticornis

Platycis minutus

Cetonia aurata

Gnorimus nobilis

Trichius fasciatus

Ampedus species

scarce in the north. Visits a wide range of flowers including blossoms such as hawthorn, also umbellifers, bramble, and daisy-type composites.

Anaspis garneysi Widespread but local in wooded areas throughout England and Wales. Visits hawthorn, bramble, dogwood, field maple, cherry laurel, plus Internet photos purporting to be this species feature umbellifers.

Anaspis lurida Widespread but local in the southern half of Britain. Has been reared from dead branchwood of oak. Occurs in wooded areas and fens. Adults visit bramble, elder and wild angelica.

Anaspis maculata Widespread and common over much of England and Wales, scarce in southern Scotland. Develops in small girth branch wood of various broadleaved trees. Visits blossoms such as hawthorn, elder and umbellifers.

Anaspis pulicaria Widespread but local in the southern half of Britain. Likes fairly open habitats. Visits umbellifers (e.g. hemlock, wild angelica, wild parsnip, wild carrot), dogwood, radish, buddleia, *Clematis*, sweet chestnut.

Anaspis regimbarti Widespread and fairly frequent in wooded areas of England, Wales and Scotland. Has been reared from a decaying oak log and large girth oak branchwood. Visits hawthorn, rowan, umbellifers (e.g. hogweed, wild angelica), bramble, oilseed rape, dogwood.

Anaspis rufilabris Widespread and common over much of southern Britain, scarcer in the north. Has been reared from large girth oak branchwood. Occurs in woodland and scrub. Visits hawthorn, umbellifers (e.g. cow parsley, pignut), mint, rowan, rhododendron, holly, melancholy thistle, guelder-rose, elder and bird cherry.

Anaspis thoracica Widespread but local England and Wales, rare in Scotland. Graded Least Concern/Nationally Scarce. Wooded areas and fens. Visits blossom and umbellifers.

Scraptia fuscula
General: A tiny brown beetle associated with the heart-rot of veteran oaks. Lifecycle and habitat requirements: The larvae develop under the bark and within the relatively soft rotten heartwood of very old oaks in historic parkland and pasture-woodland. Flowers visited: Members of this genus are claimed to visit hawthorn. Status and distribution: Very rare with records confined to Windsor Great Park, Berkshire and some nearby sites in Buckinghamshire and Surrey (including Richmond Park), also Brockworth Park, Gloucestershire. Graded Vulnerable/Nationally Rare by Alexander, Dodd & Denton (2014). Map: https://species.nbnatlas.org/species/NHMSYS0020153386. Conservation requirements: Protect and promote veteran oaks and associated dead wood; also hawthorn blossom for adult foraging. Key references: Alexander, Dodd & Denton (2014).

Scraptia testacea
General: A tiny brown beetle associated with the red heart-rot of old trees. Lifecycle and habitat requirements: The larvae develop in red-rotten heartwood of old oak and to a lesser extent, beech and hawthorn, typically in ancient woodland and pasture-woodland. Flowers visited: Members of this genus are claimed to visit hawthorn. Status and distribution: Very localised with records scattered sparingly over the southern half of Britain. Graded Least Concern/Nationally Scarce by Alexander, Dodd & Denton (2014). Map: https://species.nbnatlas.org/species/NBNSYS0000024903. Conservation requirements: Protect and promote veteran tree such as oaks; also hawthorn blossom for adult foraging. Key references: Hyman & Parsons (1992), Alexander, Dodd & Denton (2014).

Scraptia dubia
Considered long-extinct in Britain (recorded at Glanville Wootton, Dorset in 1842). Apparently visits hawthorn.

4.21 Staphylinidae (rove beetles)
A huge family (about 1,130 British species), most of which can only be identified using a combination of old keys supplemented by more recent papers and Lott (2009). Conservation statuses are provided by Hyman & Parsons (1994) with tachyporines revised by Lane (2019). Two flower-visiting saproxylics have been identified:

Dropephylla ioptera Widespread but local over much of southern Britain except the SW. It develops under bark probably as a predator. Adults can be frequent on spring blossom such as hawthorn, rowan, sycampre and apple.

Hapalaraea pygmaea Widespread but local over much of southern Britain except the SW. It develops under bark or in decaying fungi on trees. Adults can be frequent on spring blossom such as hawthorn.

Phyllodrepa nigra A localised species and poorly-known species (graded RDBi by Hyman & Parsons, 2004). The larvae are thought to develop in bird nests in hollow trees or the wood mould beneath. Visits hawthorn but adults have also been found at sap-runs, in tree fungi, in pigeon dung and in a hornet nest.

4.22 Tenebrionidae (darkling beetles)
Represented in Britain by nearly 50 species that use a variety of larval habitats. The British species are covered by Duff (2020) and conservation statuses are provided by Alexander, Dodd and Denton (2014). Flower-visiting information has only been found for two saproxylic (or presumed saproxylic) species:

Gonodera luperus
General: A 6.5-9 mm long beetle, rather undistinguished looking oval black beetle. Lifecycle and habitat requirements: Presumed to be saproxylic but few details available. Typically encountered in wooded habitats. Flowers visited: Very keen on

flowering shrubs such as hawthorn. Status and distribution: Very local in the southern half of Britain. Graded Least Concern/Nationally Scarce by Alexander, Dodd & Denton (2014). Map: https://species.nbnatlas.org/species/NBNSYS0000024859. Conservation requirements: Promote the presence of old trees and dead wood; also suitable flowers for adult foraging. Key references: Duff (2020).

Pseudocistela ceramboides

General: A 10-12 mm long beetle with a chestnut-coloured elytra and a black pronotum, head and appendages. Lifecycle and habitat requirements: The larvae develop in wood debris and detritus in the hollows of post-mature broadleaved trees where they feed on fungal mycelia. Various tree species can be used but especially oak and beech in old broadleaved woodland, parkland and pasture-woodland. S. Lane (pers. comm.) has also found it in association with old rosaceous trees in an orchard (apple and hawthorn. Flowers visited: Hawthorn, rowan and umbellifers. Status and distribution: Very local in the southern half of England. Graded Least Concern/Nationally Scarce by Alexander, Dodd & Denton (2014). Map: https://species.nbnatlas.org/species/NBNSYS0000024860. Conservation requirements: Promote the presence of old broadleaved trees with heart-rot and other hollows; also suitable flowers for adult foraging. Key references: Duff (2020), Hyman & Parsons (1992), UK Beetles: https://www.ukbeetles.co.uk/pseudocistela-ceramboides

5 A Review of the Diptera (flies)

Britain's fly fauna contains over 400 strongly saproxylic species (Alexander, 2002; Perry & Rotheray, 2010). Several hundred more species have a less explicit or direct requirement for dead wood through an association with fungi. Not all fungi require dead wood but many do, even if the fruiting bodies appear to grow from the soil seemingly independent of dead wood. As such, the total fauna of directly and indirectly wood and tree-associated flies could be as many as 750 species.

As a generalisation, flies prefer damper habitats and damper decaying wood to beetles and are the main insects of water-filled rot-holes, soggy wood and sap-runs. Hoverflies are the most conspicuous saproxylic pollinators within the Diptera, and this assemblage contains some of our rarest and most spectacular species. Establishing both saproxylic and flower-visiting credentials is fairly straightforward for hoverflies as they are relatively well-studied. It can be a lot more difficult for most other fly families due to a lack of sufficiently detailed, consistent and trustworthy data. Aside from the hoverflies, saproxylic flies are not as well understood as saproxylic beetles but useful overviews are provided by Ulyshen (2018), Perry & Rotheray (2010) and Godfrey (2010). The list assembled by Alexander (2002) has proved very useful as a foundation for the list of species below.

5.1 Anthomyiidae

Represented in Britain by over 240 species. They can be some of the most abundant insects on spring-blossoming shrubs, buttercups, umbellifers and composites. The five British *Eustalomyia* species are cleptoparasites of crabronid wasps nesting in dead wood and can be frequently seen on log piles and dead stumps in summer but these do not appear to visit flowers. *Anthomyia* species have been reared variously from fungi and bird nests and are at best weakly saproxylic. They will visit assorted flowers including composites, umbellifers and ivy. The fairly frequent *Hylemya nigrimana*, which will visit flowers such as woodland umbellifers, may develop under bark (Alexander, 2002) though this genus seems to be more strongly associated with dung and *H. nigrimana* has been reared from cow dung (Smith, 1989). *Pegomya transversa* larvae burrow into fruiting bodies of various fungi associated with dead wood or old trees (Alexander, 2002) and several other *Pegomya* have been reared from woodland fungi (Chandler *in* Chandler, 2010) but members of this genus are not often seen on flowers. *Leucophora* species, which are cleptoparasites of ground-nesting mining bees (*Andrena*) or furrow bees (*Lasioglossum*, *Halictus*), could conceivably benefit from the exposed root-plates of wind-blown trees where the earth on these is supporting host nesting.

5.2 Bibionidae (St Mark's flies)

Represented in Britain by 18 species, many of which (but not all) are flower-visitors. The typical development location is soil but some species have also been reared from wood decay possibly as a spill-over from soil. Larvae are occasionally found in rot-hole material. No species seems to be strongly saproxylic.

5.3 Bombyliidae (bee-flies)

The spectacular black-winged *Anthrax anthrax* appears to have recently recolonised Britain after a gap in records of nearly 80 years. It is a parasitoid of *Osmia* mason bees including *O. bicornis* and *O. cornuta*. Both of these bees are generalist aerial nesters that will use walls, cliffs, bee hotels, building timbers as well as dead or partially dead trees and fallen branches. To date, the bee fly has only been recorded in a few gardens with bee hotels or old walls but in theory it could exploit *Osmia* nests in trees or timber. *Bombylius* species, which are cleptoparasites of ground-nesting mining bees (*Andrena*) or furrow bees (*Lasioglossum*, *Halictus*), could conceivably benefit from the exposed root-plates of wind-blown trees where the earth on these is supporting host nesting.

5.4 Calliphoridae (blowflies)

Represented in Britain by about 30 species as newly defined (without *Pollenia* and *Stomorhina* species). They can be identified using Falk (2016). Only a single species, *Bellardia bayeri*, seems to have any particular association with dead wood, having been reared from under bark on several occasions. *Bellardia* species all appear to be earthworm parasitoids and it is possible that *B. bayeri* targets earthworms in wood mould but records are too few to know if this is an obligate situation. *Bellardia* species are keen flower visitors and the internet features several purported foreign photos of *B. bayeri* on daisy-type composites. It is also likely that *Calliphora* and *Lucilia* species (keen flower visitors) take advantage of any fresh carrion within tree cavities or bird nests for larval development. The Bird Blowfly *Protocalliphora azurea*, which has larvae that suck blood from bird nestlings, almost certainly takes advantage of bird nests in old trees but there is no particular association with older trees. It is particularly keen on the flowers of umbellifers and ivy.

5.5 Empididae (dance flies)

A large family (about 210 British species) of small to medium-sized predatory flies. The larval biology of most is unknown though saproxylic habits seem to be scarce within the family. Alexander (2002) only lists 6 species as being reared from dead wood but it is not known if all these are obligate saproxylics or if they visit flowers. Only one species is highlighted here:

Dryodromia testacea A scarce species that has been recorded from an emergence trap set over a dead beech stump and also set over branches in soil. It seems to be a species of old woodland and parkland, especially that with old beech. It is graded Lower Risk/Nationally Scarce in Falk & Crossley (2005) and is known from scattered sites in southern England and east Wales. The adults characteristically visit spring blossoms such as hawthorn, rowan and spindle.

5.6 Fanniidae

Represented in Britain by 60 species, all but two of which are placed in the genus *Fannia*. The British fauna is covered by D'Assis Fonseca (1968) and conservation statuses are provided by Falk & Pont (2017). The precise larval habits of many are unknown or confused by highly contradictory published information, which might indicate that some of them have rather flexible saprophagous larval habits but could

also have been affected by misidentification or finding larvae or pupae that have moved away from the main developmental medium. Alexander (2002) lists 13 species that have been recorded in association with saproxylic habitats in some way. This includes species reared from fungi (*Fannia aequilineata*, *F. difficilis*, *F. manicata*, *F. monilis*, *Piezura graminicola* and *P. pardalina*), wood detritus or decaying timber (*F. aequilineata*, *F. gotlandica*, *F. lineata*, *F. monilis*, *F. polychaeta*, *F. postica*, *F. umbrosa*), or from bat droppings in hollow trees (*F. vespertilionis*). Smith (1989) lists 14 *Fannia* species reared from bird nests. This includes birds such as Little Owl that require cavities in older trees. It is possible for one *Fannia* species to have been purportedly reared from wood detritus, bird nests and fungi. Despite this confusion, several *Fannia* species seem to be strongly associated with old trees or standing dead trees in ancient woodland and old parkland/pasture-woodland. In terms of flower-visiting, some *Fannia* species clearly visit flowers (especially females) but as most species cannot be easily identified in the field there is not much information for what species visit what flowers. The adults of some saproxylic species may prefer to feed at sap-runs rather than flowers. The following two known flower-visitors seem to be most strongly associated with old trees.

Fannia aequilineata Widely recorded in southern Britain but very local (graded Nationally Scarce). It has been reared from rotten wood, wood detritus, several fungi, various birds' nests, the detritus in a wasp nest, and the nests of small mammals (Falk & Pont, 2017); also compost (Harvey, 2020 - which summarises many published records). Adults have been recorded visiting garden *Bupleurum* flowers but are also keen on feeding at sap-runs, especially at trees infested with Goat Moth. Recorded habitats include woodland, pasture-woodland, mature hedges and orchards (Alexander, 2020; Harvey; 2020; S. Falk data).

Fannia gotlandica Widespread but local in southern Britain (graded Nationally Scarce). Reared from wood detritus and rotting wood of trees such as elm and beech. Occurs in woodland and other habitats with old trees. No flower-visiting information obtained.

5.7 Hybotidae

A large family (over 180 British species) of mostly small and very small, predatory flies. The habitat preferences and biology of most are poorly known but several saproxylic genera are present. Of these *Anthalia* and *Euthyneura* seem to be regular flower visitors perhaps especially to spring-blossoming shrubs such as hawthorn. They likely require dead wood in damp, shaded settings. Identification requires Collin (1961), Chvala (1983) plus various additional papers. Conservation statuses are provided by Falk & Crossley (2005).

Anthalia beatricella A poorly-known species (graded Lower Risk/Near Threatened) with records for Berkshire (it was described as new to science from Windsor Forest by Chandler, 1992), Devon, Hampshire, Norfolk, Yorkshire and North Wales (Falk & Crossley, 2005; Alexander, 2020). Associated with old broadleaved woodland and old parkland where it has been obtained by sweeping blossom and also by placing flight interception traps on old oaks. Recorded on hawthorn and bird cherry flowers at

Windsor and on spiraea flowers on the Continent.
Euthyneura albipennis A scarce species (graded Vulnerable) known from Windsor Forest, Epping Forest and a site in Shropshire. Possibly associated with rotting beech. Visits hawthorn.

Euthyneura gyllenhali Widespread but local in England, Wales and Scotland. It has been recorded in both broadleaved and coniferous woodland. Has been reported visiting bird cherry (P. Chandler – pers. comm).

Euthyneura halidayi Widespread but local in England and Wales. Rare in Scotland. Can occur in broadleaved and coniferous woodland, or non-woodland settings with trees and shaded dead wood. No information obtained for flower visits.

Euthyneura inermis Widespread but local (graded Lower Risk/Nationally Scarce). Has been reared from under the bark of a rotting beech log in Oxfordshire (Cole, 1987). Adults visit hawthorn and *Prunus* species.

Euthyneura myrtilli Widespread but local in England, Wales and Scotland. Bred from rotten beech wood in Shropshire. Can occur both in broadleaved woodland and conifer plantations. Has been reported visiting hawthorn (P. Chandler – pers. comm).

Oedalea apicalis Widespread but local in southern England north to Staffordshire. *Oedalea* species all appear to be saproxylic and possible pupal fragments of *O. apicalis* were found in dead, damp wood from a fallen hollow beech log. Adults have been on and about old decaying beech trees and on a Goat Moth-infested oak (Falk & Crossley, 2005). Adults have been recorded visiting the flowers of hawthorn (P. Chandler – pers. comm.). It is possible that the other eight British Oedalea species visit flowers but no information has been obtained.

5.8 Keroplatidae & Mycetophilidae (fungus gnats)
About 565 species of fungus gnat occur in Britain arranged within 5 families (Bolitophilidae, Diadocidiidae, Ditomyiidae, Keroplatidae and Mycetophildae). They can be abundant around fungus-infested dead wood and old living trees, especially in more shaded and damp locations. Many species of Mycetophilidae, including some saproxylic species, visit ivy flowers in autumn (P. Chandler – pers. comm.). Several keroplatids (not all saproxylic) regularly visit flowers such as umbellifers (Falk & Chandler, 2005; Hutson et. al., 1980; Bechev, 2010. Three saproxylic flower-visiting species are featured here:

Greenomyia mongolica (Mycetophilidae) A recent arrival (Chandler, 2008) but now well established, which is partially saproxylic. It regularly visits flowers, and has been found on hogweed and shrubby hare's-ear flowers as well as several records from ivy. It is now widespread in southern England

Macrorrhyncha flava (Keroplatidae) A widespread species that has been bred from rotting wood. It visits umbelifers which it feeds on using its long probscis.

Macrorrhyncha hugoi (Keroplatidae, formely known as *M. rostrata*) A rare species

(graded Vulnerable by Falk & Chandler, 2005) is recorded from the New Forest, Windsor Great Park and Wychwood (Kjærandsen & Chandler, 2011). It has been found around a standing dead beech and at other sites with old and decaying trees. It is considered to have similar habits to *M. flava* but has a much shorter proboscis.

5.9 Lonchaeidae (lance flies)

Represented in Britain by about 50 species which are not readily separable in the field but can mostly be identified using MacGowan & Rotheray (2008). A high proportion of these species are associated with old or fallen trees or detached dead wood (MacGowan & Rotheray, 2008; Alexander, 2002). It is not clear how many of them visit flowers, though the non-saproxylic *Setisquamalonchaea fumosa* regularly visits umbellifers. Two saproxylic species have been reported using flowers (MacGowan & Rotheray, 2008):

Lonchaea peregrina A widespread but local species. It is most strongly associated with poplars including aspen but will use sycamore, willow, hornbeam, Norway maple and beech. Males have been swept from lime flowers.

Lonchaea subneatosa This is a scarce southern species mostly associated with black poplar, the larvae developing under the bark. Other broadleaved species are used abroad. Both sexes have been found at flowers of bird cherry.

5.10 Muscidae

A large family with about 280 British species, most of which can be keyed out using Fonseca (1968) and Ball (2010). Many species are regular flower visitors, indeed they can be some of the most abundant flies on umbellifers such as cow parsley and wild angelica in humid habitats such as woodland and wetland. Biologies are extremely varied and often involve dung, soil, fungi and riparian or coastal habitats (Ball, 2010). A relatively small number are clearly obligate saproxylics. Others seem to be facultative saproxylics, having been reared from a variety of habitats that include dead wood or wood fungi. The most strictly saproxylic species are briefly described here (ecology based mostly on Alexander, 2002; Ball, 2010; Falk & Pont, 2017) though flower-visiting data does not seem to exist for most of them and some may not be flower visitors at all. Conservation statuses are provided by Falk & Pont (2017).

Helina abdominalis A widespread but local species (graded Nationally Scarce). Larvae develop in rot-holes in old or dead trees (Alexander, 2002). Usually found in woodland. No flower-visiting data obtained.

Helina pertusa Widespread but local, usually in older woods. Larvae develop as predators under the loose bark of decaying trees and in rot-holes according to Alexander (2002) but stated to be associated with dead or sickly trees, using the driest of dead wood by Ball (2010). But an association with trees is very clear. No flower-visiting data obtained.

Hydrotaea lundbecki An extremely rare fly (graded Data Deficient) with only four

world records, two of which are in the UK (Wytham Wood, Oxfordshire and Failand, Somerset). Reared from the decaying timber of old beech trees and possibly associated specifically with old beech woodland. No flower-visiting data obtained.

Mydaea maculiventris A very local species (graded Nationally Scarce) with records scattered thinly over England north to Durham. Reared from dryad's saddle bracket fungus *Cerioporus squamosus*. No flower-visiting data obtained.

Phaonia bitincta Very rare (graded Near Threatened) only known in the UK from a handful of English sites. Reared from elm sap and sour humus of wych elm. No flower-visiting data obtained.

Phaonia canescens A very scarce species (graded Near Threatened) of southern and central England. Strongly associated with mature and veteran trees in old woodland, parkland and wetland. Larvae/pupae have been found in assorted saproxylic habitats including under fermenting oak bark, under the sodden bark of a fallen alder and associated with mature beech trees with sappy wounds (Falk & Pont, 2017); also reared from fungi according to Alexander (2002). No flower-visiting data obtained.

Phaonia cincta A widespread but localised species (graded Nationally Scarce). Reared from sap-runs in elm and horse chestnut as well as from a rot-hole in alder and from a cavity in horse chestnut with sappy wood mould (Falk & Pont, 2017); also wet, rotten fungus-ridden wood within the trunk base of a large old beech and from damp tree humus from the rot-hole of a large sycamore (Alexander, 2002). The larvae are predators of other Diptera larvae such as lonchaeids and clusiids. No flower-visiting data obtained.

Phaonia exoleta Very local (graded Nationally Scarce) with most records from ancient woods and old parkland. Reared from water-filled holes in rotten wood or rot-holes in living trees, where they swim actively and feed on the larvae of mosquitoes and midges. They have also been found in very humid decomposed wood and tunnelling in the "ceiling" of rot-holes. Host trees include beech, elm, ash, horse chestnut and sycamore. No flower-visiting data obtained.

Phaonia gobertii Widespread but local in older woodland and parkland. Reared from Goat Moth borings; larvae and pupae are also often found under the bark of broadleaved trees such as Oak (Falk & Pont, 2017); also said to develop in woodland leaf litter and fungi (Alexander, 2002). No flower-visiting data.

Phaonia laeta Widespread but scarce (graded Nationally Scarce) in older woods, pasture-woodland and parkland. Reared from rot-holes in birch and horse chestnut and often associated with trees infested with Goat Moth (Falk & Pont, 2017) but stated to develop in sap-runs of birch, horse chestnut and oak (Alexander, 2002). Adults are very much attracted by sap-runs and can often be found alongside the hoverfly *Brachyopa bicolor*. No flower-visiting data obtained – it may prefer to feed on sap.

Phaonia mystica Widespread but very local (graded Nationally Scarce). Reared from under the bark of a rotten log and from rotten beech; also from under moss. No flower-visiting data obtained.

Phaonia palpata Widespread and common, mostly in damper woods. Larvae develop as predators in the rotten wood and wood mould of broadleaved trees, preferring damp, shady places. Recorded visiting cow parsley.

Phaonia pratensis Widespread but very local (graded Nationally Scarce) in older woods and parkland. Reared from rot-holes in old and damaged trees, and also in sap-runs, although some records are uncertain because this species has been confused with *Phaonia laeta* in the past. Adults visit sap-runs on elm, horse chestnut, birch, willow and oak infested with Goat Moth. No flower-visiting data obtained.

Phaonia rufiventris Common and widespread in woods. Primarily associated with tree fungi according to Ball (2010) but dead and dying trees also cited by Alexander, 2002) and a variety of fungi (Chandler *in* Chandler, 2010). Will visit flowers of umbellifers and ivy.

Phaonia tiefii First recorded in Britain in 2011 (Perry & Chandler, 2016). Proving to be widespread but scarce in the southern half of Britain. The larvae develop in the moist soft wood of assorted broadleaved trees where the larvae are predaceous on the saproxylic larvae of clusiid flies. It is usually found in old woodland with plentiful dead wood and mature trees. It has been recorded feeding on heather flowers.

Potamia setifemur Very rare (graded Data Deficient), only known from the New Forest and Windsor Forest. Reared from detritus in the rot-hole of a beech and from rotten beech wood (Falk & Pont, 2017); also from an artificial rot-hole containing beech sawdust (Alexander, 2002). No flower-visiting data obtained.

5.11 Rhinophoridae

Represented in Britain by 6 species, all of which are obligate parasitoids of woodlice. They can be identified using Falk (2016). Alexander (2001) associates three species with dead wood: *Melanophora roralis*, *Paykullia maculata* and *Rhinophora lepida* but their relationship with dead wood is at best a weak one and all three can use woodlice in a wide variety of settings and cannot really be considered saproxylic. At best one can probably say that rhinophorid populations can be enhanced by stumps, hollow trees, lying dead wood etc. simply because they increase woodlice numbers. *R. lepida* visits many flowers but is especially keen on mayweed-types, yarrow and umbellifers. *P. maculata* likes umbellifers. *M. roralis* may not be a regular flower-visitor.

5.12 Sarcophagidae (fleshflies)

Represented in Britain by over 60 species, most of which have no particular association with dead wood or trees. However, several species from 3 genera are cleptoparasites of aerial-nesting crabronid wasp species that regularly use dead wood, especially that in more open locations that get plenty of sunlight. The British

species can be identified using Whitmore, Dupont & Falk (2020). Conservation statuses are provided by Falk & Pont (2017). The biological information below is mostly from Povolný & Verves, 1997; Pape, 1987; Falk & Pont, 2017). Most sarcophagids are flower visitors.

Amobia signata Widespread and fairly frequent. Uses the nests of assorted aerial-nesting crabronid wasps (e.g. *Crossocerus*, *Ectemnius*, *Pemphredon*) but perhaps especially aerial-nesting mason wasps such as *Ancistrocerus* species. No flower-visiting data has been obtained.

Macronychia agrestis A relatively recent addition to British list but very rare. Reared from the nests of *Psenulus* wasps but possibly using other genera. Visits umbellifers including hogweed.

Macronychia dolini Widespread but local (graded Nationally Scarce – as *M. striginervis*) usually in and around woods. Strongly associated with the nests of *Ectemnius* wasps. Visits umbellifers.

Macronychia polyodon Widespread but local (graded Nationally Scarce). Uses assorted ground-nesting and aerial-nesting crabronid wasp genera. Visits umbellifers including wild angelica.

Macronychia striginervis The true *striginervis* is a recent addition to the British list from a site in Cambridgeshire. Associated with the nests of *Ectemnius* wasps. Visits umbellifers including the cultivated shrubby hare's-ear at the British site.

Oebalea cylindrica and ***O. minuta*** Both are widespread but localised species (neither with a conservation grade) that specialise on small crabronid wasps using dead wood and plant stalks. No flower-visiting data has been obtained for either.

5.13 Stratiomyidae (soldierflies)

Represented in Britain by nearly 50 species, most of which have no association with saproxylic habitats but are regular flower visitors. The British species are covered by Stubbs & Drake (2014). Three of the five British pachygasterines are saproxylic (*Eupachygaster tarsalis*, *Neopachygaster meromelas* and *Zabrachia tenella*) but do not appear to visit flowers. The frequent *Chorisops tibialis* seems to be a facultative saproxylic. It has been reared from shallow rot-holes in tree trunks and from small accumulations of damp wood mould but also from other habitats such as grass tussocks. No evidence of flower-visiting has been found for it or the related *C. nagatomii* which is likely to have a similar biology to *C. tibialis*.

5.14 Syrphidae (hoverflies)

About 285 species occur in Britain of which 38 can be considered saproxylic pollinators. These include some of Britain's most spectacular and rarest species. Several are exceptionally good bee mimics (most notably *Pocota personata* and *Criorhina* species); others are metallic-green (*Caliprobola speciosa*, *Callicera aurata*, *C. spinolae* and *Ferdinandea cuprea*). *Psilota anthracina* and *Hammerschmidtia*

ferruginea do not even look much like hoverflies. As with longhorn beetles, this saproxylic pollinator assemblage is not cleanly delimited. *Microdon analis* (which develops in the nests of ants within decaying wood) is not thought to visit any flowers, a feature common to all British *Microdon* species. Within the genus *Xylota*, only *X. jakutorum* regularly visits flowers. Most of the others are occasional visitors, preferring to obtain pollen and honeydew from leaf surfaces (Ssymank & Gilbert, 1993), and *Callicera rufa* and *Chalcosyrphus eunotus* are also reluctant flower-visitors. No flower-visiting records appear to exist for *Xylota xanthocnema*.

All but a few recently added species can be keyed out using Stubbs & Falk (2002) and a less comprehensive but very useful photographic guide by Ball & Morris (2015). Most British species are also covered by the author's online Flickr resource: https://www.flickr.com/photos/63075200@N07/collections/72157629600153789/. Conservation grades are provided by Ball & Morris (2014) which also furnishes valuable species accounts for the scarcer species. European species accounts are provided by 'Syrph the Net' (Speight, 2016). Hoverflies are served by a very active recording scheme which furnishes up-to-date maps: http://sgbtest.me.uk/hrs/. This is supported by two active Facebook groups, one for adults, another for larvae.

***Blera fallax* – Pine Hoverfly**

General: A rather small, slate-grey hoverfly with an orange-red tail that is confined to a few Caledonian pine forest sites. Lifecycle and habitat requirements: The rat-tailed larvae develop as filter feeders in water-filled rot-holes of pine stumps (of over 40 cm diameter) and may require pine heart–rot fungus *Phaeolus schweinitzii* to create these conditions. They take 1-2 years to develop. It would appear that much Caledonian pine woodland today is unsuitable for it due to the lack of sufficient breeding habitat. It seems to prefer denser, more shaded pine woodland as this offers the shade and damp microclimates that stop rot-holes drying out. The open-structured pine woodland that occurs at many key sites is very vulnerable to the effects of droughts and heatwaves, which soon dry out rot-holes. Flowers visited: In Britain several early records were from wild raspberry. Data from Speight (2016) and the internet additionally features hawthorn, dog rose, *Parnassia* species, *Prunus* species, cow parsley, forget-me-nots, valerian, *Berberis*, *Potentilla*. Ellen Rotheray (Rotheray, E & MacGowan, 2015) managed to get caged *B. fallax* to feed in the following flowers: rowan (66%), greater stitchwort (27%), umbellifers (23%), bedstraws (2%), dog rose (<1%), and buttercups (< 1%). Status and distribution: Recent 'wild' records (i.e. not involving reintroduction) are confined to two pine woods on the west side of the Cairngorms (Anagach Wood and Curr Wood) but older records exist more widely within the eastern Grampians. Graded Critically Endangered by Ball & Morris (2014) and a Scottish Priority species. Map: http://sgbtest.me.uk/hrs/species-details/385/map. Conservation requirements: Promote the presence of water-filled rot-holes and other cavities in old pine trees and their stumps; also suitable flowers for adult foraging. Do not over-thin forests where *Blera* is present. *Blera* is subject to much ongoing conservation action and monitoring by a partnership that includes NatureScot, the Malloch Society, Royal Society for the Protection of Birds, Forestry Commission, Cairngorms National Park and the Royal Zoological Society of Scotland. This involves the creation of water-

Artificially-created *Blera* breeding stumps in the Caledonian pine woodland of Abernethy Forest.

filled holes in large pine stumps and artificial breeding of larvae. An action plan was prepared by Scottish Natural Heritage (Rotheray & MacGowan, 2015). Key references: Rotheray & Rotheray (2012), Rotheray, E (2013), Rotheray, E. L. & MacGowan (2015); Rotheray, E & MacGowan (2015); Rotheray, E. et. al. (2015), Ball & Morris (2014), Speight (2016), Hoverfly Recording Scheme website, Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157631646188121/.

Brachyopa bicolor

General: One of several similar-looking grey and orange hoverflies associated with sappy wounds. Lifecycle and habitat requirements: The larvae are filter feeders on yeast and bacteria of sap-runs, perhaps especially those of oaks and beech but other broadleaved species such as horse chestnut, birch and lime to a minor extent and there is even a foreign report for fir (Speight, 2016). Was previously considered to be associated with the activity of Goat Moth but this might be incidental. Clearly associated with old pasture-woodland and parkland where there are good concentrations of old broadleaved trees. Adults are usually found on trunks close to sap-runs in late spring. Flowers visited: Hawthorn in Britain but Speight (2016) gives what may be foreign records for *Photinia* and bird cherry. Status and distribution: Recorded sparingly in the southern half of Britain, with relatively strong populations in the beech woods of the New Forest and Windsor Great Park/Windsor Forest but some evidence of recent expansion and increase within the Midlands. Graded Nationally Scarce by Ball & Morris (2014). Map: http://sgbtest.me.uk/hrs/species-details/115/map. Conservation requirements: Promote the presence of old broadleaved trees with sap-runs; also suitable flowers for adult foraging. Key references: Ball & Morris (2014), Speight (2016), Hoverfly Recording Scheme website, Steven Falk Flickr:

https://www.flickr.com/photos/63075200@N07/sets/72157629249301934/.

Brachyopa insensilis

General: One of several similar-looking grey and orange hoverflies associated with sappy wounds. Lifecycle and habitat requirements: The larvae develop in sap-runs or accumulations of sap under the bark of living broadleaved trees but can also use rot-holes. In Britain it was traditionally associated with elm though it will also use ash, beech, lime and perhaps especially horse chestnut. Many more species are reported abroad including fir (Speight, 2016). Most often recorded in old parkland but sometimes found in urban parks or roadsides featuring mature horse chestnut trees. It will also occur around the sap-runs of relatively small elms – perhaps those succumbing to Dutch Elm Disease. Adults are usually found sitting on tree trunks or on nearby vegetation. They will also hover immediately in front of a sap-run, sometimes in small swarms. Stirring up a sap-run (presumably releasing odours) can often result in the rapid arrival of adults. Flowers visited: Has been reported visiting hawthorn in Britain (P. Chandler – pers. comm). Speight (2016) gives records (possibly of a foreign source) for white umbellifers, *Photinia*, bird cherry and common whitebeam. Status and distribution: Recorded sparingly across Britain as far as North Scotland but thought to be under-recorded and occurring at low population levels that make it hard to detect. However, the demise of horse chestnut through bacterial canker could impact this hoverfly significantly and compound the decline of elm. Map: http://sgbtest.me.uk/hrs/species-details/117/map. Conservation requirements: Promote the presence of old broadleaved trees with sap-runs; also suitable flowers for adult foraging. Key references: Stubbs & Falk (2002), Speight (2016), Hoverfly Recording Scheme website, Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157629900381393/.

Brachyopa pilosa

General: One of several similar-looking grey and orange hoverflies associated with sappy wounds. Lifecycle and habitat requirements: The larvae are filter feeders within sap-runs and fermenting sappy cambium under the bark of recently felled or fallen trees and associated stumps. In some areas, such as Windsor Forest, fallen beech seems to be important but at other sites a rather strong association with aspen is evident and it will occur alongside the Aspen Hoverfly *Hammerschmidtia ferruginea* at some Scottish sites. It has also been recorded in association with poplars. Adults will rest on fallen trunks. Flowers visited: Wild cherry, cherry laurel, rowan, apple and bird cherry in Britain. Speight (2016) gives records (possibly of a foreign source) for white umbellifers, Norway maple, ramsons, *Cardamine* species, hawthorn, crab apple, cherry plum, blackthorn, bird cherry, Photinia, willow, guelder-rose. Status and distribution: Local in the southern half of Britain but with a further cluster of records in the Scottish Highlands. Graded Nationally Scarce by Ball & Morris (2014). Map: http://sgbtest.me.uk/hrs/species-details/115/map. Conservation requirements: Develop a regime whereby a constant supply of recently fallen or felled trees is assured and wholesale removal of freshly cut timber is avoided. Newly-cut timber may only be suitable for breeding in the first 2-3 years. Key references: Stubbs & Falk (2002), Speight (2016), Morris (1998), Ball & Morris (2014), Hoverfly Recording Scheme website, Steven Falk Flickr:

https://www.flickr.com/photos/63075200@N07/sets/72157629249166106/.

Brachyopa scutellaris

General: The most frequent of several similar-looking grey and orange hoverflies associated with sappy wounds. Lifecycle and habitat requirements: The larvae develop in the sap-runs and sappy wounds beneath the bark of assorted broadleaved trees including ash, elm and poplar; also yew. These do not need to be especially old trees. Females can sometimes be seen investigating the lower trunks of trees and it will sometimes form small swarms. Flowers visited: Cherry laurel, bird cherry (and probably other *Prunus* species), hawthorn, apple, bramble, raspberry, Sorbus species, guelder-rose, greater stitchworts, umbellifers (e.g. cow parsley, hogweed), dogwood, *Cardamine* species, Photinia. Status and distribution: Widespread but rather local throughout Britain, becoming scarcer in the north. Map: http://sgbtest.me.uk/hrs/species-details/121/map. Conservation requirements: Promote the presence of mature broadleaved trees with sap-runs; also suitable flowers for adult foraging. Key references: Stubbs & Falk (2002), Speight (2016), Morris (2007), Hoverfly Recording Scheme website, Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157629249115950/.

Brachypalpoides lentus

General: A large and distinctive black hoverfly with a broad crimson band on the abdomen. Lifecycle and habitat requirements: The larvae develop in decaying heart-rot and roots of old broadleaved trees such as beech, oak and birch. Females can sometimes be seen investigating the lower trunks and stumps of such trees. Flowers visited: Usually seen on hawthorn and buttercups but also noted on bramble, umbellifers, rowan, raspberry, holly and bedstraw. Status and distribution: Widespread but local with records extending north to Fort William. Map: http://sgbtest.me.uk/hrs/species-details/389/map. Conservation requirements: Promote the presence of old trees with heart-rot and old stumps; also suitable flowers for adult foraging. Key references: Stubbs & Falk (2002), Speight (2016), Hoverfly Recording Scheme website, Alexander (2002), Levy & Levy (1992), Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157629241064468/.

Brachypalpus laphriformis

General: A fairly large, solitary bee-like hoverfly with greatly thickened hind legs. Lifecycle and habitat requirements: The larvae seem to typically develop in the wet, sloppy wood mould found in rot-holes and heart-rot of old living oaks and probably also the stumps of recently collapsed old oaks. Larvae have also been found in the rot-hole exudate of yew, though the majority of records are from ancient woods and parklands with plentiful old oak or beech in fairly humid, often partially shaded locations. Various other tree species are used abroad including pine (Speight, 2016). Adults will bask on trunks of standing and fallen trees and females will investigate old trees and stumps. Flowers visited: Not a very frequent flower visitor but British records include hawthorn, apple and hogweed Speight (2016) gives records (possibly of a foreign source) for *Berberis*, *Photinia*, black cherry, and *Sorbus* – probably from foreign locations. Status and distribution: Widespread but very local with records

extending north to Cumbria and a 2010 record from Perthshire. Scarce in most counties where it occurs but with relatively good populations in the New Forest and Windsor Great Park/Forest. No conservation status though only just falling outside the threshold for Nationally Scarce and an important old woodland indicator. National map: http://sgbtest.me.uk/hrs/species-details/399/map. Conservation requirements: Promote the presence of old trees with heart-rot and associated old stumps; also blossoming Hawthorn. Key references: Stubbs & Falk (2002), Speight (2016), Morris (1998), Hoverfly Recording Scheme website, Alexander (2002), Gibbs (2002), Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157629240971524/.

Caliprobola speciosa

General: A spectacular large, metallic green hoverfly that is more or less confined to two areas featuring ancient Beech woodland. Lifecycle and habitat requirements: The larvae develop in the decaying roots of mature beech trees where these have gained a porridge-like consistency. It is likely that they take several years to develop. Males congregate around the bases of old trees in late spring, darting about as if holding small territories and sunbathing in dappled light. Confined to the oldest remnants of natural beech woodland. Oak might also be used abroad. Flowers visited: Observed on hawthorn in Britain. Speight (2016) gives records (possibly of a foreign source) for umbellifers, marsh-marigold, *Rorippa*, *Rubus*, rowan, *Tamarix*, dogwood and alder buckthorn. There are internet photos of it on cow parsley and rose. Status and distribution: Two strongholds, the New Forest (notably Denny Wood) and Windsor Great Park/Forest. Graded Near Threatened by Ball & Morris (2014) but this may need to be upgraded as suitable habitat seems to be deteriorating at its surviving sites. Map: http://sgbtest.me.uk/hrs/species-details/399/map. Conservation requirements: Promote the presence of old beech trees, ensuring a varied age class to ensure long-term conditions remain and wind-blown old trees become replaced; also suitable flowers for adult foraging. Prevent Muntjac damage to the bases of young beech trees (a major issue at Windsor). Key references: Stubbs & Falk (2002), Speight (2016), Ball & Morris (2014), Hoverfly Recording Scheme website, Alexander (2002), Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157629235943594/.

Callicera aurata

General: A large, metallic gold-green hoverfly with elongate, white-tipped antennae. Lifecycle and habitat requirements: The larvae are filter feeders that develop in water-filled aerial rot-holes of mature broadleaved trees such as beech, birch, ash and oak. They probably take several years to develop. The habitat preferences are not clear as there is not a particularly strong association with pasture-woodland or old parkland and it is very sporadic and unpredictable in occurrence, often turning up some distance from obvious breeding sites, even in unremarkable suburban locations. In Switzerland it has been recorded in old orchards. Flowers visited: From British and foreign sources: bramble, hawthorn, rose, cotoneaster, pyracantha, hogweed, ivy, thistles, teasel, scabiouses, mullein, meadowsweet, devil's-bit scabious, heather, St John wort and certain non-native garden flowers including *Allium* species and giant scabious. Status and distribution: Widespread but scarce

Hoverflies associated with damp heart-rot and decaying roots

Criorhina berberina (dark form)

Criorhina floccosa

Criorhina ranunculi

Criorhina asilica

Brachypalpoides lentus

Caliprobola speciosa

with records extending north to Dunfermline in Scotland. Some evidence of an increase in recent years. Graded Nationally Scarce by Ball & Morris (2014). Map: http://sgbtest.me.uk/hrs/species-details/9. Conservation requirements: Promote the presence of mature broadleaved trees with rot-holes; also suitable flowers for adult

foraging. Key references: Stubbs & Falk (2002), Speight (2016), Ball & Morris (2014), Hoverfly Recording Scheme website, Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157629245012142/.

Callicera rufa

General: A very distinctive furry-brown, bee-like hoverfly with long antennae, associated with old pine trees. Lifecycle and habitat requirements: The larvae develop over a period of 1-5 years in the water-filled rot-holes and other cavities of conifers, especially pine but also spruce and larch. They often use pines with wet decay between bifurcating trunks and but can use wet, rotting heartwood too. Ideally they need rot-holes with at least 1 litre of liquid to act as a buffer to drying out in dry hot weather. *C. rufa* used to be a specialist of ancient Caledonian pine forest but in recent years it has been colonising mature conifer plantations elsewhere including those of Corsican pine and possibly other conifer genera. The adults are usually seen sunbathing on pine trunks and it apparently 'hill-tops' i.e. concregates in conifer woodland at the tops of hills such as The Wrekin, Shropshire. Flowers visited: Seemingly a very reluctant flower-visitor. A Welsh male captured by the author had pollen on the body but it is not known from what plant species. Observed abroad on creeping buttercup. Status and distribution: It remains scarce in the Scottish Highlands but is showing a dramatic expansion into east Wales and over much of England. Graded Nationally Scarce by Ball & Morris (2014). Map: http://sgbtest.me.uk/hrs/species-details/11/map. Conservation requirements: Promote the presence of mature and post-mature pines likely to be supporting the larval habitat. Key references: Stubbs & Falk (2002), Rotheray, E (2013), Speight (2016), MacGowan & Rotheray (2006), Ball & Morris (2014), Hoverfly Recording Scheme website, Alexander (2002), Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157630717613718/.

***Callicera spinolae* Golden Hoverfly**

General: A large, metallic gold-green hoverfly resembling *C. aurata* but with black bands across the abdominal tergites, and peaking with the ivy blossom. Lifecycle and habitat requirements: The larvae develop in aerial rot-holes of trees such as beech, horse chestnut, poplar and field maple with wet wood debris and heart-rot. Such trees may not necessarily be large or ancient ones, though most British records are from historic parkland featuring concentrations of mature trees. Flowers visited: Adults are characteristically found on ivy flowers in autumn but will also use wild angelica and goldenrod. Status and distribution: Records largely confined to the Home Counties and East Anglia but with some evidence of a gradual expansion eastwards e.g. Bedfordshire. Very sporadic in appearance which suggests a mobile and transient nature. Graded Vulnerable by Ball & Morris (2014) and a Section 41 conservation priority species. Map: http://sgbtest.me.uk/hrs/species-details/13/map. Conservation requirements: Promote the presence of mature broadleaved trees with rot-holes; also flowering Ivy. Key references: Stubbs & Falk (2002), Speight (2016), Ball & Morris (2014), Hoverfly Recording Scheme website, Rotheray (2004), Alexander (2002), Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157631858484326/.

***Chalcosyrphus eunotus* Logjammer Hoverfly**

General: A fairly large bee-like hoverfly associated with partially submerged dead wood in watercourses. Lifecycle and habitat requirements: The larvae develop in semi-submerged trunks and branches (both large and coarse woody debris) of broadleaved trees that have fallen into fairly well-shaded rivers and streams. The larvae develop in both the decaying cambial layer beneath the bark and deeper into the soggy heartwood of non-submerged parts of the timber. Jukes (2010) notes the wood of alder and birch as being important but suggests oak and beech might also be used. The author has found it associated with grey poplar stands along two Warwickshire rivers. It is likely that it is the recently-fallen, semi-submerged state of timber rather than the precise tree species involved that is important and such woody debris may only be suitable for a few years. Adults will perch on logs in streams on sunlit stream banks and low foliage close to water. Much more information on this species is furnished by Jukes (2010). Flowers visited: Flower-visiting seems to very infrequent but a photo of a female on an umbellifer flower (possibly cow parsley) in Slovakia is posted on the Diptera.info website: https://diptera.info/photogallery.php?photo_id=10332 and does not seem to have been artificially posed. Status and distribution: Records mainly confined to the West Midlands/Welsh borders and to a small number of localities in Dorset, Somerset, Staffordshire and Warwickshire. In the past ten years there have been numerous records from the Welsh Marches and it is not as rare as previously thought though targeted surveying is usually required to detect it. Graded Nationally Scarce by Ball & Morris. Map: http://sgbtest.me.uk/hrs/species-details/393/map: Conservation requirements: Promote the presence of semi-submerged coarse and large woody debris in semi-shaded stream and rivers. Key references: Stubbs & Falk (2002), Jukes (2010), Rotheray (1993), Speight (2016), Ball & Morris (2014), Hoverfly Recording Scheme website, Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157629249015498/.

Chalcosyrphus nemorum

General: A rather small, nondescript hoverfly typically associated with dead wood in damp locations. Lifecycle and habitat requirements: The larvae are found in accumulations of sappy decay under the bark of recently fallen trunks and branches (including partly submerged ones), and the roots recently dead trees. A wide range of tree species are utilised but it is most frequent in damper situations such as alder carr and wooded streams and riversides, perhaps especially where trees such as alder and willow are present. However, you can also find it regularly in drier beech woodland where there are fallen trees. Adults sunbathe on fallen trunks and branches and dart around these at great speed. Flowers visited: Buttercups, umbellifers, wood anemone, marsh-marigold, lesser spearwort, wood spurge, bramble, tormentil, raspberry, rowan, dandelion, hawkbits and wild basil. Status and distribution: Found throughout Britain; locally common in the south and Midlands but scarcer in Wales and Scotland. Map: http://sgbtest.me.uk/hrs/species-details/395/map. Conservation requirements: Promote the presence of dead wood in damper locations such as wet woodland and alongside streams and rivers; also suitable flowers for adult foraging. Key references: Stubbs & Falk (2002), Speight (2016), Morris (1998), Levy & Levy (1992), Hoverfly Recording Scheme website,

Steven Falk Flickr:
https://www.flickr.com/photos/63075200@N07/sets/72157629248946556/.

Chalcosyrphus eunotus habitat in Warwickshire showing semi-submerged woody debris.

Criorhina asilica

General: A large and distinctive Honey Bee-like hoverfly associated with old trees in ancient woods and wetlands. Lifecycle and habitat requirements: The larvae develop in decayed heartwood debris in the base of hollow trees including beech, oak, ash, beech and birch. Largely confined to ancient woodland in many counties, sometimes that of oak-birch, other times of ash. Flowers visited: Most often observed on hawthorn but it will also visit dogwood, umbellifers (e.g. hogweed), bramble, wild cherry, raspberry, alder buckthorn, ramsons and rhododendron in Britain. Speight (2016) gives records (possibly of a foreign source) for *Berberis*, *Cardamine*, *Euonymus*, purging buckthorn, wild privet, fly honeysuckle, *Ribes* and rowan (Speight, 2016). Status and distribution: Widespread but local over much of England but rare in Wales and Scotland. Map: http://sgbtest.me.uk/hrs/species-details/403/map. Conservation requirements: Promote the presence of old trees and stumps with heart-rot; also suitable flowers for adult foraging. Key references: Stubbs & Falk (2002), Speight (2016), Alexander (2002), Hoverfly Recording Scheme website, Steven Falk Flickr:
https://www.flickr.com/photos/63075200@N07/sets/72157629610243275/.

Criorrhina berberina

General: A brilliant bumblebee mimic with two very different-looking colour forms. Lifecycle and habitat requirements: The larvae develop in wet heart-rot within tree roots of mature tree or stumps. A variety of broadleaved trees are used including beech, oak and birch; also reported from fir and spruce abroad (Speight, 2016).

Females can be found investigating the lower trunks of trees or stumps, and ovipositing into crevices. Males will patrol stands of flowers and blossom, often flying around at great speed. Most frequent in ancient woodland and pasture-woodland but it can occur in old wetlands, along old hedges and sometimes in urban greenspace. Flowers visited: British records for Hawthorn, holly, bramble, guelder-rose, raspberry, dogwood, umbellifers (e.g. cow parsley, hogweed), dandelion, rhododendron, wood spurge, creeping thistle. Speight (2016) gives records (possibly of a foreign source) for ramsons, *Euonymus*, meadowsweet, alder buckthorn, St. Johns wort, fly honeysuckle, *Photinia*, buttercup, rose, willow, *Sorbus* and dandelion. Status and distribution: Widespread but local over much of Britain. Map: http://sgbtest.me.uk/hrs/species-details/405/map. Conservation requirements: Promote the presence of old trees with heart-rot and associated old stumps; also suitable flowers for adult foraging. Key references: Stubbs & Falk (2002), Speight (2016), Alexander (2002), Hoverfly Recording Scheme website, Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157629247276702/.

Criorhina floccosa

General: A striking mimic of the Common Carder Bee *Bombus pascuorum* that is associated with old trees in a variety of habitats. Lifecycle and habitat requirements: The larvae develop in wet decaying wood debris in cavities and roots of assorted broadleaved trees including beech, oak, sycamore, ash and elm. Females can be found investigating the lower trunks of trees or stumps and ovipositing into crevices. Males seem to defend small territories here and will also patrol stands of flowers and blossom, often flying around at great speed. Most frequent in ancient woodland but it can occur in old wetlands, along old hedges (perhaps especially those with old oak and ash) and sometimes occurs in urban green space with mature oak trees. Flowers visited: British records for Hawthorn, blackthorn, bramble, dogwood, rowan, wild cherry, hogweed, cow parsley, crab apple, cultivated apple, holly and rhododendron. Speight (2016) gives records (possibly of a foreign source) for *Photinia*, blackthorn, *Ribes*, raspberry, common whitebeam and wild service-tree. Status and distribution: Widespread but local over much of Britain. Map: http://sgbtest.me.uk/hrs/species-details/407/map. Conservation requirements: Promote the presence of old trees and stumps; also suitable flowers for adult foraging. Key references: Stubbs & Falk (2002), Speight (2016), Alexander (2002), Hoverfly Recording Scheme website, Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157629247728576/.

Criorhina ranunculi

General: One of our largest hoverflies, a fantastic bumblebee mimic that can very aggressive towards other large pollinators when on blossom. Lifecycle and habitat requirements: The larvae develop in moist decaying heartwood in the bases and roots of old trees and stumps. Assorted broadleaved trees are used including beech, birch, oak, ash, elm and aspen. Females can be found investigating the lower trunks of trees and ovipositing into crevices. Most frequent in ancient woodland. Flowers visited: In Britain, predominantly blackthorn, wild cherry, cherry Laurel and goat willow, less frequently Norway maple, bird cherry, other willows and early hawthorn. Speight (2016) gives records (possibly of a foreign source) for dogwood, *Photinia*,

sour cherry and rowan. Males can be very aggressive around such flowers, even attacking queen bumblebees. Status and distribution: Widespread but local over much of England and Wales, scarcer in Scotland. Map: http://sgbtest.me.uk/hrs/species-details/409/map. Conservation requirements: Promote the presence of old trees and stumps with heart-rot; also suitable flowers for adult foraging. Key references: Stubbs & Falk (2002), Speight (2016), Alexander (2002), Hoverfly Recording Scheme website, Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157629247662526/.

Ferdinandea cuprea

General: An attractive metallic-green hoverfly often seen sunbathing on tree trunks. Lifecycle and habitat requirements: The larvae seem to typically develop in sap-runs and other sappy wounds of broadleaved trees including oak, ash and probably birch, beech and other species. Thye have also been found in rotting tree roots and from non-saproxylic locations with semi-liquid decaying material. Most frequent in woodland but seemingly not dependent on particularly old trees or ancient woodland. It can even be found in hedged farmland and urban areas with scattered trees. Adults characteristically sunbathe on tree trunks and sometimes investigate humans, possibly because we resemble trunks when standing. They regularly visit sap-runs. Flowers visited (here and abroad): thistles, smooth hawk's-beard, various scabiouses, buttercups, rose, ivy, dandelions, bindweeds, lesser celandine, chicory, bramble, hawkbit, sowthistle, honeysuckle, mint, evening-primrose, greater stitchwort, nipplewort, hawkweed oxtongue, corn sowthistle, perforate St. John's wort, umbellifers and sour cherry flying from late spring into autumn. Status and distribution: Widespread and locally common over much of England and Wales, scarcer in Scotland. Map: http://sgbtest.me.uk/hrs/species-details/97/map. Conservation requirements: Promote the presence of mature trees; also suitable flowers for adult foraging. Key references: Stubbs & Falk (2002), Speight (2016), Morris (1998), Hoverfly Recording Scheme website, Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157629602691871/.

Ferdinandea ruficornis

General: Resembling a small, blacker version of the common *F. cuprea* but much rarer. Lifecycle and habitat requirements: Associated with the sap-runs of old trees, especially old oaks infested by Goat Moth. Usually found in ancient woodland, pasture-woodland and old parkland. Adults will rest on trunks close to sap-runs. It is unclear if the association with Goat Moth is a strict one though this association has also been noted on the Continent. Flowers visited: In Britain, giant bellflower, a privet and I seem to recall collecting one off hawthorn in Warwickshire. Speight (2016) also lists hogweed, possibly from a foreign source. Status and distribution. Scattered records in England north to Yorkshire but rare in Wales and Scotland. Graded Nationally Scarce by Ball & Morris (2014). Map: http://sgbtest.me.uk/hrs/species-details/99/map. Conservation requirements: Promote the presence of old Goat Moth-infested trees; also suitable flowers for adult foraging. Key references: Stubbs & Falk (2002), Speight (2016), Ball & Morris (2014), Hoverfly Recording Scheme website, Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157629602719759/.

***Hammerschmidtia ferruginea* Aspen Hoverfly**

General: A very distinctive chestnut-coloured hoverfly associated with mature or freshly fallen aspen in the Scottish Highlands. Lifecycle and habitat requirements: The larvae develop in the wet decaying cambium layer under the bark of damaged living aspen, recently fallen aspen (including the stumps), or larger detached aspen branches (over 25 cm diameter). Adults can occur in quite large numbers on freshly fallen trees, the males behaving territorially. They probably also use sap-runs and sappy wounds of living trees for breeding but are harder to detect in such locations. Fallen trees and new stumps probably take about one year to acquire suitable conditions but probably only remain suitable for about four years before the cambium layer dries out and the wood loses its characteristic smell and the bark starts to detach. Over 1000 flies have been recorded emerging in one year from one tree. *H. ferruginea* is seemingly confined to relatively large stands of aspen (at least 100 mature trees) but such stands are very scarce in the Scottish Highlands today, and the fly is considerably rarer than the tree. The fly also struggles to bridge gaps of more than 1-2 km between aspen stands and is thus highly vulnerable to habitat fragmntation. Flowers visited: Rowan, bird cherry, hawthorn, pear, buttercup, willow/sallow. There are also some foreign internet images of it on umbellifers, some of which seem to be cow parsley. Status and distribution: Confined to a few large aspen woods in the Cairngorms plus a few other locations in the Scottish Highlands. Graded Endangered by Ball & Morris (2014) and a Scottish Priority species. Map: http://sgbtest.me.uk/hrs/species-details/137/map. Conservation requirements: Protect mature aspen stands and attempt to increase the number of large stands; also promote suitable flowers for adult foraging. Fell trees selectively (in a sustainable manner) if dead wood is lacking but retain any living trees with sap-runs. Prevent bark-stripping of fallen trees and branches by grazing stock. Oppose Beaver reintroduction in areas with important riverine aspen stands. *H. ferruginea* is subject to much ongoing conservation action and monitoring by a partnership that includes NatureScot, the Malloch Society, Royal Society for the Protection of Birds, Forestry Commission, Cairngorms National Park and the Royal Zoological Society of Scotland. The Woodland Trust is also well placed to promote the creation and enhancement of aspen woodland in the Highlands. Key references: Stubbs & Falk (2002), Speight (2016), Rotheray, E. et. al. (2008, 2014), Ball & Morris (2014), Hoverfly Recording Scheme website, Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157634382148394/.

Mallota cimbiciformis

General: A large buff and dark-grey bee mimic associated with water-filled rot-holes of mature trees. Lifecycle and habitat requirements: The rat-tailed, saprophagous larvae develop inside the water-filled aerial rot-holes of varying sizes and heights of broadleaved trees including beech, horse chestnut and sycamore. They may prefer rot-holes with relatively small entrance holes but good volumes of liquid (Speight, 2016). Most records are from old parkland and woodland with plentiful old trees. It can turn up in urban locations, and there are even records from Hyde Park, London. Males will guard suitable rot-holes. Flowers visited: Bramble, hogweed, knapweed and wild parsnip in Britain, with foreign records for *Cistus*, dogwood, *Euonymus*, spurge, dog rose, elder and broom (Speight, 2016). Males will fly around these at

great speed. Status and distribution: Mainly a southern English species that occurs sporadically as far north as Glasgow. Graded Nationally Scarce by Ball & Morris (2014). Map: http://sgbtest.me.uk/hrs/species-details/255/map. Conservation requirements: Promote the presence of old trees with rot-holes; also suitable flowers for adult foraging. Key references: Stubbs & Falk (2002), Speight (2016), Alexander (2002), Morris (1998), Ball & Morris (2014), Hoverfly Recording Scheme website, Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157629241275534/.

***Myathropa florea* Batman Hoverfly**

General: A fairly large, brightly patterned hoverfly with a black 'Batman' logo on its back. Lifecycle and habitat requirements: The rat-tailed larvae develop in a wide range of wet decaying timber microhabitats from rot-holes at height to wet decaying roots underground and also the shallow pools of water at the base of trunks or inside stumps. They occasionally exploit organically-rich wet habitats away from trees including wooden water butts, pools in cow dung and pools in compost heaps. Both broadleaved and coniferous trees can be used. This hoverfly can be very common in woodland but turns up in many other habitats and can be frequent in urban areas and hedged farmland. Flowers visited: Many sorts from early spring to autumn including blackthorn, wild cherry, cherry laurel, hawthorn, sweet chestnut, dogwood, rhododendron, elder, rowan (and probably other *Sorbus*), guelder-rose, assorted umbellifers (including hogweed, cow parsley, wild parsnip, burnet-saxifrage, ground elder, wild angelica, rough chervil, hemlock water-dropwort, hemlock and wild carrot), bramble, assorted thistles, hawkbits, hawkweeds, sowthistles, goldenrods, oxeye daisy, Michaelmas daisy, common fleabane, mayweeds, ragworts, yarrow, hemp-agrimony, roses, scabiouses, bindweeds, meadowsweet, wild marjoram, mints, gipsywort, water-plantain, *Euonymus*, wild privet, heather, ivy, lesser spearwort, knotgrass, pyracantha, holly, eyebright, wood spurge and assorted garden flowers and shrubs. Status and distribution: A common and widespread species. Map: http://sgbtest.me.uk/hrs/species-details/259/map. Conservation requirements: No special measures needed. Key references: Stubbs & Falk (2002), Speight (2016), Alexander (2002), Morris (1998), Hoverfly Recording Scheme website, Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157629553127306/.

Myolepta dubia

General: A rather small black and orange hoverfly associated with water-filled rot-holes of mature broadleaved trees. Lifecycle and habitat requirements: The larvae are filter feeders in the water-filled aerial rot-holes of mature broadleaved trees such as beech, oak and horse chestnut and probably take at least 2 years to develop. It is most frequent in old woodland and pasture-woodland/parkland but can sometimes occur in hedged farmland, wetlands, old quarries and suburban locations. Flowers visited: In Britain, assorted umbellifers (e.g. hogweed, upright hedge-parsley, rough chervil, wild parsnip), bramble, thistles, dogwood, lime and Portugal laurel. Speight (2016) gives records (possibly of a foreign source) for hawthorn, *Cistus*, tormentil, *Prunus* and *Rubus*. Status and distribution: Scattered records in southern and central England mostly south of the Severn-Wash line. Graded

Nationally Scarce by Ball & Morris (2014). Map: http://sgbtest.me.uk/hrs/species-details/147/map. Conservation requirements: Promote the presence of mature trees with rot-holes; also suitable flowers for adult foraging. Key references: Stubbs & Falk (2002), Speight (2016), Alexander (2002), Verrall (1901), Ball & Morris (2014), Hoverfly Recording Scheme website, Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157629553194588/.

Myolepta potens

General: Resembling *M. dubia* but much rarer. Lifecycle and habitat requirements: The larvae are filter feeders in the water-filled aerial rot-holes of mature broadleaved trees and probably take several years to develop. Horse chestnut seems to be especially important in Britain but it will use other species abroad. British records relate to old woodland and parkland. Flowers visited: Likely to have similar preferences to *M. dubia*; (Speight (2016) lists hawthorn, dogwood and *Cistus* from abroad. Status and distribution: Recorded at Loxley Wood, Somerset and Combe Dingle near Bristol on several occasions between 1946 and 1949. In 1961 it was reared from several larvae in a rot-hole at Ashton Court near Combe Dingle. The only recent records are from Moccas Park, Herefordshire (2002 onwards) and the Forest of Dean (2009). Graded Critically Endangered by Ball & Morris (2014) and a Section 41 conservation priority species. Map: http://sgbtest.me.uk/hrs/species-details/147/map. Considered rare and endangered in many parts of Europe. The demise of horse chestnut through bacterial canker could impact this hoverfly significantly. Conservation requirements: Promote the presence of mature trees with rot-holes, especially horse chestnut; also suitable flowers for adult foraging. Key references: Stubbs & Falk (2002), Speight (2016), Ball & Morris (2014), Hoverfly Recording Scheme website, Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157702670791232/.

Pocota personata

General: Arguably the UK's finest bumblebee mimic, a rot-hole specialist that closely resembles a worker of a White-tailed Bumblebee *Bombus lucorum*. Lifecycle and habitat requirements: The larvae develop as filter feeders in water and detritus-filled aerial rot-holes of old broadleaved trees, especially beech, but to a lesser extent ash, sycamore, poplar and horse chestnut. It is likely that they take several years to mature. There may be a particular dependence on rot-holes with white-rot (Alexander, 2005). Adults can sometimes be seen investigating such rot-holes in mid or late spring and males seem to guard an individual rot-hole. Males will also occasionally hover, holding their bodies at a strange 45 degree angle. Strongly associated with old parkland, pasture-woodland and woodland containing old trees. Very occasionally found in farmland or suburban habitats lacking a parkland history but with concentrations of suitable old trees. Flowers visited: Most often seen on hawthorn blossom but it will also use cherry laurel, blackthorn (and probably other *Prunus* species), rowan and the author once observed a male hovering beside a flowering apple. Status and distribution: Widespread but very localised with records extending north to Cumbria and Durham. Graded Nationally Scarce by Ball & Morris (2014). Map: http://sgbtest.me.uk/hrs/species-details/413/map. Conservation requirements: Promote the presence of mature trees with aerial rot-holes (especially

beech); also suitable flowers for adult foraging. Key references: Stubbs & Falk (2002), Speight (2016), Alexander (2002, 2005), Ball & Morris (2014), Hoverfly Recording Scheme website, Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157629235923374/.

Psilota anthracina

General: A rather small blue-black hoverfly (resembling a giant lonchaeid fly) that uses sap-runs of old oaks. Lifecycle and habitat requirements: The larvae are filter feeders in sap-runs or sappy wounds of mature broadleaved trees, probably primarily oak. In the New Forest it is sometimes found on Goat Moth-infested trees. It has also been seen investigating rotting beech stumps (A. Jukes – pers. comm.). Foreign records for conifers may relate to other *Psilota* species. It is strongly associated with ancient woods and pasture-woodland/old parkland with lots of old trees. Flowers visited: Typically hawthorn but also meadowsweet, wild cherry, field maple, alder buckthorn, willow and rowan. Status and distribution: Scattered records in southern and central England. Graded Nationally Scarce by Ball & Morris (2014). Map: http://sgbtest.me.uk/hrs/species-details/289/map. Conservation requirements: Promote the presence of over-mature oak trees, especially those with sappy wounds or Goat Moth; also suitable flowers for adult foraging. Key references: Stubbs & Falk (2002), Speight (2016), Alexander (2002), Ball & Morris (2014), Hoverfly Recording Scheme website, Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157629238038404/.

Sphegina clunipes

General: A tiny club-tailed hoverfly typically associated with dead wood in damp, shaded spots. Lifecycle and habitat requirements: The larvae seem to develop in the decaying sappy cambium under the bark of recently fallen trunks and detached branches including semi-submerged ones, plus the sappy wounds of living trees. It is mostly associated with broadleaved trees but it will also use water-filled rot-holes in pine in Caledonian pine woodland (Rotheray, 2016). There is a marked preference for damp shaded places such as carr woodland, wooded streams/rivers and fen scrub. Flowers visited: Very keen on umbellifers (e.g. fool's watercress, cow parsley, hogweed, hemlock water-dropwort, sanicle, wild angelica) but also recorded on apple, water mint, tormentil, cuckoo flower, hawthorn, spurge, herb robert, meadow cranesbill, tormentil, blackthorn, buttercup, raspberry, woundwort, garlic mustard, enchanter's nightshade and speedwell. It prefers to forage in the dappled sunlight under a canopy, especially semi-shaded fool's watercress growing within streams and ditches but can be found in more open locations in Scotland. Status and distribution: Widespread and locally frequent in north and west Britain, scarcer in the east. Map: http://sgbtest.me.uk/hrs/species-details/375/map. Conservation requirements: Promote the presence of old trees with low rot-holes, and recently detached lying dead wood in damp, shaded spots; also suitable flowers for adult foraging. Key references: Stubbs & Falk (2002), Speight (2016), Rotheray, E (2013), Morris (1998), Hoverfly Recording Scheme website, Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157629817218691/.

Hoverflies associated with rot-holes

Pcota personata

Myathropa florea

Myolepta dubia

Mallota cimbiciformis

Callicera aurata

Xylota xanthocnema

Sphegina elegans
General: Resembling an elongate version of *S. clunipes* and often found alongside it. Lifecycle and habitat requirements: The ecology is similar to that of *S. clunipes* (Godfrey, 2003) but it prefers wetter conditions and is perhaps more shade-loving. Semi-submerged woody debris in carr woodland may be especially important. Flowers visited: Keen on umbellifers (e.g. fool's watercress, sanicle, cow parsley and hemlock water-dropwort), hawthorn, buttercup, woundwort, valerian and guelder-rose. Status and distribution: Widespread and locally frequent in England and Wales but much scarcer in Scotland. Map: http://sgbtest.me.uk/hrs/species-details/189/map. Conservation requirements: Promote the presence of recently detached lying dead wood in wet, shaded spots; also suitable flowers for adult foraging. Key references: Stubbs & Falk (2002), Speight (2016), Alexander (2002), Godfrey (2003), Hoverfly Recording Scheme website, Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157631707523158/.

Sphegina sibirica
General: The only *Sphegina* associated with conifers and the only one that can have a predominantly orange body. Lifecycle and habitat requirements: The larvae seem to develop primarily in sappy decay under the bark of fallen trunks or branches of conifers such as spruces in damp, shady places. Females have been seen swarming around freshly-cut spruce logs. Most records are from conifer plantations though it is occasionally taken some distance from conifers (e.g. Perry 1998) suggesting either a highly mobile nature (which would explain its rapid recent spread across NW Europe including Britain) or some ability to use broadleaved trees. Flowers visited: The internet features numerous photos of this species on umbellifers, also recorded on hawthorn, water mint, *Photinia*, *Potentilla*, elder, *Sorbus*, guelder-rose and *Spiraea* (some of these records probably foreign). Status and distribution: A presumed recent colonist first detected in NW Scotland in 1991 since when it has spread over much of northern and western Britain. It is still rare in the east. Often very common where it occurs. Map: http://sgbtest.me.uk/hrs/species-details/191/map. Conservation requirements: Promote the presence of recently detached lying dead conifer wood in wet, shaded spots; also suitable flowers for adult foraging. Key references: Stubbs & Falk (2002), Speight (2016), Perry (1998), Hoverfly Recording Scheme website, Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157632437273766/.

Sphegina verecunda
General: The scarcest British *Sphegina* but with an ecology seemingly similar to that of *S. clunipes* and *S. elegans*. Lifecycle and habitat requirements: A larva has been found in the exudates from a sap-run on elm but it probably uses a broader range of locations including the sappy decay beneath the bark of fallen trunks and branches, and there is no obvious association with elm. Also stated to use sap in the tunnels of the weevil *Hylobius abietis* in conifer stumps (Alexander, 2002) but this might relate to *S. sibirica*. In common with other *Sphegina* species it likes wet, shady situations in woodland and carr. Flowers visited: British records for cow parsley and wild angelica. Speight (2016) gives records (possibly of a foreign source) for sanicle and *Photinia*. Status and distribution: Widespread but local in England, Wales and

Scotland. Map: http://sgbtest.me.uk/hrs/species-details/193/map. Conservation requirements: Promote the presence of old trees with low rot-holes, and recently detached lying dead wood in wet, shaded spot; also suitable flowers for adult foraging. Key references: Stubbs & Falk (2002), Alexander (2002), Speight (2016), Morris (1998), Hoverfly Recording Scheme website, Steven Falk Flickr: *https://www.flickr.com/photos/63075200@N07/sets/72157631707613203/*

Volucella inflata
General: A large black and orange hoverfly that is associated with sappy wounds of mature trees. Lifecycle and habitat requirements: The larvae develop in sap-runs and probably other sappy wounds of mature broadleaved trees such as oak with wood-boring insects, presumably as scavengers and predators (like other *Volucella* species). It is often associated with Goat Moth-infested trees but it is not known if this is a strict association. It is mostly found in ancient woodland and old parkland. Flowers visited: Hawthorn, dogwood, guelder-rose, bramble, roses, wild privet, hogweed, cow parsley, wild parsnip, thistles, alder buckthorn, buddleia, rhododendron, selfheal, elder, *Euonymus*, common valerian, and occasionally certain garden flowers such as Mexican orange blossom. Males will patrol stands of flowers at great speed. Status and distribution: Widespread but rather local in southern and central England, extending north to Yorkshire. Scarce in Wales. Map: http://sgbtest.me.uk/hrs/species-details/375/map. Conservation requirements: Promote the presence of over-mature oak trees, especially those with sappy wounds or Goat Moth; also suitable flowers for adult foraging. Key references: Stubbs & Falk (2002), Speight (2016), Alexander (2002), Morris & Ball (2004), Hoverfly Recording Scheme website, Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157629817218691/.

Volucella inanis, *V. pellucens* and *V. zonaria* have larvae that develop in social wasp nests and probably use such nests in tree cavities on occasion but there is no obvious preference for wasp nests in trees or dead wood.

Xylota abiens
General: A slim, medium-sized hoverfly with four squarish yellow spots on the abdomen, usually found in damp broadleaved woodland. Lifecycle and habitat requirements: The larvae have been found in the wet, decaying roots of beech; also from sap under the bark of moribund Scots pine and adults have been observed collecting on a semi-submerged pine (A. Jukes – pers. comm). Adults are usually found in damp broadleaved woodland close to streams and pools, which suggests that alder and willow rather than beech and pine might be more typical for larval development. Flowers visited: In Britain recorded on buttercups and hawthorn. Speight (2016) gives records (possibly of a foreign source) for umbellifers, holly, buttercup, raspberry and elder. Status and distribution: Local in southern England, rare in Wales, northern England and Scotland. Graded Nationally Scarce by Ball & Morris (2014). Map: http://sgbtest.me.uk/hrs/species-details/425/map. Conservation requirements: Promote the presence of old trees and dead wood; also suitable flowers for adult foraging. Key references: Stubbs & Falk (2002), Speight (2016), Hoverfly Recording Scheme website, Steven Falk Flickr:

https://www.flickr.com/photos/63075200@N07/sets/72157629477168354/.

Xylota florum
General: A slim, medium-sized hoverfly with four ill-defined yellow spots on the abdomen, usually found in damp broadleaved woodland. Lifecycle and habitat requirements: The larvae have been reared from a rot-hole in poplar and from a fallen trunk of spruce but it is also stated to use semi-submerged logs (Godfrey, 2003). The author has seen it congregating around semi-submerged conifer logs in a large plantation. However, the typical habitat in Britain seems to be damp, broadleaved valley woodland often near streams. Flowers visited: Rarely seen on flowers but records exist for hogweed (P. Chandler - pers. comm.), also umbellifers and raspberry (Speight (2016). Status and distribution: Local but widespread in England and Wales. Map: http://sgbtest.me.uk/hrs/species-details/427/map. Conservation requirements: Promote the presence of old trees and dead wood; also suitable flowers for adult foraging. Key references: Stubbs & Falk (2002), Speight (2016), Godfrey (2003), Hoverfly Recording Scheme website, Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157629900308411/.

Xylota jakutorum
General: A slim, medium-sized hoverfly with four squarish yellow or grey spots on the abdomen, associated with conifers stumps. Lifecycle and habitat requirements: The larvae develop in sap-filled tunnels created by the Large Pine Weevil *Hylobius abietis* in assorted conifers. This includes both living trees and the stumps of recently felled trees. It is particularly abundant in areas felled 2-3 years previously, after which time the stumps become suitable for the weevil larvae. It can occur in native Caledonian pine woodland, conifer plantations and heathland with invading pines. Flowers visited: Typically buttercups but Speight (2016) also lists tormentil, rose, raspberry and rowan, possibly from a foreign source. This is the only British *Xylota* species that regularly visits flowers. Status and distribution: Widespread in the north and west of Britain in conifer-rich landscapes; much rarer in the south and east. Victorian specimens are purely from Caledonian pine forest and it seems to have spread south as plantations have matured and pines on heathland have matured. Map: http://sgbtest.me.uk/hrs/species-details/429/map. Conservation requirements: Promote rotational harvesting of conifers to produce a regular supply of suitable stumps; also rides and clearings with buttercups for adult foraging. The Large Pine Weevil is regarded as a serious forest pest by Forestry England. Key references: Stubbs & Falk (2002), Speight (2016), Hoverfly Recording Scheme website, Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157629477164066/.

Xylota segnis
General: A very common slim hoverfly with a broad orange banded across the abdomen, associated with dead wood of many sorts. Lifecycle and habitat requirements: The larvae have been found in decaying sap under the bark of trees, and in sap-runs created by the bark weevil *Hylobius abietis* in conifers. It can also occur in habitats not associated with trees, such as silage and decomposing potatoes but seems to be predominantly saproxylic. It can be found in all sorts of woodland

(ancient and secondary, broadleaved or coniferous), also along hedgerows and in parks and gardens. Flowers visited: A reluctant flower-visitor that seems to prefer gathering pollen and aphid honeydew from leaf surfaces but British records exist for buttercup (mostly), hawthorn, broom, rowan, hogweed, ragwort, dog rose, meadowsweet, wild angelica. Speight (2016) gives records (possibly of a foreign source) for ivy, wild goldenrod, lime and guelder-rose. Rotheray (2018) suggests that during this occasional flower-visiting pollen is taken from the petal surface rather than the anthers (this may apply to most of the *Xylota* species covered here). Status and distribution: Common throughout Britain – one of the UK's most abundant saproxylic insects. Map: http://sgbtest.me.uk/hrs/species-details/431/map. Conservation requirements: Promote the presence of lying dead wood. Key references: Stubbs & Falk (2002), Speight (2016), Morris (2005, 2008), Hoverfly Recording Scheme website, Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157629477160086/.

Xylota sylvarum

General: A fairly large, elongate hoverfly with bright yellow hairs covering the tip of the abdomen. Lifecycle and habitat requirements: The larvae have been found beneath bark and in damp, decaying, fungus-ridden wood of stumps, decaying roots and fallen trunks. In Britain it is predominantly a species of broadleaved woodland where it can use oak, beech, ash, aspen and probably birch, but it has also been recorded from the wood of fir and Douglas fir. Abroad it has been reported using further broadleaved and coniferous species. Flowers visited: Rarely visits flowers but Morris (1998) lists ground elder and hemlock water-dropwort. Status and distribution: Widespread and frequent over much of Britain. Map: http://sgbtest.me.uk/hrs/species-details/433/map. Conservation requirements: Promote plentiful dead wood such as stumps and fallen trunks, in shady or semi-shaded locations. Key references: Stubbs & Falk (2002), Speight (2016), Hoverfly Recording Scheme website, Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157629841470621/.

Xylota tarda

General: Resembling a small version of the common *X. segnis* but scarcer and strongly associated with aspen. Lifecycle and habitat requirements: The larvae have been reared from a sap-run at the base of an aspen trunk but it is likely that it can also use general sappy decay below the bark of recently fallen or felled aspen. The association with aspen-rich woodland seems almost absolute. Flowers visited: A reluctant flower-visitor that seems to prefer gathering pollen from leaf surfaces but records exist for heather (ling), hawkbit, *Potentilla*, buttercup and elder. Status and distribution: Very local in the southern half of Britain with further records in the Scottish Highlands. Graded Nationally Scarce by Ball & Morris (2014). Map: http://sgbtest.me.uk/hrs/species-details/435/map. Conservation requirements: Promote the presence of mature aspen and a constant but sustainable supply of dead aspen wood. Key references: Stubbs & Falk (2002), Speight (2016), Hoverfly Recording Scheme website, Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157629841774585/.

Xylota xanthocnema
General: Resembling *X. sylvarum* but smaller and with the hind tibiae entirely yellow without a broadly black tip. Lifecycle and habitat requirements: In Britain, larvae have been reared from the exudate and rot-holes of yew and rot-holes in oak but there is a foreign record for fir (Speight, 2016). Adults are typically found in old broadleaved and mixed woodland but show no obvious association with coniferous settings. Flowers visited: Seemingly no flower-visiting data from Britain or abroad. It seems to prefer gathering pollen and aphid honeydew from leaf surfaces and may not visit flowers at all. Status and distribution: Widespread but local in the southern half of Britain. Graded Nationally Scarce by Ball & Morris (2014). Map: http://sgbtest.me.uk/hrs/species-details/437/map. Conservation requirements: Promote the presence of mature and post-mature trees with rot-holes. Key references: Stubbs & Falk (2002), Speight (2016), Hoverfly Recording Scheme website, Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157629900277851/.

5.15 Tachinidae
Represented in Britain by about 270 species. All but some recent additions can be identified using Belshaw (1993). These flies are obligate parasitoids of other invertebrates, especially lepidopterous larvae but also bugs, beetles, fly larvae, earwigs and centipedes. Most are highly specific to one host species or a group of closely-related ones. Many tachinids are regular and abundant flower visitors with a particular liking for umbellifers and composites. A relatively small number use hosts that are partially or totally reliant on dead wood and old trees. Alexander (2002) identifies 10 such species though two are excluded here on the basis that there is insufficient evidence to suggest a strong association with dead wood, namely *Admontia blanda* (which attacks cranefly larvae) and *Triarthria setipennis* (which attacks earwigs). The jury is out for *Loewia phaeoptera* (which attacks centipedes) but present limited evidence suggests it may prefer hosts in rotting wood. Conservation statuses are provided by Falk, Pont & Chandler (2005).

Admontia maculisquama A widespread and fairly frequent woodland species that seems to target the larvae of woodland *Tipula* craneflies including the saproxylic *T irrorata*. It is unclear how reliant the tachinid fly is on saproxylic species. No flower-visiting data obtained.

Admontia seria A scarce species graded Lower Risk (Near Threatened) that seems to be strictly associated with saproxylic craneflies including *Ctenophora* species, *Tipula irrorata* and *T. flavolineata*. It is recorded from old woodland, parkland and pasture-woodland in the southern half of Britain. No flower-visiting data obtained.

Billaea irrorata A scarce species graded Lower Risk (Near Threatened) associated primarily with the wood-boring longhorn beetle *Saperda populnea* in ash, aspen and possibly willow. There are foreign online images purportedly of this species and other *Billaea* species visiting umbellifers and thistles.

Elodia ambulatoria A scarce species graded Lower Risk (Near Threatened)

associated with tineid moths such as *Morophaga choagella* that develop on bracket fungi. No flower-visiting data obtained.

Leskia aurea A very rare species (graded Data Deficient) only ever seen once in Britain (Romsey, Hampshire, 1928). It attacks wood-boring clearwing moths such as Yellow-legged Clearwing *Synanthedon vespiformis* in oak and Red-belted Clearwing *S.myopaeformis* in rosaceous trees (Pohjoismäki, 2019). Internet photos from abroad show it visiting umbellifer flowers (much as the related genus *Solieria* does).

Loewia phaeoptera A local, southern species (graded Nationally Scarce) that is parasitic on centipedes. It is not known to what extent it can use centipedes in other settings i.e. the extent to which dead wood is required but there is a chance it is not a strict or strong requirement. No flower-visiting data obtained.

Phytomytera cingulata A widespread small tachinid chiefly associated with microlepidopterous larvae of the families Gelechiidae, Oecophoridae and Tineidae using bracket fungi, rotting wood or lichens. No flower-visiting data obtained.

Xylotachina diluta The special parasitoid of the Goat Moth and extremely rare (graded Data Deficient). Again, no flower-visiting seems to be reported but it is not easily distinguished from various other tachinids in the field.

5.16 Tipulidae (long-palped craneflies)

There are four families of cranefly in Britain (Cylindrotomidae, Limoniidae, Pediciidae and Tipulidae). Of these, the Tipulidae contains some of our largest and most impressive species, notably the saproxylic feather-horned craneflies of the genera *Dictenidia*, *Ctenophora* and *Tanyptera*. Two *Ctenophora* species have been reported visiting flowers but it is not clear if the do this often. About 10 *Tipula* species are associated partially or wholly with dead wood. No flower-visiting records seem to exist for any of these but it should be noted that some soil-developing *Tipula* such as the *T. paludosa* and also *Nephrotoma* species will occasionally be found actively feeding on flowers such as thistles and umbellifers. Conservation statuses are provided by Falk (1991b) and a new guide to all craneflies is in prep. Species of the largest cranefly family, Limoniidae, will also sometimes visit flowers but no evidence of flower-visiting by any of the 22 or so saproxylic limoniids has been found.

Ctenophora flaveolata A very scarce but widespread species (graded Nationally Vulnerable) associated with old woodland and pasture-woodland containing old and decaying trees, especially beech. The wasp-patterned adults have been reported visiting hawthorn (Alexander, 2002).

Ctenophora pectinicornis A widespread but local species (graded Nationally Scarce) associated with a variety of locations with mature trees, including woodland, historic parkland and not infrequently urban or suburban settings with old trees. The author has also seen it ovipositing into the fissure of a hawthorn trunk growing beneath a woodland canopy suggesting it is quite adaptable as to developmental location. Adults have been reported visiting hawthorn (Falk data; Skidmore, 1962) and elder

(Clemons, 2000).

The craneflies *Ctenophora flaveolata* male (left) and *C. pectinicornis female* (right).

6 A Review of the Hymenoptera (wasps and bees)

Hymenoptera is the largest order of insects in Britain with approaching 8,000 species. However, aside from groups such as bees and ants, it is also one of the least studied and recorded, especially the enormous infraorder Parasitica. This review concentrates on the better known and much smaller infraorder Aculeata. The main literature required to identify these is given below. Conservation grades are provided by Falk (1991a) but these are mostly badly out of date and use different (non-IUCN) grading criteria to more recent reviews.

6.1 Apidae sensu lato (bees)

About 270 bee species occur in Britain and all but the recent additions are covered by Falk (2015) and Else & Edwards (2018) though Steven Falk Flickr plugs those gaps and provides good photographic coverage of most: https://www.flickr.com/photos/63075200@N07/collections/72157631518508520/. Fairly up-to-date maps are provided by BWARS: https://www.bwars.com/. Bees vary from small and relatively hairless (e.g. *Hylaeus* and *Sphecodes*) to large and densely hairy (*Bombus*). They loosely categorise into ground-nesters and aerial-nesters. Most of the aerial nesters will use dead wood and timber especially that which is dry, has pre-existing holes (e.g. beetle exit holes), and is exposed to sunshine. Good examples include log piles, stumps and standing dead or partly dead trees in the open or at sunny woodland margins. However, few aerial bees are strictly confined to saproxylic locations. Many will also use bee hotels, old fence posts, hollow twigs/plant stems, window frames, and even non-wooden locations such as soft mortar. The majority are treated here as facultative saproxylics and all but a few that are strictly saproxylic are subject to brief accounts. A few ground-nesting bees (notably species of *Andrena*, *Halictus*, *Lasioglossum* plus their associated *Nomada* and *Sphecodes* cleptoparasites) plus certain crabronid and pompilid wasps will nest in the earth of exposed root-plates of wind-blown trees. It should be noted that over 70 British bees are cleptoparasites (cuckoos) of other bees. This includes members of the genera *Coelioxys*, *Melecta*, *Nomada*, *Stelis* and *Sphecodes*. These have been listed below if they target wood-nesting hosts.

***Andrena* species (mining bees)** Classic ground-nesting bees with several species that will occasionally nest in the earth of exposed root-plates at sunny woodland margins e.g. *Andrena clarkella* and *A. helvola*. These in turn can attract certain nomad bees (*Nomada* species), *Leucophora* flies (Anthomyiidae), *Bombylius* beeflies (Bombyliidae) and possibly oil beetles such as *Meloe violaceus* (Meloidae).

***Anthidium manicatum* (Wool Carder Bee)** A widespread and frequent bee (perhaps especially in gardens) that will nest in pre-existing cavities of a variety of aerial locations including dead wood where this has the exit holes of longhorn beetles or Goat Moth. Most foraging is from labiates (e.g. woundworts and black horehound) and legumes (e.g birds's-foot trefoils and restharrows). It is host to the cuckoo bee *Stelis punctulatissima*.

Aerial-nesting bees, wasps and their flower-visiting parasites

Chelostoma florisomne and its parasitoid *Monosapyga clavicornis*.

Anthidium manicatum and its cleptoparasite *Stelis punctulatissima*.

Ancistrocerus nigricornis and its parasitoid *Chrysis terminata*.

Anthophora furcata **(Fork-tailed Flower Bee)** A widespread and frequent species that forages mainly on woundworts, black horehound and other labiates (including many garden species). Nesting is mostly in decaying wood within woodland and within hedges but it can use fence posts, building timbers and even driftwood. It is a host to the cuckoo bee *Coelioxys rufescens*.

Anthophora plumipes **(Hairy-footed Flower Bee)** A very common spring-flying bee that will occasionally nest in the earth of exposed root-plates though it prefers walls with soft mortar, cliff faces and other vertical banks. Any nesting in a root-plate could potentially attract its special cuckoo bee, *Melecta albifrons*. The use of root-plates by ground-nesting *Anthophora* species has been noted abroad (Campbell et. al. 2017).

Apis mellifera **(Honey Bee)** Feral populations of this domesticated bee will often nest in the cavities of trees and such colonies can last for several years.

Bombus **species (bumblebees)** A number of bumblebee species will nest in cavities of trees but the most frequent is *Bombus hypnorum* (Tree Bumblebee) a relatively recent British colonist that is now found over much of the UK. It is the only bumblebee that regularly nests at height but it is not especially reliant on tree cavities and will also use buildings and bird boxes. It forages on numerous plants but the workers are especially keen on bramble, cotoneaster and comfreys. Queens also visit a variety of spring-blossoming shrubs, thistles, scabiouses and ivy.

Chelostoma campanularum **(Small Scissor Bee)** A widespread and frequent, very small bee that seems to like nesting in the exit holes of woodworm and other small beetles. It can use natural dead wood of various sorts but is frequently associated with old building timbers. It primarily forages on *Campanula* species including harebell and assorted garden bellflowers.

Chelostoma florisomne **(Large Scissor Bee)** A widespread but local species that often nests in dead or partly dead trees, foraging on buttercups nearby. It can also nest in fence posts, building timbers and roofing thatch but seems to be predominantly associated with woodland and mature hedges. It is attacked by the parasitic sapygid wasp *Monosapyga clavicornis*.

Coelioxys elongata **(Dull-vented Sharp-tail)** Widespread but local. Attacks the aerial-nesting leafcutter *Megachile willughbiella* but also the ground-nesting *M. circumcincta*. Visits bird's-foot trefoil, fleabane, ragworts, thistles, cranesbills.

Coelioxys inermis **(Shiny-vented Sharp-tail)** Widespread but local. Mainly attacks the aerial-nesting leafcutter *Megachile centuncularis*. Visits bramble, cross-leaved heath, bird's-foot trefoil, assorted daisy-like flowers (including garden varieties), various hawkish composites, spurges, mulleins.

Coelioxys quadridentata **(Grooved Sharp-tail)** Very scarce and declined (graded Nationally Rare). Attacks several *Megachile* species, also *Anthophora furcata*. Visits

bird's-foot trefoil, white bryony in Britain and other flowers abroad.

Coelioxys rufescens **(Rufescent Sharp-tail)** Widespread but local. Attacks *Anthophora furcata* and possibly *Megachile willugbiella*. Visits bramble, thistles, buttercups, common vetch, rosebay willowherb, scabiouses.

Heriades truncorum **(Large-headed Resin Bee)** A local (graded RDBK) but expanding southern species that will nest in dead trees and logs where these have beetle holes of the right diameter. It can also use hollow twigs and is an increasingly frequent exploiter of garden bee hotels. Foraging is from composites such as ragwort, fleabane, cat's-ear and assorted garden varieties.

Halictus **and** ***Lasioglossum*** **species (furrow bees)** Classic ground-nesting bees but with several species (notably *Lasioglossum parvulum* and *L. rufitarse*) that can occasionally nest in the earth of exposed root-plates at sunny woodland margins. These in turn can attract cleptoparasitic blood bees (*Sphecodes*). Furrow bees visit assorted flowers but those of relevance here are especially keen on spring-blossoming shrubs and composites such as cat's-ear.

Hoplitis adunca **(viper's-bugloss bee)** A relatively recent addition to the addition list known from several sites in the London area. It can nest in holes in wood, hollow stems and bee hotels. It forages on viper's-bugloss.

Hoplitis claviventris **(welted mason bee)** Widespread but localised in the southern half of Britain, rare in the north. It probably mostly nests in hollow stems and twigs but is occasionally reported using dead wood. Foraging is mostly on bird's-foot trefoils.

Hylaeus communis **(common yellow-face)** Widespread and common. Nests in a variety of holes and cavities including those in dead wood, walls, building timbers, plant stems and garden bee hotels. Visits numerous flowers from many families including assorted garden plants.

Hylaeus confusus **(white-jawed yellow-face)** Widespread and common. Nests in a variety of holes and cavities including those in dead wood, walls, building timbers, plant stems and garden bee hotels. Visits numerous flowers from many families but especially umbellifers and bramble.

Hylaeus hyalinatus **(hairy yellow-face)** Widespread and common. Nests in a variety of holes and cavities including those in dead wood, walls, building timbers, hollow stems, garden bee hotels, also vertical faces and cliffs. Visits numerous flowers from many families but especially umbellifers, thistles, bramble and assorted garden plants.

Hylaeus incongruus **(white-lipped yellow-face)** A restricted southern species (graded Nationally Rare) that nests in dead wood and hollow stems. Visits bramble, hogweed, tormentil, wild angelica and wild parsnip.

Megachile centuncularis **(Patchwork Leafcutter)** Widespread and fairly frequent (the commonest garden leafcutter). Will nest in dead wood, stems, garden bee hotels and building timbers. Visits a wide variety of flowers but especially composites (e.g. fleabanes, thistles, knapweeds, burdocks), also bird's-foot trefoils, bramble, St John's wort, and assorted garden flowers.

Megachile ligniseca **(Wood-carving Leafcutter)** Widespread and frequent – the big leafcutter you commonly see collecting pollen on spear thistle though it will also use knapweeds, burdocks, chicory and obtains nectar from flowers of many families. It nests in soft decaying wood, old building timbers, garden bee hotels etc.

Megachile versicolor **(Brown-footed Leafcutter)** Widespread and frequent in many areas. Nests in dead wood, hollow stems and garden bee hotels. Visits a wide variety of flowers but especially composites (e.g. thistles, knapweeds, and hawkish types), also bird-foot trefoils, everlasting peas, bramble and wild angelica.

Megachile willughbiella **(Willughby's Leafcutter)** Widespread and frequent. Nesting can occur in dead wood, garden bee hotels and in various non-wood locations such as door keyholes, folded garden parasols and plant pots containing desiccated compost. Visits many sorts of flowers including everlasting peas, bird's-foot trefoils, thistles, knapweed, bramble, willowherbs and assorted garden plants.

Melecta albifrons **(Common Mourning Bee)** The cuckoo of *Anthophora plumipes* (see above).

Nomada **species (nomad bees)** These cuckoos will occasionally exploit nests of *Andrena* species nesting in the mud of exposed root-plates but perhaps especially *Nomada leucophthalma* and *N. panzeri*. They visit a wide variety of flowers including dandelions and hawkish-type composites, greater stitchworts, willows/sallow, blackthorn and other *Prunus* species, umbellifers, ragworts, thistles, knapweeds, yarrow, scabiouses and heathers.

Osmia bicornis **(Red Mason Bee)** A common bee that will nest in a great variety of locations but especially walls, garden bee hotels and vertical cliff faces where it can form large colonies. It will use pre-existing holes in dead wood or partly dead standing trees but such nesting colonies are not usually very large. *O. bicornis* must have a source of wet mud for constructing nest cells. It visits many types of flowers including commercial fruit trees and oilseed rape. Mason bees such as *O. bicornis* can be far more effective at pollinating fruit trees than *Apis mellifera* (Garratt et. al, 2016).

Osmia caerulescens **(Blue Mason Bee)** A widespread and frequent bee that will nest in pre-existing holes in dead/partly dead trees, fence posts, hollow stems and garden bee hotels. It visits a great variety of flowers but perhaps especially legumes (e.g. bird's-foot trefoil) and labiates, including numerous garden species. A major host of the parasitic sapygid wasp *Sapyga quinquepunctata*.

***Osmia cornuta* (European Orchard Bee)** A recent British colonist that resembles a large black and red *O. bicornis* and has a very similar biology though it peaks earlier. It is considered a very important pollinator of fruit trees on the Continent (Vicens & Bosch, 2000). If it continues to expand in Britain, standing dead wood could become a regular nesting location.

***Osmia leaiana* (Orange-vented Mason Bee)** A widespread and frequent species that nests in pre-existing holes in dead wood, hollow stems, building timbers and garden bee hotels. It mostly forages on composites including thistles, knapweeds, daisy-type flowers (including various garden varieties) and hawkish types. It is the main host of the dark bee *Stelis phaeoptera*.

***Osmia niveata* (Jersey Mason Bee)**. Seemingly very rare on mainland Britain. Its habits seem to be very similar to *O. leaiana*, and the two are not readily separable in the field.

***Osmia pilicornis* (Hairy-horned Mason Bee)**
General: A medium-sized, black and chestnut bee that is now very rare in southern England. Lifecycle and habitat requirements: Nesting occurs in dead wood such as old coppice stools or lying dead wood in sunny, sheltered rides, clearings and margins of old woods. Most of its known sites are coppiced ancient broadleaved woodland but it has been recorded in the rides of coniferised ancient woods. The flight peak is late spring. Flowers visited: The main pollen source in Britain is bugle with ground ivy used to a lesser extent. It will also use lungwort on the continent and this was apparently important at one old Wiltshire site. It will take nectar from violets, comfeys and willows. Status and distribution: Very rare and much declined with records now confined to a handful of woods in SE England. Graded Nationally Scarce (Notable A) in Falk (1991a) but that grade is badly misleading. Map: https://www.bwars.com/bee/megachilidae/osmia-pilicornis. Conservation requirements: Maintain broad woodland rides/large clearings and a coppicing regime, with plentiful lying dead wood and old coppice stools; also abundant bugle and violets in sunny, sheltered locations. Key references: Earwaker (2014), Else & Edwards (2018), Falk (2015), Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157633281216156/.

***Osmia uncinata* (Pinewood Mason Bee)**
General: A medium-sized, black and chestnut bee that is a rarity of Scottish pinewoods. Lifecycle and habitat requirements: Nesting occurs in pre-existing holes (e.g. longhorn beetle exit holes) and other small cavities of lying dead pine wood of various sizes, also the trunks of veteran pines. These need to be in sunny, sheltered locations. It is confined to Caledonian pine forest and mature plantations. Flowers visited: The pollen source in Scotland is mainly common bird's-foot trefoil but it will also visit common broom and bilberry. Status and distribution: Very rare with records mostly confined to the Cairngorms (where it is scarce) and a few sites in East Ross. Graded Nationally Vulnerable in Falk (1991a) and a Scottish Priority Species. Map: https://www.bwars.com/bee/megachilidae/osmia-uncinata. Conservation requirements: Maintain broad rides, large clearings, or an open woodland structure

Classic *Osmia pilicornis* habitat – coppiced ancient woodland (Fore Wood, Sussex).

Classic *Osmia uncinata* habitat – old pine woodland (Nethy Bridge, Cairngorms).

in pine woodland; promote the presence of plentiful lying dead wood and bird's-foot trefoil for adult foraging. The latter is most likely to occur along tracks and on rocky outcrops where heather, bilberry, mosses and grasses are less dominant. Key references: Else & Edwards (2018), Falk (2015), Steven Falk Flickr: https://www.flickr.com/photos/63075200@N07/sets/72157634376777019/.

***Sphecodes* species** These cuckoos will occasionally exploit the nests of *Halictus* and *Lasioglossum* species nesting in the mud of exposed root-plates. They visit a wide variety of flowers including dandelions and other hawkish types composites, spring-blossoming shrubs, umbellifers, ragworts, thistles, knapweeds, yarrow, scabiouses, heathers and ivy.

***Stelis brevisucula* (Little Dark Bee)** The cuckoo of *Heriades truncorum*. Scarce (graded RDBK) but increasing as its host expands its range. Visits composites such as ragwort, fleabane, mouse-ear hawkweed, yarrow and assorted garden varieties.

***Stelis phaeoptera* (Plain Dark Bee)** Primarily a cuckoo of *Osmia leaiana*. Scarce (graded Vulnerable) but increasing in gardens. Visits bird's-foot trefoil, thistles, yarrow, scabiouses and assorted garden composites.

***Stelis punctulatissima* (Banded Dark Bee)** The cuckoo of *Anthidium manicatum*. Much rarer than the host (Graded Nationally Scarce (Notable B)). Visits assorted composites (thistles, fleabane, ragwort, yarrow, knapweeds), labiates, cranesbills, scabiouses, heathers and assorted garden flowers.

***Xylocopa violacea* (Violet Carpenter Bee)** This huge black bee with blue and violet wing reflections occasionally turns up in Britain as an adventive and can form short-lived populations. It will nest in wood of various sorts including dead or partly dead trees, fence posts, telegraph poles and artificial tubes. It forages on a wide range of flowers.

6.2 Chrysididae (ruby-tailed wasps)

These are mostly parasitoids of bees and wasps, including ground-nesting and aerial-nesting species and are beautiful metallic insects (usually green and red). About 35 species are present in Britain but the taxonomy of genera such as *Chrysis* is very unstable and foreign literature is required in addition to Morgan (1984) to identify them. This means that host preference, distribution and status is often unclear for a species. Nevertheless, they can be conspicuous insects as they run over sunlit dead wood and tree trunks with exposed heartwood. Most species seem to visit flowers, perhaps especially umbellifers. Those most associated with dead wood are summarised here:

Chrysis angustula Widespread and frequent. Attacks *Ancistrocerus* and *Symmorphus* species.

Chrysis fulgida Rare (graded Endangered). Attacks *Symmorphus crassicornis* in aspen-rich woods.

Chrysis gracillima Scarce in the south (graded Vulnerable). Attacks small crabronids and possibly *Microdynerus exilis*. Visits umbellifers such as wild carrot (BWARS website).

Chrysis ignita Widespread but local, attacks *Ancistrocerus* species. Visits angelica and other flowers (BWARS website).

Chrysis impressa Widespread and frequent. Attacks *Ancistrocerus* species.

Chrysis longula Graded Nationally Rare and a Section 41 conservation priority species. Attacks *Ancistrocerus antilope*.

Chrysis pseudobrevitarsis Very rare (graded Vulnerable). Attacks *Ancistrocerus antilope*.

Chrysis terminata A fairly recent discovery in Britain that is proving widespread. Attacks *Ancistrocerus nigricornis*.

Chrysis viridula A widespread but local species that attacks *Odynerus spinipes*. Both species can occasionally be found using exposed root-plates of fallen trees as a proxy for vertical clifflets.

Chrysura hirsuta Very rare in the north and west (graded Nationally Rare). Attacks several northern-biased *Osmia* species including the saproxylic *O. uncinata*.

Chrysura radians Scarce but increasing in the southern half of Britain (graded Nationally Scarce (Notable A)). Attacks *Osmia caerulescens* and *O. leaiana*. Visits umbellifers.

Omalus aeneus Local in southern Britain. Attacks small, aerial-nesting crabronids of the genera *Psen, Psenulus, Pemphredon*, and *Passaloecus.* Visits bird's-foot-trefoil, hogweed and knotweeds (BWARS website).

Omalus puncticollis Local in southern Britain (graded Nationally Scarce (Notable A)) but difficult to separate from *O. aeneus*. Biology probably similar to *O. aeneus*. Visits devil's-bit scabious (BWARS website).

Pseudomalus auratus Fairly frequent in southern Britain, scarcer in the north. Attacks small aerial-nesting crabronids of the genera *Pemphredon*, *Passaloecus*, *Rhopalum* and *Trypoxylon*. Visits umbellifers (e.g. wild angelica, wild carrot), also mint (BWARS website).

Pseudomalus violaceus Local in the southern half of Britain (graded Nationally Scarce (Notable B). Attacks small aerial-nesting crabronids of the genera *Pemphredon* and *Passaloecus*. Visits great burnet (BWARS website).

Trichrysis cyanea Frequent in southern Britain. It seems to attacks assorted aerial-

nesting wasp and bees including species of *Trypoxylon*, *Pemphredon*, *Stigmus*, *Heriades truncorum* and *Chelostoma florisomne*. Visits wild carrot and wild parsnip (BWARS website).

6.3 Crabronidae (hunting and digger wasps)

Represented in Britain by approximately 120 species. These are all predatory wasps that vary in appearance from tiny and black (e.g. *Spilomena*, *Stigmus*) to almost honey bee-sized and yellow-banded (e.g. *Crabro*, *Ectemnius*). As with bees, the fauna tends to classify into ground-nesters and aerial-nesters, and a small number of species are cleptoparasites of other crabronids. A number of genera can produce large nesting colonies on standing dead or partly dead trees, log piles and fallen trunks and large branches. Warmth and sunshine is important for most and they will not use damp, shaded dead wood. Many will also use artificial forms of timber such as fence posts and building timbers but they are less inclined to use bee hotels than aerial-nesting bees and are generally more saproxylic in nature. Most can be identified using Richards (1980) and Lomholdt (1984). Those strongly or partially associated with dead wood are summarised here (information mainly from the BWARS website, Lomholdt, 1984, trusted internet photos, personal data):

Crossocerus annulipes Widespread and fairly frequent in the south, scarcer in the north. Stocks its nest cells with typhlocybid bugs. No flower-visiting data obtained but most *Crossocerus* species seem to visit umbellifers.

Crossocerius binotatus Local (graded Nationally Scarce (Notable B)) and mostly southern. Stocks its cells with medium-sized flies such as lauxaniids and rhagionids. No flower-visiting data obtained but most *Crossocerus* species seem to visit umbellifers.

Crossocerus cetratus Widespread and fairly frequent in the south, scarcer in the north. Stocks its nest cells with small flies. Reported visiting spurge (G.M. Spooner notes) but probably also uses umbellifers.

Crossocerus dimidiatus Local but widespread. Stocks its cells with medium-sized flies from various families. No flower-visiting data obtained but most *Crossocerus* species seem to visit umbellifers.

Crossocerus leucostomus A scarce northern species (graded Nationally Scarce (Notable A)). Quite common in Caledonian pine woodland of the Cairngorms but using mature conifer plantation further south. Cells are stocked with small flies. No flower-visiting data obtained but most *Crossocerus* species seem to visit umbellifers.

Crossocerus megacephalus Widespread and frequent – often one of the most numerous crabronids around dead wood. Stocks its nest cells with small flies. Visits umbellfers.

Crossocerus nigritus Widespread and fairly frequent in the southern half of Britain. Stocks its nest cells with small flies. No flower-visiting data obtained but most

A standing dead beech at Wytham Woods, Oxfordshire, that is used by very large numbers of nesting hunting wasps.

Crossocerus species seem to visit umbellifers.

Crossocerus podagricus Widespread and common – often one of the most numerous small crabronids around dead wood. Stocks its nest cells with very small flies. Visits umbellifers.

Crossocerus vagabundus Very rare (graded Nationally Endangered) with few modern records. Typically stocks its cells with craneflies. Will nest in veteran oaks in the New Forest. No flower-visiting data obtained but most *Crossocerus* species seem to visit umbellifers.

Crossocerus walkeri Widespread but very local (graded Nationally Scarce (Notable B)). Stocks its cells with small mayflies and tends to occur close to rivers and streams. No flower-visiting data obtained but most *Crossocerus* species seem to visit umbellifers.

Several ground-nesting *Crossocerus* species will occasionally nest in the mud of exposed root-plates of wind-blown trees e.g. *Crossocerus quadrimaculatus* and *C. pusillus*.

Ectemnius borealis A very restricted southern species (graded Nationally Rare). Stocks its cells with flies. Visits umbellifers and yarrow.

Ectemnius cavifrons Widespread and common, often the commonest black and yellow hunting wasp around dead wood. Stocks its cells with medium-sized flies. Visits a variety of umbellifers.

Ectemnius cephalotes Widespread and frequent. Stocks its cells with medium-sized flies. Visits a variety of umbellifers.

Ectemnius continuus Widespread and common, often the commonest black and yellow hunting wasp around dead wood. Stocks its cells with medium-sized flies. Visits a variety of umbellifers, also thistles, ragworts, yarrow and spurges.

Ectemnius dives Widespread but local in the south. Stocks its cells with medium-sized flies. Visits a variety of umbellifers.

Ectemnius lapidarius Widespread but local and declining. Stocks its cells with medium-sized flies. Visits a variety of umbellifers, also goldenrods and spurges.

Ectemnius lituratus Widespread and common, often the commonest black and yellow hunting wasp around dead wood. Stocks its cells with medium-sized flies. Visits a variety of umbellifers.

Ectemnius ruficornis Widespread but local in the south ((graded Nationally Scarce (Notable B)). Stocks its cells with medium-sized flies. Visits a variety of umbellifers.

Ectemnius sexcinctus Widespread but local ((graded Nationally Scarce (Notable B)). Stocks its cells with medium-sized flies. Visits a variety of umbellifers.

Lestica clypeata Only known as British from two 19th century records from Weybridge, Surrey. It nests in dead wood and stocks its nest cells with adult moths. Visits umbellifers, daisy-type composites and spurges abroad.

Mimumesa dahlbomi Fairly frequent in southern Britain. Nesting is thought to typically occur in dead wood. Nest cells are stocked with paralysed delphacid and cicadellid hoppers. Visits wild parsnip, wild angelica and wood spurge (Spooner, 1948).

***Nitela* species** Two small and poorly-known species of SE England (both graded RDBK) that nest in small beetle holes of dead wood such as fence posts, also hollow stems. They stock their nest cells with booklice. No flower-visiting data obtained.

***Passaloecus* species** All the British species except *P. clypealis* regularly nest in dead wood, particularly stumps, standing dead trees and exposed heartwood or old trees though *P. corniger* is a cleptoparasite of some of the others. They stock their cells with paralysed aphids and related insects. Very little flower-visiting data has been obtained though the author has swept *P. insignis* from creeping thistle flowers (it may have been hunting rather than foraging).

Pemphredon inornata Widespread and frequent, often stem-nesting too. Nest cells are stocked with aphids. Visits umbellifers.

Pemphredon lethifer Widespread and frequent, perhaps mostly stem-nesting. Nest cells are stocked with aphids. Probably visits umbellifers.

Pemphredon lugubris Widespread and common, often one of the most abundant hunting wasps around dead wood. Stocks its nest cells with aphids and possibly cicadellid bugs. No flower-visiting data obtained but probably visits umbellifers.

Pemphredon morio Widespread but local in the southern half of Britain (graded Nationally Scarce (Notable B). It probably stocks its cells with aphids. No flower-visiting data obtained.

Pemphredon rugifera Probably two species, a southern and northern one (formerly called *P. wesmaeli* and *P. mortifer*). Both are very local (graded Nationally Rare) but '*mortifer*' can be frequent in Caledonian pine woodland around dead wood and old trees. Nests cells are stocked aphids. No flower-visiting data obtained.

Psenulus chevrieri A very recent addition to the British list that probably has a similar biology to *P. pallipes*. Proving to be widespread in southern Britain but overlooked in the past.

Psenulus concolor Widespread and fairly frequent north to Yorkshire. Nesting occurs variously in old beetle holes in dead wood, hollow twigs/stems, thatched roofs and *Lipara* cigar-galls on common reed. Nest cells are stocked with psyllid bugs. No flower-visiting data obtained but all *Psenulus* species are presumed to visit flowers.

Psenulus pallipes Widespread and frequent over much of southern and central England, scarcer in Wales and the north. Nesting occurs variously in old beetle holes in dead wood, hollow twigs/stems and thatched roofs. The cells are stocked with aphids. Flower visits reported for wild carrot, wood spurge, hogweed, wild parsnip, bramble and weld.

Psenulus schencki Widespread but local in southern and central England (graded Nationally Scarce (Notable A)). Nesting occurs in old beetle holes in dead wood, and hollow twigs/stems. The cells are stocked with psyllid bugs. Has been reported visiting hogweed.

Rhopalum coarctatum Widespread and fairly frequent, the only one of 3 British *Rhopalum* species that regularly uses dead wood as opposed to stems/stalks. Nest cells are stocked with tiny flies and other insects. Visits umbellifers such as angelica, also ivy.

Spilomena troglodytes A tiny wasp (2-3 mm long) that nests variously in tiny beetle holes in dead wood/timber or hollow stems/twigs and stocks its cells with thrips. Reported to visit the flowers of bramble. This is the most frequent *Spilomena*

species. The four other British species (*S. beata*, *S. curruca*, *S. differens* and *S. enslini* are thought to have similar habits.

***Stigmus* species** Two tiny species (*S. pendulus* and *S. solskyi*) that nest in small beetle holes stocking their nest cells with aphids. *S. pendulus* is graded RDBK but has shown a substantial increase in recent years. No flower-visiting data obtained.

***Trypoxylon* species** Five or six British species, several of which are extremely difficult to separate. Some are primarily stem/tube-nesters but others such as *T. medium* can be common around dead wood. Nest cells are stocked with tiny spiders. It is unclear if they visit flowers.

6.4 Pompiilidae (spider wasps)

Represented in Britain by about 45 species, most of which can be identified using Day (1988). The majority seem to be flower-visitors, and they are especially keen on umbellifers and spurges. Some are ground-nesters (sometimes using the earth of exposed root-plates), others develop in aerial cavities and a couple develop within the host spiders's web. The following species are the ones most strongly associated with dead wood:

Auplopus carbonarius A scarce but increasing southern-biased species (graded Nationally Scarce (Notable B)) that nests in a great variety of locations with natural small cavities, including dead wood, living trees and exposed root-plates. Unusually for a spider wasp it uses mud to create nest cells which it stocks with small spiders. Has been recorded visiting spurge flowers.

Dipogon bifasciatus A very scarce species of southern Britain (graded Nationally Rare). Nests are usually made in old insect burrows in dead wood, but cavities in walls and rocks may also be used. Cells are stocked with thomisid (crab) spiders. No flower-visiting data obtained.

Dipogon subintemedius Widespread and fairly frequent over much of England, Scarce in Wales and rare in Scotland. The nest is made in pre-existing cavities, usually crevices or old beetle holes in wood but possibly also in walls, bee hotels and other locations away from wood. The cells are stocked with the spider *Segestria senoculata*. This is the most frequent *Dipogon* in woodland but can occur in a variety of open habitats too. No flower-visiting data obtained.

Dipogon variegatus Widespread in England and Wales. Rare in Scotland. The nest is made in pre-existing cavities, including crevices or old beetle holes in wood but also in walls, bee hotels and other locations away from wood e.g maritime cliffs. The cells are stocked with *Xysticus* crab spiders. No flower-visiting data obtained.

6.5 Sapygidae (sapygid wasps)

Two British parasitoid species, both of which can attack host bees in dead wood.

Monosapyga clavicornis The special parasite of the bee *Chelostoma florisosomne*

(see above). Widespread but rather local in southern Britain (graded Nationally Scarce (Notable B). Visits umbellifers and various daisy-type flowers.

Sapyga quinquepunctata A parasite of various *Osmia* mason bees but especially *Osmia caerulescens*. Widespread and fairly frequent. Visits forget-me-nots, thyme, daisy-type flower, umbellifers, bramble, stonecrops, goldenrods.

6.6 Vespidae (mason and social wasps)

Represented in Britain by about 35 species which include the solitary mason wasps (Eumeninnae) plus the social paper wasps (*Polistes*), yellowjacket wasps (*Vespula*, *Dolichovespula*) and Hornet (*Vespa crabro*). They can be identified using Archer (2014) but the mason wasps are hard to distinguish in the field and much published information for nesting, prey preference and flower-visiting is dubious. Nevertheless, mason wasps and social wasps can be much in evidence around dead wood such as standing dead trees, stumps and log piles. This is usually for nesting in the case of mason wasps but in the case of the yellowjackets and Hornet, it is to scrape off wood fibres to create nesting material. Those most strongly associated with dead wood are listed below but few if any show an obligatory requirement for natural dead wood. They are all keen flower-visitors, especially umbellifers, composites and ivy.

Ancistrocerus antilope Graded Nationally Rare and with only two recent records. It can nest both in twigs and dead wood. Cells seem to be stocked with small moth larvae. Purportedly visits Michaelmas daisy, dwarf elder, privet, sea-holly, spurge and thistles.

Ancistrocerus gazella Widespread and frequent. It can nest in dead wood, twigs, walls and garden bee hotels. Nest cells are stocked with moth larvae. Purportedly visits sea-holly, bramble, hogweed and thistles and goldenrod.

Ancistrocerus nigricornis Widespread and frequent. It can nest in dead wood, twigs, walls and garden bee hotels. Nest cells are stocked with tortricid larvae. A definite flower-visiting record for box and ivy plus purported records for bramble, goldenrod, hogweed, nightshades, yarrow and thistles.

Ancistrocerus parietinus Widespread and frequent. It can nest in dead wood, twigs, walls and garden bee hotels. Nest cells are stocked with small moth larvae. Purportedly visits Sea-holly, bramble, hogweed, goldenrods, thistles and assorted garden flowers.

Ancistrocerus parietum Widespread and frequent. It can nest in dead wood, twigs, walls and garden bee hotels. Nest cells are stocked with small moth larvae. Probably visits similar flowers to *A. gazella* and not easily distinguished from it

Ancistrocerus trifasciatus Widespread and frequent. It can nest in dead wood, twigs, walls and garden bee hotels. Nest cells are stocked with small moth larvae, possibly also leaf beetle larvae. Visits bramble, goldenrod, yarrow.

Microdynerus exilis A local (graded Nationally Scarce (Notable B) but increasing species of southern England that can nest in dead wood of various sorts, also hollow twigs and stems. The nest cells are stocked with small weevil larvae. Visits hawk's-beard, hogweed, mayweeds, asters.

Chrysis viridula A widespread but local species that can occasionally be found using exposed root-plates of fallen trees as a proxy for vertical clifflets.

Symmorphus bifasciatus Widespread and frequent in willow-rich habitats. Nesting can occur in dead wood or hollow stems. Nest cells are stocked with the larvae of the willow-feeding leaf beetle *Phratora vulgatissima*. Visits umbellifers and mayweed-type flowers.

Symmorphus connexus Very scarce (graded Nationally Rare) in southern England using aspen-rich woodland. Nesting can occur in dead wood as well as other locations. Nest cells are stocked with the larvae of the leaf beetle *Zeugophora subspinosa* and the gracillarid moth *Caloptilia stigmatella*. There are purported images of it visiting umbellifers.

Symmorphus crassicornis Very scarce in southern England (graded Nationally Rare), typically within in aspen-rich woodland, or associated with dunes with creeping willow patches (but possibly still benefiting from dead wood here). Nesting can occur in dead wood as well as other locations. Nest cells are typically stocked with the larvae of the leaf beetle *Chryomela populi*. Visits umbellifers.

Symmorphus gracilis Widespread and common in figwort-rich habitats. Nesting can occur in dead wood or hollow stems. Nest cells are stocked with the larvae of *Cionus* weevils taken from figworts. Visits umbellifers, figwort, bramble.

Vespa crabro **(hornet)** This huge social wasp frequently nests in the cavities and crevices of mature trees and is most frequent where big old trees are abundant in the landscape. It also likes the sap-runs of trees infested by Goat Moth and wood-boring beetles. It will hunt other insects here as well as feeding on the sap. However, it can also nest in the roof spaces of buildings, in bird boxes and within the interior of sheds and outhouses. Workers do much of their hunting for prey on flowers but actual feeding on flowers is mainly observed in autumn on ivy.

Other vespine (social) wasps *Vespula vulgaris* (Common Wasp) and *V. germanica* (German Wasp) are generalist cavity nesters and will sometimes use tree cavities but this is much less frequent than using underground cavities such as old rodent burrows or loft spaces. Long-cheeked *Dolichovespula* wasps generally suspend their nests from twigs and could conceivably use an old tree from time to time but there is no particular association with old trees or dead wood other than dead wood as a source of nesting material (which they will also take from fence posts or old stems of plants such as hogweed).

6.7 Hymenoptera Parasitica

This huge group of parasitic wasps (about 5,500 British species) contains numerous families, the best known of which are the ichneumons (Ichneumonidae), braconids (Braconidae), chalcoids (Chalicidoidea) and gasteruptiids (Gasteruptiidae). Very few people record them and they can be extremely difficult to identify. Numerous species target saproxylic insects including wood-boring beetles and sawflies, aerial nesting bees and hunting wasps, assorted saproxylic flies, and fungus-associated moths, beetles and flies. Alexander (2002) furnishes a provisional list of those associated with wood-using hosts. It is known that many (but probably far from all) Parasitica visit flowers but there is very little published information on which species visit what flowers, though umbellifers such as cow parsley and hogweed seem to be the most important in woodland and along hedgerows. The best that can be said is that dead wood, tree wounds and old trees probably help to boost the abundance of flower-visiting Parasitica – indeed the number of species involved might well outnumber all the other species covered in this report. However, they are at best marginal pollinators, picking up little pollen as they feed, and are often small or tiny in size.

7 Important saproxylic features for pollinators

7.1 Living trees

The management of veteran trees is covered in detail by a number of publicatons, notably Read (1996, 2000) and Lonsdale (2013). Definitions are important here (see Alexander, 2008). The ancient and veteran trees described above are sometimes described as moribund but most are still very much alive and can survive for several centuries in that 'moribund' state, representing precious features that support some of our rarest and most endangered insects. In many cases, they are acting as important refuges for saproxylic insect assemblages in a suboptimal environment whilst a new generation of trees matures sufficiently to share and eventually replace that role.

The most important living trees for saproxylic pollinators, especially the rarer ones, are the oldest trees, particularly where the number and density of such trees is relatively high, as in pasture-woodland or historic parkland settings. Island biogeography theory dictates that a single isolated veteran or ancient tree will struggle to sustain a large and secure assemblage of saproxylic insects compared with a collection of such trees. No two veteran or ancient trees are identical in terms of the microhabitats and other features they support so a collection of them will offer a bigger variety of saproxylic conditions than a single tree, and will offer a greater quantity and continuity of those key microhabitats so that there is less likelihood of losing any key saproxylic insects associated with them. This is the thinking that underpins the Index of Ecological Continuity grading system for beetles in veteran trees settings, and the data it has produced explicitly demonstrates this reality (e.g. Alexander, 1998).

The conditions and microhabitats associated with older trees are many (Alexander, 1999; Lonsdale, 2013; Falk, 2014). Subtle variation within any one of those conditions can render them suitable or unsuitable for a particular saproxylic insect. The exact tree species involved can be important for some insects but in many cases, it is the type of feature or rot-type, the fungus involved, or the age and location of the tree that matters more. Location of a tree can be especially important. An old tree in a very open and exposed setting can support a very different saproxylic assemblage to a tree in a more densely-wooded, humid, sheltered valley. Geographic location is also important. The more thermophilic species will tend to favour southern Britain. The following summarises the main features of a living tree used by saproxylic pollinators:

7.1.1 Heart-rot and decaying underground roots Heart-rot can become initiated in surprisingly young trees but is best formed and most complex in older trees with greater girth. The character of heart-rot can vary according to the trees species, the location of the tree (e.g. open-growing versus closed canopy), the age of the decay, the fungi involved, the wetness of the wood, the invertebrate assemblage feeding on it, and whether bird nesting or bat activity is present in any associated cavities. A high proportion of the species covered in this report can develop in heart-rot. Some beetles require it in a fairly dry state and often specifically red-rotted/brown-rotted

A red-rotten oak in the depths of Windsor Forest.

(e.g. *Pedostrangalia revestita*, *Ampedus elongantulus*, *A. quercicola* and *Scraptia testacea*) and within trees that are warmed by sunshine (Lindhe, Lindelow & Asenblad, 2005). Others prefer white rot (e.g. *Platycis minutus*, *Pyropterus nigroruber* and *Ischnomera cyanea*. Various hoverflies (*Brachypalpus lentus*, *Brachypalpoides laphriformis*, *Caliprobola speciosa and Criorhina* species) require damp rotting wood that has a soft consistency. They tend to use the wettest heart-rot at the bottom of a trunk and within the decaying dead roots. Some of our rarest beetles (e.g. *Gnorimus variabilis*), appear to specifically require the heart-rot of

veteran and ancient living trees. Others can also use that of dead hulks, stumps and fallen trunks.

7.1.2 Rot-holes and cavities These vary greatly in size and configuration. They can be low in a tree or many metres high, especially those in trees such as beech. They can have small entrances or large, gaping ones and vary in the volume of liquid they contain. They are generally more numerous in a large mature tree (especially an unpollarded one that has a full crown) but can also form in non-ancient trees and even relatively small trees and shrubs such as hawthorn and orchard trees.

Rot-holes are particularly important for saproxylic pollinators when filled with water and submerged decaying wood-debris and other organic matter. The water can contain micro-organisms for filter-feeding fly larvae. Small dipterous larvae and other small invertebrates developing in rot-holes can provide a food source for predatory dipterous larvae such as those of the muscid fly *Phaonia exoleta*. The hoverfly assemblage of wet rot-roles is particularly interesting and includes several spectacular species including *Pocota personata*, *Mallota cimbiciformis*, *Callicera aurata* and *C. spinolae*, also the smaller but internationally rare *Myolepta potens*. Tree species is often not too crucial for these though beech stands out as a tree that is singularly good at producing lots of good rot-holes by the time it is 200 years old, and that is probably why so many good records are associated with it. *Callicera rufa* is specific to water-filled rot-holes of old conifers, particularly pines with bifurcating trunks. *Myathropa florea* and *Xylota xanthocnema* can use rot-holes in both broadleaved and coniferous trees.

Dry rot-holes and cavities may support the nesting of Tree Bumblebee *Bombus hypnorum*, Hornet *Vespa crabro* and other social wasps; also valuable over-wintering sites for non-saproxylic fly pollinators such as the hoverflies *Eristalis tenax* and *Episyrphus balteatus*, *Pollenia* cluster flies (Calliphoridae) and the queens of social wasps. If they contain bird nests, bat shelters and the homes of other mammals, they can provide a suite of further conditions for saproxylic or generalist pollinators with scavenging or saprophagous larvae such as assorted *Fannia* fly species and the beetle *Trinodes hirtus* which is associated with spider webs.

7.1.3 Sap-runs and sappy wounds Sap-runs are the external manifestation of sappy wounds caused by physical damage to a tree such as twisting during a gale, the activity of wood-boring insects such as Goat Moth *Cossus cossus*, or diseases such as chestnut canker and bacterial wetwood. The best sap-runs are the large, smelly, fermenting ones that are associated with old oaks, but smaller and inconspicuous sap-runs can occur in most broadleaved tree species. Sappy wounds can also occur beneath bark, hidden from view but still accessible to saproxylic insects. Saproxylic pollinators associated with sap-runs include hoverflies of the genera *Brachyopa* and *Ferdinandea*, *Psilota anthracina*, *Volucella inflata* and probably *Hammerschmidtia ferruginea* (using sap-runs in living aspen when no freshly-fallen aspen trees are available); also muscid flies such as *Phaonia cincta* and *P. laeta*. Flower-visiting beetles include nitidulids such as *Soronia grisea* and *Epuraea* species. It should be noted that many species using sap-runs in living trees can also take advantage of the

Sap-runs

A pungent, fermenting sap-run on an old apple tree.

Volucella inflata

Brachyopa bicolor

Ferdinandea cuprea

Phaonia laeta

short-lived sappy decay period that takes place under the bark of recently fallen trees or detached large limbs. Aside from acting as a breeding site, sap-runs are visited by a variety of adult insects as a source of liquid food (Fox Wilson, 1926; Godfrey & Whitehead, 2001; Wolton & Luff, 2016). This includes Hornet, Red Admiral *Vanessa atalanta*, Purple Emperor *Apatura iris*, night-flying moths, plus assorted flies and beetles of a saproxylic or non-saproxylic nature.

7.1.4 Attached dead limbs and exposed dry heartwood Attached dead limbs of the crown can be important for flower-visiting beetles such as *Grammoptera ustulata*, *Stenurella nigra* and *Orchesia undulata*. The dry dead wood with beetle exit holes that dead limbs often contain can also provide a nesting location for many of the aerial-nesting wasps and bees described in section 6. This also applies to the dry exposed heartwood that can occur on the trunks of trees that have lost sections of bark. The bees and wasps need this exposed wood in reasonably sunny locations such as woodland edge and along rides and clearings – they cannot use it in permanent shade because the wood cannot warm up sufficiently and is often too damp.

7.1.6 Fungi of living trees Many species of fungi can grow on a living tree and help to shape the saproxylic microhabitats that develop. Several hundred species of beetle, fly and moth can use the fruiting bodies of these fungi for larval development, though relatively few seem to be flower-visitors.

7.1.7 Ivy-clad trees Ivy is often viewed as a threat to trees and something that should be prevented from growing up a trunk. In reality, it often coexists happily with a living tree, even a veteran or ancient one. Its liana-like growth produces an extra series of external habitats on a tree, but from a pollinator perspective, it is the pungent autumn blossom that is important. That blossom is generally the final big feed of the year for pollinators – mostly non-saproxylic ones, but including the large hoverfly *Callicera spinolae* (which breeds in rot-holes), *Ferdinandea cuprea* (which breeds in sap-runs) and the semi-saproxylic Hornet. The dense evergreen foliage and entwined stems of ivy may provide hibernation sites for some saproxylic pollinators.

7.2 Dead trees and detached dead wood

7.2.1 Stumps and standing hulks These can support some of the conditions found in old living trees but death unleashes an explosion of fungus and invertebrate-driven decay that eventually produces late-decay conditions that suit different saproxylic insects to those associated with old, living trees. Again, many species are more influenced by the type and state of decay, and the location of the stump or hulk, than the tree species involved. However, there are some rare Caledonian pine forest specialists such as the beetles *Anastrangalia sanguinolenta* and *Dictyoptera aurora* and the hoverfly *Blera fallax* that rely on Scot's pine. *Blera fallax* is actually a rot-hole species but prefers these rot-holes in large pine stump (as opposed to a living tree) that has become partly hollowed out by fungal activity and filled with water and wood-detritus. It needs these stumps in more shaded locations where they are not prone to drying out and is not really a species of classic open-structured pine woodland. It often shares this breeding habitat with more generalist rot-hole

Semi-submerged woody debris

The River Dene near Combrook, Warwickshire, a site for hoverflies that require semi-submerged dead wood.

Chalcosyrphus eunotus © Andy Jukes

Sphegina clunipes

hoverflies such as *Sphegina clunipes* and *Myathropa florea*, and ocasionally with another conifer-associated species, *Callicera rufa* (Rotheray, E., 2013).

7.2.2 Fallen trees and detached limbs These can be particularly interesting in the first 1-3 years as the sappy cambium layer under the bark decays. Several hoverflies target this decay, including *Hammerschmidtia ferruginea* (aspen), *Brachyopa pilosa* (especially beech and aspen), *Sphegina* species and some *Xylota* species. As a generalisation, lying dead wood in damper, shadier places suits flies better than beetles. Aerial-nesting bees and wasps can only use dead wood where it is dry and in

reasonably sunny spots. Semi-submerged timber in wooded streams is the special breeding location for the hoverfly *Chalcosyrphus eunotus* (Godfrey, 2003; Jukes, 2010). Its larvae develop under the soggy bark that is not submerged. They often share this location with the more generalist larvae of *Chalcosyrphus nemorum* and *Sphegina* species (Jukes, 2010). *Xylota florum* also seems to like semi-submerged wood of both broadleaved and coniferous trees but is less well studied.

Fallen pine wood is important for a number of very rare beetles entirely or largely restricted to ancient Caledonian pine woodland. These include *Anastrangalia sanguinolenta*, *Rhagium inquisitor*, *Dictyoptera aurora* and *Chrysanthia nigricornis*.

7.2.3 Exposed root-plates When a tree falls over, the root-plate generally lifts up large quantities of earth which can be clay-rich, loamy or sandy depending on the soil on which the tree was growing. That elevated earth will tend to become much drier than that of the surrounding land surface which makes it ideal for ground-nesting bees (e.g. *Anthophora*, *Andrena*, *Halictus* and *Lasioglossum* species) and wasps (e.g. *Crossocerus* and pompilid species) that might typically use the earth of a clifflet, bare slope or well-trodden track. If the wind-blown tree is in a damp location such as wet heath or wet woodland, those root-plates may end up being the only features suitable for ground-nesting bees and wasps. Ground-nesting bees can, in turn, attract cleptoparasites and parasitoids that are themselves flower-visitors such as nomad bees (*Nomada*), blood bees (*Sphecodes*), *Bombylius* beeflies, (Bombyliidae), *Leucophora* flies (Anthomyiidae) and *Myopa* bee-grabbers (Conopidae). In more wooded locations of places such as SW England, it is even possible that the larvae of oil beetles such as *Meloe violaceus* could be exploiting *Andrena* nests in root-plates.

7.2.4 Fungi of dead trees and detached timber Despite this habitat supporting many species of fungivorous insects and their predators, relatively few species are proven flower-visitors – possibly just a few fungus gnats, plus fanniid, anthomyiid and muscid flies.

8 Important flowers for saproxylic pollinators

8.1 General

Saproxylic pollinators of one species or another can be on the wing from March until October, at least in the warmer parts of southern Britain. Some multiple-brooded species such as the hoverflies *Ferdinandea cuprea* and *Myathropa florea* can be seen for much of that period but the majority of saproxylic pollinators have shorter flight periods with a pronounced peak of abundance. The timing of the flight period and its peak, the habitat(s) used, the geographic location, and local land-use will tend to dictate what flowers are being used by a saproxylic species.

Checking the species accounts and the plant list in Appendix 1 reveals the tremendous variety of blossoming trees, blossoming shrubs and herbaceousflowers visited by adult saproxylic insects. The species accounts also reveal which blossoms and flowers are most popular, in the sense of most used. These are categorised and reviewed below.

8.2 Spring-blossoming trees and shrubs.

8.2.1 Hawthorns Common hawthorn comes out as the most popular blossom by a substantial margin. There are three main reasons for this: i) it is very common in most districts and often the most abundant blossoming shrub near to old trees and dead wood; ii) the flowering peak coincides with the emergence peak of many saproxylic pollinators in May and early June; iii) it is sometimes the only substantial late-spring pollen and nectar source in a well-grazed deer park with species-poor grassland, in woodland lacking a decent ground-flora, or in hedged farmland with species-poor pasture or lacking flowery arable margins. Hawthorn is visited by most of the longhorn beetles, click beetles and hoverflies listed in this report. Be aware that in upland areas it can peak up to a month later than in southern lowland areas (typically early June). Midland hawthorn is probably just as good as common hawthorn but is much scarcer and often not distinguished from it when recording flower-visiting. Introduced *Crataegus* species such as broadleaved cockspur thorn or hybrid cockspur thorn are potentially valuable in more urbanised and formal settings and have a flowering peak a little after wild hawthorns. Cultivated hawthorns with double flowers e.g. 'Paul's scarlet' and 'punicea flore plena' attract little pollinator activity.

8.2.2 Plums, cherries etc. The genus *Prunus* is very important and the species it contains can produce a valuable 2-3 month blossom sequence in many areas. This can start with cherry plum in late February, followed by blackthorn and bullace by late March, then wild cherry, cherry laurel, bird cherry, with Portugal laurel completing the sequence in late May and early June. Cherry plum and blackthorn peak before the main activity peak of saproxylic pollinators but the early-flying hoverfly *Criorhina ranunculi* is particularly keen on blackthorn. Wild cherry can be especially valuable in ancient woodland and both it and bird cherry are important in places like the Scottish Highlands where hawthorn can be scarce. Cherry laurel and Portugal laurel are both invasive in woodland and can damage its value if they become too dominant but they are a well-established element of many suburban

Blossoming hawthorn in a ride at Wytham Woods, Oxfordshire.

Blossoming cherry laurel at Wytham Woods, Oxfordshire.

settings, historic parks and gentrified old woods. Their blossom can pull in lots of saproxylic pollinators, and is very useful when trying to record the presence of hoverflies such as *Pocota personata*, *Criorhina species* and *Brachyopa* species. There

is a good chance that single-flowered (5 petals per flower) ornamental cherries within formal settings, such as Fuji cherry and hybrid varieties such as 'Pandora' or 'Umineko' are attractive too, and these can often occur in parklands alongside mature trees such as nineteenth-century beech and sycamore with rot-holes and other saproxylic features. Again, these ornamental cherries produce a long blossom sequence in parallel with wild species but the double-flowered varieties such as 'Kanzan' and 'Shogetsu' are of little value for pollinators.

8.2.3 Willows and sallow These tend to peak a little before the main activity peak of saproxylic pollinators but goat willow and grey willow (sallow) are much used by *Criorhina ranunculi*. They can be valuable in places like the Scottish Highlands where they flower later than in the south (even into June) and often in places where both hawthorns and *Prunus* species are scarce. Again, they provide a lengthy blossom sequence that starts with goat willow in early March and can finish with the assorted tree-willows in May.

8.2.4 Rowans and whitebeams *Sorbus* species tend to be less abundant in the landscape than the previous genera but rowan can sometimes be the main blossom in the depths of ancient broadleaved woods and in Caledonian pine woodland, at roughly the same time as hawthorn blossoms. It can attract many of the saproxylic hoverflies listed and some of the longhorns too, including the very rare *Anastrangalia sanguinolenta*. Relatively few records were obtained for usage of other *Sorbus* species. This might be because they are generally infrequent in old woods, parkland and pasture-woodland but also because they are often tall, trunked trees with pollinator activity generally very high up and hard to observe (e.g. wild service-tree).

8.2.5 Others Further spring blossoms of value include dogwood, guelder-rose, holly, maples (including sycamore), apples, pears, privets, alder-buckthorn and elder. Elder is notorious for not attracting much in comparison with rosaceous blossom but this review has picked up quite a few records for it and it is a favourite blossom for the Section 41 conservation priority Noble Chafer *Gnorimus nobilis*. Records for non-native shrubs such as *Photinia* in Syrph the Net (Speight, 2016) are probably from the Continent but reveal the potential value of garden shrubs (including pyracantha, buddleia, cotoneasters and viburnums) in more formal or urbanised British settings where old trees and dead wood are present.

8.3 Brambles and roses

Rubus species (brambles, dewberry, raspberry and relatives) are without doubt some of the most important summer flowers for saproxylic pollinators and tend to replace the shrubs in 8.2 from the end of spring, peaking in June and July. The flowers are much used by longhorn beetles and hoverflies such as *Criorhina* species and *Callicera aurata*. Rose flowers attract many of the same species as bramble but are generally less attractive to pollinators than bramble flowers.

8.4 Ivy and other climbers/scramblers

Ivy is typically the final big feed of the season for pollinators – mostly non-saproxylic

A bramble-fringed ride at Wappenbury Wood, Warwickshire.

ones, but also including the large hoverfly *Callicera spinolae* (breeds in rot-holes), *Ferdinandea cuprea* (breeds in sap-runs) and also the semi-saproxylic hornet. Other climbers such as white bryony, wild honeysuckle, bindweeds and woody nightshade are also used by saproxylic pollinators to a small extent. No records for traveller's-joy were encountered but there is a good chance it will be used.

8.5 Herbaceous flowers

8.5.1 Umbellifers Within the family Apiaceae, cow parsley and hogweed are probably the two most important wildflowers for saproxylic pollinators. This in part stems from their abundant and semi-ubiquitous nature, often in areas supporting old trees and dead wood, plus the fact that their flowering coincides with the main activity peaks of many saproxylic pollinators. Their flowers are also designed to provide plentiful nectar and pollen for a wide range of insects with the minimum of fuss. Many of the insects listed in this report use these two plants. Other umbellifers such as upright hedge-parsley, wild parsnip and angelica are certainly attractive to pollinators but peak too late to match the popularity of cow parsley and hogweed. However, they are important for aerial-nesting hunting wasps such as *Ectemnius* and *Crossocerus* species plus *Hylaeus* bees.

8.5.2 Other flowers From the large family Asteraceae (composites) creeping thistle, yarrow and oxeye daisy come out top, attracting many of the listed hoverflies and longhorn beetles. Additional flowers that are well-represented in the species accounts include buttercups, scabiouses, cinquefoil, meadowsweet and wood spurge. Legumes (Fabaceae) and labiates (Lamiaceae) are important for some of the bees listed, notably *Anthidium manicatum*, *Anthophora furcata*, some *Megachile*

Hogweed in a ride at Wytham Woods, Oxfordshire.

species and some *Osmia* species. Other tight floral associations worth mentioning include buttercups for the bee *Chelostoma florisomne* and *Campanula* species (harebell and bellflowers) for the smaller *C. campanularum*. The very rare *Osmia pilicornis* is almost entirely dependent upon in bugle for pollen, and the pinewood speciality *Osmia uncinata* does most of its foraging on common bird's-foot trefoil.

8.6 Conclusions

Plentiful blossom and flowers that can provide pollen and nectar sources between early spring and mid-autumn are crucial for many saproxylic pollinators. It is important to be aware of seasonality and the blossom and flowering sequences at play so that temporal gaps in floral provisions can be identified. Once identified, the shortfalls can be addressed variously by tree/shrub planting, seeding of wildflowers or modifying site management, for example by not mowing woodland rides, nearby field margins or road verges during important flowering peaks, and not ivy-stripping all the trees of an area.

9 Further discussion

9.1 Ecosystem services (pollination) provided by saproxylic insects

Do saproxylic insects make a big contribution to the pollination of blossoming trees, shrubs, wildflowers and crops close to where they develop? There seems to be little hard data on the subject, though the author has accumulated enough field days to postulate a little. Saproxylic species are rarely, if ever, the most abundant insects on any blossom or flower species. Species developing variously in dung, carrion, earthworms, shallow water, or (in the case of about half of Britain's hoverflies) with predatory, aphid-feeding larvae, are typically much more abundant than saproxylic species. What is more, the saproxylic beetles and wasps that visit flowers are not particularly effective pollinators as they pick up little pollen on their bodies, and do not move particularly actively between flowers, which is one of the fundamental prerequisites of an effective pollinator. Even some of saproxylic hoverflies seem to be reluctant flower-visitors e.g. most *Xylota* species, *Callicera rufa*, *Chalcosyrphus eunotus* and *Brachypalpus laphriformis*.

Any substantial contribution to pollination that is made by saproxylic insects will probably arise from the following:

- *Osmia bicornis* (Red Mason Bee) nesting in standing dead trees and pollinating assorted spring-blossoming trees and shrubs, any nearby orchard trees, and any oilseed rape in the vicinity.
- Larger, furrier hoverflies (e.g. *Criorhina* species, *Pocota personata*, *Mallota cimbiciformis, Myathropa florea*) foraging on spring-blossoming shrubs and assorted herbaceous flowers.
- Any feral honey bee nests within in tree cavities, which can pollinate a tremendous variety of species over a large area from from early spring until late autumn.

In summary, the contribution is probably a fairly minor one, but it can involve some rare and unusual species and there can be little doubt that saproxylic habitats enhance the abundance and diversity of pollinating insects in many areas.

9.2 Key places to see saproxylic pollinators

Almost any location with mature trees and dead wood can produce sightings of saproxylic pollinators in spring and summer. The author is based in Warwickshire and used to be the City Ecologist for Coventry, surveying and evaluating greenspace of all sorts all over the city. During the 1990s, Tile Hill Wood at the edge of the city produced records of numerous saproxylic hoverflies including *Brachypalpoides lentus*, *Brachyopa pilosa*, *Chalcosyrphus nemorum*, *Criorhina asilica*, *C. floccosa*, *C. berberina*, *Ferdinandea cuprea*, *Xylota abiens*, *X. segnis*, *X. sylvarum*, *X, tarda* and *X. xanthocnema*. This is impressive by national standards. In 1999, the author added the elusive Logjammer Hoverfly *Chalcosyrphus eunotus* to the Warwickshire list from a suburban stream at the edge of Leamington Spa. Many other towns and cities with active entomologists will have similar stories and interesting species have even been

Caledonian pine woodland

Open-structured Caledonian pine woodland (Mar Lodge Estate, Cairngorms).

Anastrangalia sanguinolenta

Rhagium inquisitor

Callicera rufa

Blera fallax

recorded from royal parks in the centre of London where mature trees often occur in settings full of exotic blossoms and flowers. The most important areas nationally for saproxylic pollinators tend to be the same ones identified as important for saproxylic beetles generally through the Index of Ecological Continuity. These include the New Forest, the Windsor Forest/Great Park area, Epping Forest and Moccas Park. Those with open-grown trees tend to be best for the beetles. Those with old trees and dead wood within denser and more humid woodland tend to be best for hoverflies.

For pine and conifer specialists, the Caledonian pinewoods of the Cairngorms area (e.g. Abernethy Forest, Rothiemurchius Forest and the Mar Lodge Estate) seem to have the finest assemblages though many other areas have yet to be surveyed in detail and the value of small scraps of native pine woodland in more sheltered valley bottoms of Speyside and Deeside may be under-estimated.

9.2 Areas for further study

The recording and understanding of saproxylic invertebrates in Britain is probably the best anywhere in the world but is still far from complete. With so much pressure on the countryside and a general trend for slow deterioration of many key sites, study and active conservation must continue. Three themes for ongoing research are highlighted:

- Learn more about the ecology and distribution of individual species, including larval development plus adult foraging and behaviour.
- Better recording of key sites and other potentially important locations.
- Studying the impacts of different habitat management regimes on saproxylic pollinator assemblages to help develop a range of best practice scenarios.

The parties that could be involved in this include entomological societies and recording schemes, academia, conservation charities, and statutory agencies. There may be potential for citizen science too, focussing on more easily-recognised species. This has already been successfully achieved by the People's Trust for Endangered Species such as the Noble Chafer *Gnorimus nobilis*: https://ptes.org/campaigns/noble-chafer-beetles/; also the saproxylic non-pollinator Stag Beetle *Lucanus cervus* through *The Great Stag Hunt*: https://ptes.org/get-involved/surveys/garden/great-stag-hunt/stag-hunt-survey/.

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The Wildlife garden at Regents Park, London where a variety of blossoms, plus flowers such as cow parsley, can serve saproxylic insects developing in the Park's mature trees.

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Appendix 1 - Scientific names of trees and other plants mentioned

Alder *Alnus glutinosa*
Alder-buckthorn *Frangula alnus*
Apples *Malus* species
Arum-lily - possibly *Zantedeschia aethiopica*
Ash *Fraxinus excelsior*
Aspen *Populus tremula*
Bedstraw(s) *Galium* species
Beech *Fagus sylvatica*
Bellflowers *Campanula* species
Bilberry *Vaccinium myrtillus*
Bindweed *Calystegia* or *Convolvulus* species
Birch(es) *Betula* species
Bird Cherry *Prunus padus*
Bird's-foot trefoil(s) *Lotus species*
Black Cherry *Prunus serotina*
Black Horehound *Ballota nigra*
Black Poplar *Populus nigra*
Blackthorn *Prunus spinosa*
Bluebell (native) *Hyacinthoides non-scripta*
Box *Buxus semervirens*
Box honeysuckle *Lonicera nitida*
Bramble(s) *Rubus fruticosus* agg. (often extended to cover *R.caesius*)
Bridewort *Spiraea* species
Broad-leaved cockspur thorn *Crataegus persimilis*
Broom *Cytisus scoparius*
Buddleia *Buddleja davidii*
Bugle *Ajuga reptans*
Bullace *Prunus institia*
Burdock(s) *Arctium* species
Burnet-saxifrage *Pimpinela saxifraga*
Buttercups *Ranunculus* species
Campion *Silene* species
Cat's-ear *Hypochoeris radicata*
Cherry Laurel *Prunus laurocerasus*
Cherry Plum *Prunus cerasifera*
Chicory *Cichorium intybus*
Colt's-foot *Tussilago farfara*
Common Bird's-foot Trefoil *Lotus corniculatus*
Common Fleabane *Pulicaria dyssenterica*
Common Hawthorn *Crataegus monogyna*
Common Lime *Tilia* x *europaea*
Common Ragwort *Jacobaea vulgaris*
Common Reed *Phragmites australis*
Common Rockrose *Helianthemum nummularium*
Common Valerian *Valeriana officinalis*

Common Vetch *Vicia cracca*
Common Whitebeam *Sorbus aria*
Composites – family Asteraceae
Cornsalad *Valerianella* species
Corn Sowthistle *Sonchus arvensis*
Corsican Pine *Pinus nigra*
Cotoneasters *Cotoneaaster* species
Cowbane *Cicuta virosa*
Cow Parsley *Anthriscus sylvestris*
Crab Apple *Malus sylvestris*
Cranesbills *Geranium* species
Creeping Buttercup *Ranunculus repens*
Creeping Thistle *Cirsium arvense*
Creeping Willow *Salix repens*
Cross-leaved Heath *Erica tetralix*
Cuckoo flower *Cardamine pratense*
Damson *Prunus institia*
Dandelion(s) *Taraxacum* species
Devil's-bit Scabious *Succisa pratensis*
Dewberry *Rubus caesius*
Dog Rose *Rosa canina*
Dogwood *Cornus sanguineum*
Douglas Fir *Pseudotsuga menziesii*
Dwarf Elder *Sambucus ebulus*
Elder *Sambucus nigra*
Elm(s) *Ulmus* species
Enchanter's Nightshade *Circaea lutetiana*
Everlasting peas *Lathyrus latifolius* and *L. sylvestris*
Eyebright *Euphrasia* species
False Acacia *Robinia pseudoacacia*
Field Bindweed *Convolvulus arvensis*
Field Maple Acer *campestre*
Field Speedwell *Veronica arvensis*
Figwort(s) *Scrophularia* species
Fir(s) *Abies* species
Fleabane (Common Fleabane) *Pulicaria dysenterica*
Fool's Watercress *Apium nodiflorum*
Forget-me-not *Myosotis* species
Foxglove *Digitalis purpurea*
Fuji cherry *Prunus incisa*
Garden Privet *Ligustrum ovalifolium*
Garlic Mustard *Allaria petiolata*
Giant Bellflower *Campanula latifolia*
Giant Scabious *Cephalaria gigantea*
Goat Willow *Salix caprea*
Goldenrod(s) *Solidago* species
Goldenrod (native) *Solidago virgaurea*

Gorse(s) *Ulex* species
Great Burnet *Sanguisorba officinalis*
Great Mullein *Verbascum thapsus*
Grey Poplar *Populus* x *canescens*
Grey Willow *Salix cinerea*
Ground Elder *Aegopodium podagraria*
Ground-ivy *Glechoma hederacea*
Guelder-rose *Viburnum opulus*
Gypsywort *Lycopus europaeus*
Harebell *Campanula rotundifolia*
Hawkish composites – composites resembling Cat's-ear and hawkweeds
Hawksbeard(s) *Crepis* species
Hawkbits *Leontodon* and *Scorzoneroides* species
Hawkweed *Hieracium* and *Pilosella* species
Hawkweed Oxtongue *Picris hieracioides*
Hawthorn(s) *Crataegu*s species (typically *C. monogyna* or *C. laevigata*)
Hazel *Corylas avellana*
Heather (Ling) *Calluna vulgaris*
Heathers *Calluna vulgaris* and *Erica* species
Hemlock *Conium maculatum*
Hemlock Water-dropwort *Oenanthe crocata*
Hemp-agrimony *Eupatorium cannabinum*
Hoary Cress *Lepidium draba*
Hogweed *Heracleum sphondylium*
Holly *Ilex aquifolium*
Honeysuckle(s) *Lonicera* (probably *L. periclymenum*)
Hornbeam *Carpinus betulus*
Horse Chestnut *Aesculus hippocastanum*
Horse chestnuts *Aesculus* species
Hybrid cockspurthorn *Crataegus x lavallei*
Ivy *Hedera helix*
Juniper *Juniperus* species
Knapweed(s) *Centaurea* species (probably mostly *C. nigra*)
Knotgrass *Polygonum* species
Labiates – family Lamiaceae
Larch(es) *Larix* species
Lesser Celandine *Ficaria verna*
Lesser Spearwort *Ranunculus flammula*
Lilic *Syringa* species
Lime(s) *Tilia* species
Maple(s) *Acer* species
Marjoram *Origanum* species
Marsh-marigold *Caltha palustris*
Marsh Thistle *Cirsium palustre*
Marsh Valerian *Valerian dioica*
Mayweeds – *Matricaria* and *Tripleurospermum* species
Meadow Foxtail *Alopecurus pratensis*

Meadow-rues(s) *Thalictrum* species
Meadow Thistle *Cirsium dissectum*
Meadowsweet *Filipenula ulmaria*
Meadow Vetchling *Lathyrus pratensis*
Melancholy Thistle *Cirsium heterophyllum*
Mexican Orange Blossom *Choisya ternata*
Michaelmas Daisy/Daisies *Aster* species
Midland Hawthorn *Crataegus laevigata*
Mint(s) *Mentha* species
Mugwort *Artemisia vulgaris*
Mullein(s) *Verbascum* species
Narrow-leaved Ash Fraxinus angustifolia
Nightshades probably *Solanum* species as used here
Nipplewort *Lapsana communis*
Norway Maple *Acer platanoides*
Oak(s) *Quercus* species (probably *Q. robur* or *Q. petraea*)
Oil-seed Rape *Brassica napus*
Oxeye Daisy *Leucanthemum vulgare*
Pear(s) *Pyrus* species
Peony *Paeonia* species
Perforate St John's wort *Hypericum perforata*
Pine(s) *Pinus* species
Plantain *Plantago* species
Plum *Prunus domestica*
Poplar(s) *Populus* species
Portugal Laurel *Prunus lusitanica*
Privet(s) *Ligustrum* species
Purging Buckthorn *Rhamnus cathartica*
Pyracantha *Pyracantha coccinea*
Pyramidal Orchid *Anacamptis pyramidalis*
Ragwort(s) *Jacobaea* species
Ramsons *Allium ursina*
Raspberry *Rubus idaeus*
Red Elder *Sambucus racemosa*
Restharrow(s) *Ononis* species
Rhododendron *Rhodendron* species
Rose(s) *Rosa* species
Rough Chervil *Chaerophyllum temulentum*
Rowan *Sorbus aucuparia*
Rosebay Willowherb *Chamerion angustifolium*
Sallow (Grey Willow) *Salix cinerea* (occasionally used more loosely for similar shrubby willows)
Sanicle *Sanicula europaea*
Scabiouses – *Knautia*, *Scabiosa* and *Succisa* species
Scentless Mayweed *Tripleurospermum inodorum*
Scots Lovage *Ligusticum scoticum*
Scots Pine *Pinus sylvestris*

Sea Holly *Eryngium* species (use here could refer to garden varieties)
Shrubby Hares-ear *Bupleurum fruticosum*
Siberian Iris *Iris sibirica*
Smooth Hawk's-beard *Crepis capillaris*
Sour Cherry *Prunus cerasus*
Sowthistles *Sonchus* species
Spear Thistle *Cirsium vulgare*
Speedwell(s) *Veronica* species
Spindle(s) *Euonymus* species
Spiraea *Aduncus* or *Spiraea* species (but occasionally used for Meadowsweet)
Spruce(es) *Picea* species
Spurges *Euphorbia* species
Stitchwort *Stellaria* species
St John's worts *Hypericum* species
Stonecrops *Sedum* species
Strawberry *Fregaria* species
Sweet Chestnut *Castanaea sativa*
Sycamore *Acer pseudoplatanus*
Tansy *Tanacetum vulgare*
Teasel *Dipsacus fullonum*
Thistles - typically *Cirsium* and *Carduus* species
Thrift *Armeria* species
Thyme(s) *Thymus* species
Tormentil *Potentilla erecta*
Traveller's Joy *Clematic vitalba*
Turkey Oak *Quercus cerris*
Umbellifers – family Apiaceae
Upright Hedge-parsley *Torilis japonica*
Valerian – *Valeriana* (probably *V. officinalis*)
Violets – *Viola* species in part
Water-dropworts *Oenanthe* species
Water Mint *Mentha aquatica*
Water-plantain *Alisma plantago-aquatica*
Wayfaring tree *Viburnum lantana*
White Bryony *Bryonia dioca*
White Clover *Trifoilium repens*
Wild Angelica *Angelica sylvestris*
Wild Carrot *Daucus carota*
Wild Cherry *Prunus avium*
Wild Marjoram *Origanum vulgare*
Wild Mignonette *Reseda lutea*
Wild Parsnip *Pastinaca sativa*
Wild Privet *Ligustrum vulgare*
Wild Service-tree *Sorbus torminalis*
Wild Thyme *Thymus polytrichus*
Willow(s) *Salix* species
Willowherb(s) *Chamerion* and *Epilobium* species

Wood Anemone *Anemone nemorosa*
Wood Spurge *Euphorbia amygdaloides*
Woody Nightshade *Solanum dulcamara*
Woundworts *Stachys species*
Wych Elm *Ulmus glabra*
Yarrow *Achillea millefolium*
Yew *Taxus baccata*

Appendix 2 – 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 of the

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.