Mill Coppice, Malvern: five acres of ancient woodland biodiversity.

Study by Malvern U3A Natural History Group 2021-2

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Area of Outstanding Natural Beauty

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Mill Coppice from the NW taken from the track leading to Storridge. This shows Mill Coppice on the ridge, the valley of Whippets Brook, the northern end of the Malvern Hills and, in the distance, the Severn plain, Bredon Hill and the Cotswold scarp.

Introduction

Mill Coppice is a small wood of 2.3 hectares (c. 5 acres) that covers the steep western slope of a limestone capped hill and some flatter land beyond its northern end. It is situated c. 1 km north of the edge of the built-up area of Malvern. Species present indicate that it is ancient woodland and it is shown on maps of the early nineteenth century.[1] [2]

The diversity of habitats and plant life within the wood was the stimulus for a study of its natural history that was planned and undertaken by members of the Malvern University of the Third Age natural history group between autumn 2021 and autumn 2022. The study confirmed the richness of the plant, animal and other life that was present and investigated how this related to the features of the site, including its geology, aspect and human interventions over the centuries.

Active study participants were: Moira Jenkins, Cherry Greenway, Lynn Clearwaters, David Barber, Richard Edwards, David Taft and Tim Carter (who co-ordinated the project and composed this report), with assistance both from other members of the U3A Group and from Mike Pullen (birds), Diana Dine (soils), Gerry Davies and Janet Parry (plant species list).

This report reviews the main findings from the study and indicates the importance of preserving and nurturing the wood as well as showing how it could be used to help others learn about woodland ecology.

Location references, such as (a9), are described on page 9 and shown on Figure 8, page 10.

Contents **Page**

[1] Sources relevant to this study include the books of Oliver Rackham on English woodlands,
Thomas PA. *Trees.* Collins New Naturalist, 2022.
Fieldwork for Atlas 2020: a beginners guide to recording. Atlas_2020_beginners_guide.pdf.
Rapid Woodland Assessment. Plantlife. Rapid_woodland_assessment_WEB.pdf.
The Woodland Heritage Manual. Woodland Heritage Manual Revised Version.pdf.

[2] Hill A. *Plant species as indicators of ancient woodland in the Malvern Hills and Teme Valley natural area.* PhD Thesis, University College, Worcester (2003). Level 4 The Hive, Worcester.

1. The setting of Mill Coppice.

Figure 1. Location of Mill Coppice: the woodland area east of the Geopark and Worcestershire Ways. Crown copyright Ordnance Survey.

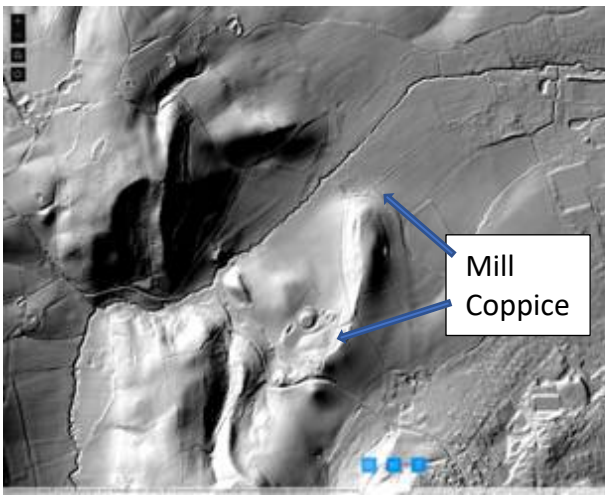

Figure 2. Mill Coppice, on west of promontory and extending almost to Whippets Brook, the stream flowing across this Lidar scan. Open access Lidar data

Access to the coppice from Malvern is either to its western boundary along the Worcestershire Way (car park near Cowleigh Park Farm) or by the field path from Cales Farm to the south-east. It can also be approached from the north along the Worcestershire Way or by a field path from Storridge.

The Lidar image shows the shape of the land around the coppice, with two hills almost enclosing the lower ground through which Whippets Brook flows once it emerges from cutting through the higher ground to the west, with the flatter landscape of the Severn Valley to the east.

The origin of the name 'Mill Coppice' is obscure. No remains or record of either a water mill on Whippets Brook or of a windmill on the ridge exist.[3] It has been suggested that the wettest part of the wood could once have been a mill pond, but there is no sign of a leet feeding it and it would have had little head of water to drive a wheel on the brook.

[3] Worcestershire historic environment records WSM71883, WSM10131.

2. History of human intervention

No detailed records of the wood and its management have been found. There are some shallow wood-edge banks, which may have been boundary markers.[4] The Worcestershire and Geopark Ways pass through a cutting at the south end of the wood, where they cross the summit of the ridge, indicating that this may well have been an ancient trackway. Corresponding signs exist on the slope to the north of Whippets Brook (foreground on cover picture). There are also a series of ditches in the woods adjacent to the south-west corner of the coppice.

Within the coppice itself there are indications of quarrying, with a steep slope along the limestone scarp and nineteenth century geologists noted that the wood was 'lightly quarried', with the limestone presumably used locally as a soil conditioner as there are no suggestions of limekilns being present.

Land Registry documents record that the wood formed part of the Madresfield Estate until the 1920s, then passing to Cowleigh Park farm. This ceased to be a working farm in the 1980s with a transfer of ownership of the wood and the adjacent areas of orchard and pasture to a land management company Consolidated Rank Properties that is currently registered in the Isle of Man.[5] The same company also own the adjacent land to the east that formed Cales Farm and now appears as an area with potential for housing development in local planning documents.[6]

Madresfield Estates pursued active policies of woodland management. These are still in place in adjacent woodlands. The canopy trees in Mill Coppice show signs indicating that the wood was coppiced at least twice in the nineteenth and twentieth centuries, but probably not during the last fifty years, as all the coppiced trees are greatly overgrown. In addition, there are a number of mature standard oaks present that have never been coppiced, suggesting that the wood was managed as coppice with standards.

Figure 3. Mature standard oak tree, November (e2).

Parts of nearby High Wood, which, remains Madresfield land, show a similar pattern. In addition, both the standard oaks and stands of the rare large leaved limes in both woods are of a similar age, with the oaks seeming to have similar leaf morphology intermediate between the sessile and pedunculate species, suggesting that both woods were planted up at about the same time, perhaps using

[4] Worcestershire historic environment records WSM10131.

[5] Land Registry TR_id_d4ab1.pdf, TP_id_d4ab1.pdf, CD_id_d4ab1.pdf.

[6] South Worcestershire Development Plan as of 2021. New Proposed Housing Allocations-Malvern. SWDP NEW 90 Land at Cales Farm. 400 houses on 23 hectares.

seedlings from a tree nursery managed by the estate.

The only indications of recent woodland management are signage and a gate on the two waymarked long-distance paths, some cutting away of ivy climbing tree trunks, plus a report of the culling of saplings some years ago.[7]

The western and north-eastern boundaries of the wood are ungrazed, with a good growth of natural hedge. On the western side this is regularly cut (last in January 2022). The other two boundaries, to the east and north are pastureland and sheep graze up to the rather dilapidated fencing at the woodland boundary, with plant indicators of disturbance, such as stinging nettles, at the field edges.

Figure 4a. Grazed boundary with pasture, note pollard field maple marking corner of coppice with epiphytic elder (e4). Figure 4b. Cut hedgerow, Worcestershire Way and orchard (e1).

The finger of woodland that juts out from the coppice into the pasture to the east has a comparable limited and disturbed ground flora, probably both from grazing and from soil turnover from a large colony of badgers (e6).

Since Cales Farm and Cowleigh Park Farm came into common ownership there has been a modification to the track through the lower part of the wood. Previously this ended at a gate into the field ahead. It now merges with the track through the wood where a wide vehicle access was created, possibly without authorisation, to allow a second route of access to the orchard to the west of the coppice.[8]

[7] Personal communication 2022.

[8] Personal communication 2022.

Figure 5a. Cales Farm path entrance to wood now showing wide track crossing wood. 5b. Entrance before modifications (e8).

The designation of the long-distance Worcestershire and Geopark Way paths along the western side of the wood leads to additional footfall, but with little impact on the wood.

Informal use of Mill Coppice has increased since the nearby housing development at Malvern Vale. Dog walkers and off-road cyclists use routes through the wood. Cyclists have opened additional paths and even installed ramps and other cycling challenges. The wood is sometimes used for campfires, leaving litter such as drinks cans and bottles. Litter also arises from the occasional rough sleeper and from the decay of an animal shelter beside the upper boundary of the wood (e7), which sheds asbestos fibro-cement roofing down the slope from time to time.

The wood was designated as a Local Wildlife Site on 17th January 2007 (Site number SO74/31). It is also protected by a tree preservation order issued by Malvern Hills District Council on 24th September 1990. The western boundary of the wood lies along the edge of the Malvern Hills Area of Outstanding Natural Beauty.

3. Geology, soils and topography

Geology

The rocks in the Mill Coppice and Cowleigh Park area were something of a puzzle to Victorian geologists. To the south of the wood the Malvern Hills end abruptly, to be replaced by a lower ridge of Silurian Rocks forming the high ground to the west of Mill Coppice where Whippets Brook cuts through (Figure 3). In the 1830s Murchison noted the two small bosses of rock similar to that of the Malvern Hills just up the valley from Mill Coppice.[9] John Phillips in the first British Geological Survey Memoir on the area in 1848 indicated that the limestone of Mill Coppice corresponded to the Woolhope Limestone formation.[10] It was not until the end of the century that Groom provided an interpretation of the structural geology which forms the basis for current understanding.

A modern description of the geology of Mill Coppice notes that it is mainly underlain by a sequence of sedimentary rocks of mid-Silurian age (425 million years), apart from the north-eastern sector where the East Malvern Fault has juxtaposed sedimentary rocks of Triassic age (230 million years).[11]

The Silurian sequence comprises two units of geological time referred to as Formations. Most of the Coppice is underlain by the Coalbrookdale Formation; siltstones and mudstones laid down in shallow detritus-rich waters. Limestones belonging to the Much Wenlock Formation form the ridge along the eastern boundary of the wood. These rocks were deposited in clear warm sub-tropical water which favoured the growth of corals, molluscs and brachiopods. Some small-scale quarrying of the limestone has taken place (a6). Apart from occasional blocks of fossiliferous limestone there are very few exposures where the rocks can be examined.

Tectonic forces have played a major role in the geological history of the area. Towards the end of the Carboniferous Period (about 310 million years ago) a major mountain building event took place in continental Europe and the associated compressive forces had a major influence here, forcing the igneous rocks of the Malvern Hills to the surface and deforming the Silurian sedimentary rocks which are folded and faulted. In the Mill Coppice area the rocks lie on the eastern limb of an anticline and are tilted towards the east. The western slope which characterises much of the Coppice is probably defined by a fault.

During the Permian and Triassic Periods (280 -220 million years) the nature of the tectonic forces changed with the Earth's crust being pulled apart to form a structure similar to the East African Rift. The East Malvern Fault defines its western margin and the subsiding crust was filled with sediments formed under arid continental conditions. In the north-east section of the coppice these are red mudstones belonging to the Eldersfield Mudstone Formation. These mudstones can be seen in Whippets Brook nearby.

[9] Murchison RI. *The Silurian System.* London, John Murray. 1839 p419.

[10] Phillips J. *British Geological Survey Memoir Vol.2 part 1.*1858 pp 36-7.

[11] *The Country Round Worcester.* British Geological Survey. HMSO, 1997.pp15-16.

Figure 6. Fossils from Much Wenlock limestone, Mill Coppice 6a) *Halysites* chain coral.
6b) Probable *Ketophyllum subturbinatum* solitary lacy coral.
6c) Stomatoporoid, layers of a reef building sponge.
(Photos by Moira Jenkins)

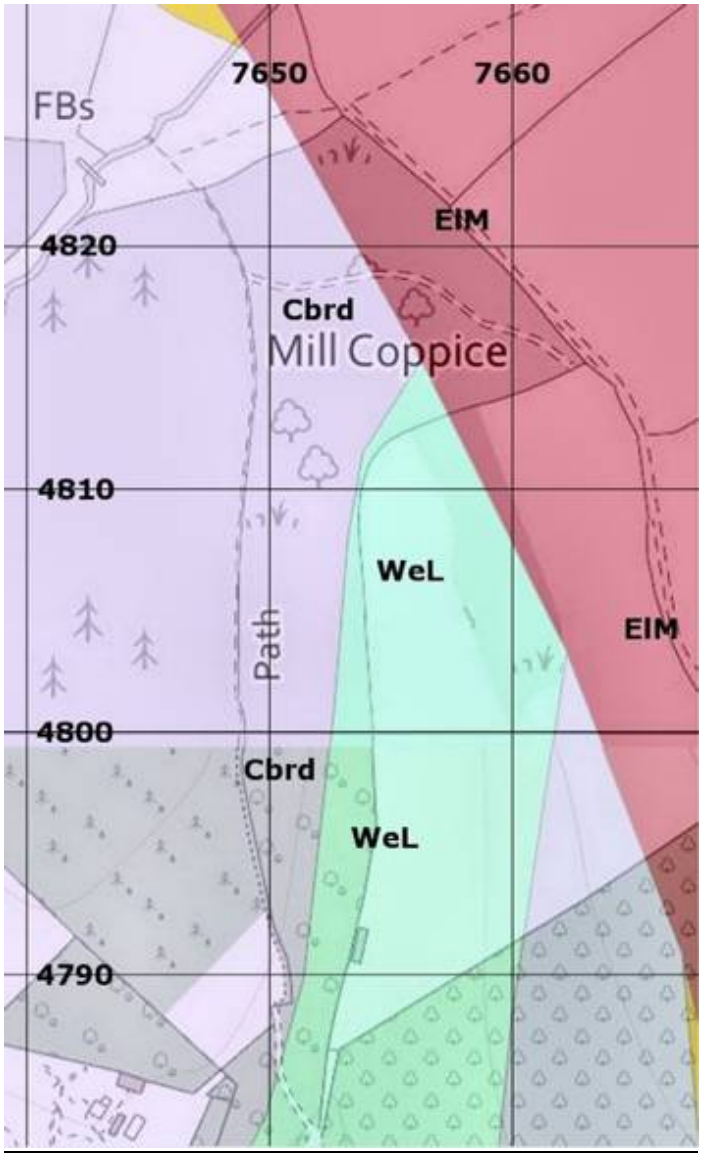

Figure 7. Geology underlying Mill Coppice. (Cbrd – Coalbrookdale shales, WeL – Much Wenlock limestone, EIM – Eldersfield Mudstone. East Malvern Fault between WeL and EIM). Crown copyright British Geological Survey.

Soils

A programme of soil sampling was undertaken to look at composition and changes in different parts of the wood. Texture, moisture, pH and nitrogen, potassium, magnesium and phosphate levels were determined. The results are summarised in Appendix 1. Five sites were sampled, there were differences in texture, one site had particularly high nitrogen levels, possibly a consequence of badger and dog urine. All sites showed

high magnesium and low phosphate levels. pH values showed that the soil was neutral to alkaline, thus providing conditions favouring element mobility and plant uptake.[12] It was not possible to sample the wetland area at the same time as other sites. Later in the year when it had dried out the surface soils were peaty, but with a high pH, and where trees had been uprooted the soil had the appearance of an anoxic gley.

Topography

There is a drop of 40 metres between the highest point in the wood (140m) on the limestone ridge at the southern end and the lowest, where water drains out of the wood towards Whippet's Brook.

The landscape of the wood and its surroundings is determined by both the underlying geology and the effects of erosion on it, in particular by Whippets Brook. The limestone capping is underlaid to the west by the less durable Coalbrookdale shales, which have eroded to form the steep west facing slope on which the southern part of the wood grows. Where the protective capping of limestone ends towards the northern end of the wood there is a steep north facing slope, made up of shales to the west and Triassic mudstones to the east of the fault line. Beyond this the wood flattens, probably as a result of river erosion, giving a slightly higher and drier area over the mudstone to the east and a low-lying wetland over the shales, the latter being irrigated by seepages of water at the foot of the north facing slope.

This topography can be followed in detail on Lidar images with 1m contours. The same images also provide an indication of the height of the tree canopy. An additional feature that shows on Lidar images is the sharp slope of the area that has been quarried. This can be seen as the dark area on the light-coloured western slope in Figure 2. It became apparent at an early stage of the study that it is topography, aspect of the slopes and drainage which together have a major impact on the pattern of vegetation.

Five major zones can be used to characterise this:

a) The west facing slope that forms the southern part of the wood. This has a limestone on its upper slopes and shales lower down.
b) The north facing slope at the end of the limestone capped promontory.
c) The flat land overlying the Triassic rocks at the north-east corner.
d) The low wetland in the north-west corner overlying shales.
e) Hedges and edges.

These zones can be further sub-divided and it is these subdivisions that are used to locate many of the findings presented throughout this report (Figure 8). These are supplemented by Ordnance Survey grid references from GPS devices where more precision is useful.

[12] Thomas p192.

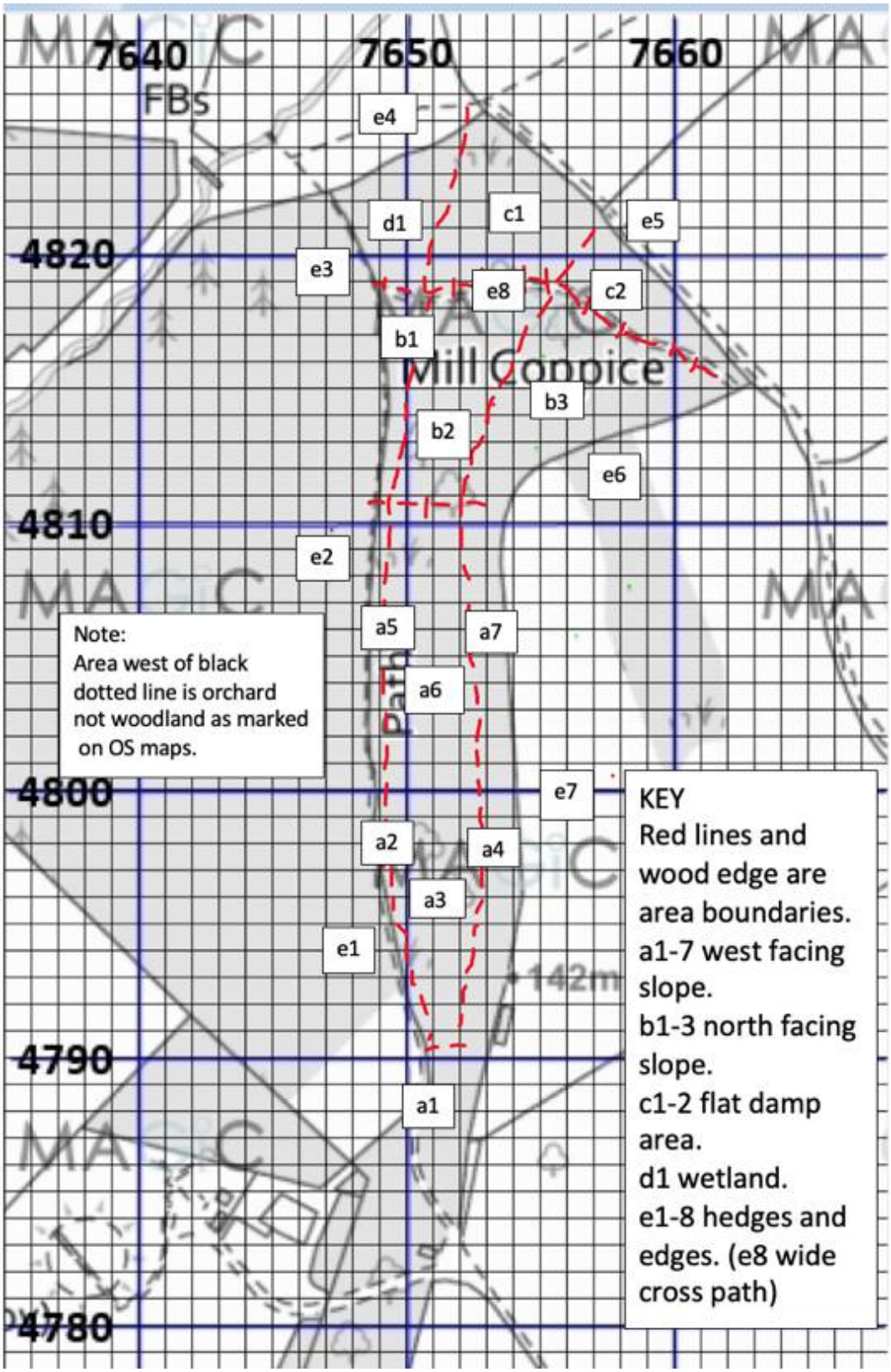

Figure 8. Zones and subdivisions of Mill Coppice. Crown copyright Ordnance Survey

4. Plant life

The woodland canopy is largely formed from oak and ash trees, with large leaved lime in a few places and a mix of wild cherry, wild service and thorns on the limestone at the southern end of the wood where the canopy height is lower. The canopy trees have been subject to human intervention from coppicing in the distant past. A dense stand of alder reaches canopy height in the wettest area of the wood. Field maple, wych elm and hawthorn are scattered throughout the wood and occasionally reach canopy height. Beneath the canopy there is a wide range of smaller trees and shrubs. Most parts of the wood have a rich ground flora that varies from place to place. Much of the interest of the wood comes from the variability of plant life in different parts of the wood and how this may be related to the geology and aspect of the slopes and to the level of saturation with moisture.

Appendix 2 is a list of plant species with their locations and the Ellenberg categorisation of the environments which favour their growth.[13] More detailed information on the status of trees and shrubs is also given.

Mosses, liverworts, lichens and algae are present but were not studied.

The edges of the wood differ from its core, with hedgerows on the west and north-east boundaries and fenced parts with canopy cover descending to above sheep grazing height on the east and north-west boundaries.

Figure 9. Mill Coppice, the woodland canopy. (The finger of woodland to the east surrounded by meadow lies along the eastern edge of the limestone. It has little ground flora because of sheep grazing and soil disturbance by a large colony of badgers. Two cider apple orchards are seen to the west and south of the wood.) Open source image.

The wide track crossing the wood between zone b and zones c and d also shows edge effects as well as having small wetlands from ditching on both its sides. Other paths are narrow and do not appear to influence patterns of vegetation.

[13] www. Ellenberg values modified for UK.pdf

a) West facing slope

Figure 10. West facing slope, February (a3).

The canopy of this area is largely overgrown coppice oak and ash, with a few standard oaks at the base of the slope. A line of large leaved lime coppices is found at the middle of the slope. Along the upper part of the slope and at the southern end, where it directly overlays the limestone and becomes a dry ridge, the canopy is lower, with a preponderance of wild cherry, wild service and field maple trees.

Figure 11. Limestone ridge with wild cherry, February (a1).

These same three species grow beneath the canopy along the rest of the slope, with the addition of wych elm, hazel, spindle (mainly over the limestone), crab apple, hawthorn, blackthorn (especially near the wood edge) and holly, along with a solitary yew tree.

Figure 12. Crab apple, July (a2).

This pattern of tree growth makes for many thin trunks reaching the full height of the wood as well as dense shade after

the trees have come into full leaf. These may be responsible for the limited amount of lower shrub and ground cover. There are important exceptions, and several shade tolerant plants are present. The most notable of these is spurge laurel, which is restricted to this part of the wood and forms the subject of a more detailed investigation (see Annex). Ivy is dominant over large areas of the ground as well as being present as a climber. Brambles and wild rose, mainly field rose, form patches. There is also a small colony of wild privet.

Ground cover is limited in the upper parts of the slope, with dog's mercury and wood sedge as the commonest species, but lower down there is a greater diversity, with early spring flowers that bloom before the trees are in full leaf. These include violets, primroses, celandines, wood anemones, bluebells and, in one small area, early purple orchids.

Figure 13. Early purple orchid and dog's mercury, April (a6).

Ramsons form small colonies at the base of the slope, probably where it is damper, and there is a lone stinking iris plant.

The western wood edge of this part of the wood is described separately as it is separated from the wood in most places by a dense hedge-line.

Figure 14. Stinking iris, June (a2).

b) <u>North facing slope</u>

This covers a smaller area than zone a. Its aspect suggests that it is less well-lit and it is considerably moister than further south. There are important differences in the vegetation, although the canopy trees are unchanged, with the exception of a single large uncoppiced wild cherry. The overall appearance is much more jungle-like, with a dense hazel, elder and hawthorn under layer, with trunks and limbs at many angles. There are also more fallen trees, some showing the effects of storm damage. A few goat willows are present near to the cross path.

One notable feature is the dense colony of holly, which forms a near monoculture at the western end of this slope. The

frequency of holly trees seems to increase progressively as this area is approached. A single yew is growing in the midst of this colony, but there is very little ground flora, likely a consequence of the year-round shading from the holly.

Figure 15. Storm damage to oak and dense hazel growth on north facing slope, June (b2).

Clematis adds to the jungle effect, becoming common in the northern part of the wood, while being absent further south, despite being regarded as a lime loving plant. Several species that need higher moisture levels are also absent further south but present in this area. These include male and broad buckler ferns and two colonies of herb paris.[14]

On the lower parts of the slope ramsons takes over from dog's mercury as the dominant ground cover and is accompanied by pendulous sedge in the vicinity of the track across the wood. Sanicle is also present along the western edge of the wood from just south of where this slope starts right into the wetlands of zone d. It does not seem to occur anywhere except near this edge.

Figure 16. Sanicle, May (b1).

c) <u>Flat land (NE corner)</u>

This area has a number of large uncoppiced oaks (Figure 4). These form a dense canopy but with considerable areas of unencumbered space beneath it. Hazel is the main understory plant and ground cover is a mix of dog's mercury with ramsons on lower lying ground. Overall the appearance is similar to other small woods in lowland Worcestershire. One place shows active regeneration following the collapse of several mature trees (Figure17).

[14] Herb paris grows in clones that are connected by a long-lived system of branching roots. Within a colony, individual rosettes tend to be segregated by size, with shorter stems at the edge of the colony and taller flowering and fruiting ones in the centre. See Jacquemin H et al. Biological flora of the British Isles: Paris quadrifolia. *Journal of Ecology.* 2008; 96; 833-844.

Figure 17. Regrowth following tree fall, June (c1).

d) Wetland (NW corner)

The flora in this area is markedly different. The most prominent feature being the dense stand of alder trees that forms the canopy for a large part of the area, to the exclusion of other tree species apart from ash. Clumps of alder link this part of the wood to the nearly continuous line of alders that grow along Whippets Brook, where the wetland drains. At the southern boundary near the cross path there are several mature silver birches and sycamore seedlings. No parent sycamore is apparent.

There is an understory of hazel, holly, elder, with occasional wych elm, goat willow and dogwood. The dominant ground cover is pendulous sedge with ivy in places. Several colonies of herb paris are thriving and bearing fruit.

Figure 18. Herb paris colony with ivy ground cover and alder trees, June (d1).

Ferns are abundant, male fern in drier areas and broad buckler in the dampest ones. Harts tongue ferns line one of the wettest depressions. Water flows through the area much of the season and creates an island on which kingcups flower.

Figure 19. Pendulous sedge and broad buckler fern, with kingcup leaves on 'island' beyond, July (d1). (It was not possible to visit this area when kingcups were in flower as ground was saturated and unsafe.)

e) Hedges and edges

Figure 3b shows the well-defined western hedge-line. While this is outside the formal boundary of the wood, there is continuity of vegetation on both sides of what remains of the fence.

Figure 20. Primroses in March on hedge line cut back in January (e1).

The sequential flowering of woodland plants in spring is very apparent, while the winter prominence of spurge laurels in flower becomes completely hidden by leaves from the deciduous hedge plants. These include oak, which also overhangs from within the wood, blackthorn, hawthorn, dogwood, field maple and wild service.

Climbers thrive, notably dog and field rose as well as black bryony.

Figure 21. Field and dog roses flowering together June (e2).

There is a rich summertime ground flora along this boundary and this results in visits from pollinating insects.

Figure 22. Wild service leaves overhanging hedge October (e1). State of fencing visible.

By autumn the hedge loses most of its leafy cover and bare ground again becomes apparent.

Comparable changes are seen on the hedge at the north-east boundary of the wood, but here large leaved limes form both canopy and hedge for part of the line, while hazel and dogwood are also prominent. In one area where trees have fallen there is a dense growth of clematis from ground level upwards. This hedge lacks the sunny bank found on the west side and has a less varied ground flora.

The two boundaries adjacent to grazing land have trees similar to those in the wood behind but sometimes pollarded or coppiced along the line of the boundary. These are grazed to sheep head height. There is growth of nettles and docks along the edge of the meadows (Figure 3a).

The wide cross-track (see Figure 5a) also shows edge effects from increased illumination and local drainage. Goat willows follow the track as do two lines of pendulous sedge, with ferns and ramsons along the drainage ditches on each side of the track . Figwort and ground ivy are only present in this area.

Figure 23. Male fern and ramsons, May (e8).

5. Animal life

Mammals

Badgers

There are widespread signs of badger activity. An extensive group of setts is just outside Mill Coppice (e6). One active sett has been found in the wood. In addition, there is extensive ground disturbance at the southern end of the wood, suggesting past badger or possibly rabbit or fox burrowing. Web cam data show a thriving colony at the main location for setts.

Figure 24. Still from webcam of badgers at their setts (e6).

There are several badger latrine sites in Mill Coppice. Badgers tend to regularly use such sites and they are often situated just to one side of the many well walked badger tracks through the wood. Most tracks cross from east to west through the wood and lead to disturbed fencing at its boundaries.

Figure 25. Badger track exiting wood under fence.

Rabbits

Few rabbits were seen during the period of study, but in past years they were common, especially on the west facing slope where they left the wood to feed in the orchard. There was, however, some evidence of burrowing with droppings present in the vicinity.

Figure 26. Recent burrowing, probably rabbit. March (a3)

Grey squirrels

Common throughout the wood.

Bank voles

Seen in western hedgerow area.

Moles
Lines of molehills at eastern end of north facing slope.

Deer
No evidence found. Present in nearby woods.

Birds

Three visits were made to the wood with an expert on bird song (Mike Pullen of Colwall). These were on 2nd February, 14th March and 25th April. The locations at which birds were identified by their song were recorded (Appendix 3). There were changes in the populations of birds between each of the visits and there were differences in species and frequencies in different parts of the wood.

In February most were either non-migratory or winter migrants. The dominant migrant group being winter thrushes (redwings and fieldfares) which flocked in their hundreds and were accompanied by mistle thrushes and finches. Their target was the unharvested cider apple crop in the two nearby orchards and they passed between the two through the wood.

In March only a small number of winter thrushes remained. There was considerably more territorial song. Greater spotted and green woodpeckers were active. Chiffchaffs had arrived in considerable numbers at the north end of the wood and males were actively competing with one another, including one observed incident where two seemed to be locked together and fluttered from the canopy almost to the ground, where they separated.
An overflying buzzard showed the importance of the wood for other species, with for instance, fieldfares flying away from the open setting of the orchard and landing on trees within the wood, while other species were signalling with alarm calls.

By April there were more summer migrants, notably redstarts that were mimicking the songs of other species that they had incorporated into their repertoire.

A surprising observation was that much of the bird life and displaying was taking place in a small part of the wood, the flat area at the north-east corner of the wood. This has more mature non-coppiced oaks than elsewhere resulting in a dense top canopy, perhaps with more horizontal branches to perch on, but relatively sheltered and unobstructed flight paths beneath it. These observations could explain why the area is favoured, alternatively the mature oaks may offer better opportunities for feeding or nesting.

In addition to these three visits features of interest were seen at other times. Examples included a tawny owl being mobbed off its daytime perch by blackbirds.

Reptiles and amphibians

None seen, although it could be expected that the wetland area would provide a good habitat for frogs and toads.

Free living invertebrates

No specific studies were made. There was no shortage of signs of spiders' webs and snail shells within the wood and arthropods such as centipedes and woodlice were found on rotten wood and under stones. The western hedge row, with its diverse flowers and sun had a

seasonal sequence of butterflies, bumble and other bees and hover flies.

Figure 27. One flower and a meal for two (Male meadow brown butterfly *Maniola jurtina* and common carder bumblebee *Bombus pascuorum)*. June (e2).

Other butterfly species seen around the western hedgerow (e 1-3) included Peacock, small tortoiseshell, comma and brimstone. In addition, speckled wood and small white were noted on the cross path (e8).

Bumble bees present included: red tailed *Bombus lapidaries,* tree *Bombus hypnorum* and buff tailed *Bombus terrestris.* Bee flies were common. Marmalade – *Episyrphus balteatus* – and footballer *Helophilus pendulus* - hoverflies were also noted.

Figure 28. Dark edged bee fly *Bombylus major* (e2).

Three species of ladybird were seen including the common seven spot.

Figure 29a. Orange ladybird. 29b. Cream spot ladybird (e 2).

There was evidence of leaf eating and leaf mining insects on many of the plant species, notably the scarce maple pigmy micromoth *Stigmella aceris.* This species has only recently become established in Worcestershire.

Figure 30. Maple pigmy moth burrow in field maple leaf. (Figures 28-30 Dave Taft)

Evidence of a colony of feral bees showed following storm damage. Combs were found scattered on the ground. They were traced back to a cavity in an oak tree which was the fracture point for the branches above. The cavity showed the attachments for the combs and had a well-crafted entry hole suggesting that it was originally made as a nest site by a woodpecker.

Figure 31a. Feral bee honeycomb. 31b. Attachment of combs to oak tree cavity (a6).

Gall forming invertebrates etc.

There is extensive evidence of plant gall formation within the wood. A range of insects and mites as well as certain fungi and viruses infect or parasitise the host plant and subvert its pattern of growth to produce structures that can shelter the developing intruder.

Figure 32. Dog rose 'Robin's pin cushion' - gall wasp *Diplolepis rosae* (e2).

Figure 33. Large leaved lime – midge gall *Didymomyia tiliacea* (a3).

Figure 34. Large leaved lime 'nail gall' – mite gall *Eriophyes tiliae* (a3).

Figure 35. Field maple - mite pimple gall *Aceria macrochela* (a4)

Figure 36. Alder – mite pimple gall *Eriophyes laevis* (e4).

Figure 37. Wild service tree – mite gall *Eriophyes torminalis* (a3).

Oak galls were not seen in 2021, also a general observation for the Malvern area.

Other galls noted included:
Eriophyes similis - mite gall on blackthorn
Stenacis conlvens - mite gall on spindle
Acalitus brevitarsus - mite gall on alder
Eriophyes nalepai - mite pimple gall on alder
Chirosia betuleti - fly gall on Male Fern

6. Fungi and recycling

There is a large amount of fallen and decaying timber in the wood, in addition to dead leaves, animal remains etc. Various stages of decay can be identified.

Figure 38a. Dead oak tree with decay of sapwood and resistant heartwood (b1). 38b. Living field maple with decay of heartwood and repair of tissue at cambium and bark (a2).

There were good displays of fungi in 2021 and early 2022, but few fungi were found in the wood in autumn 2022 and much of the ground remained hard.

Fungi identified 11th February 2022.

Jelly ear *Auricularia auricula-judae* on fallen unidentified branch but often found on elder.

Oak barkspot *Diatrypella quercina* on fallen oak branch

Hairy curtain crust *Stereum hirsutum* on fallen branches.

Snowy disco *Lachnum virgineum* on rotting wood

Turkey tail *Trametes versicolor* on stump

Figure 39. King Alfred's cakes/cramp balls *Daldinia concentrica* on fallen ash branch, showing decay of wood under intact bark (b3).

Figure 40. Hairy bracket fungus *Trametes hirsuta* growing on rotting heartwood (b3).

Figure 41. Willow bracket/blushing bracket *Daedaleopsis confragosa* on fallen willow trunk at early stage of decomposition (b3).

Figure 42. St George's mushroom *Calocybe gambosa (a7).*

,

Figure 43. Rust fungus *Melampsora populnea* on dog's mercury (a4).

Later observations included:
- rust fungi: *Puccinia iridis* found on Stinking Iris leaves.

Figure 44. Eyelash fungus *Scutellinia scutellata* on wood fragments at advanced stage of breakdown (d1).

Figure 45. Dryad's saddle bracket *Cerioporus squamosus* on living but wounded alder (d1).

Figure 46. Magpie ink cap *Coprinopsis picacea* (e2).

Although strictly not a fungus an image of slime mould on decaying wood is also included here. The wood shows several facets of recycling, with rot dividing it into friable chunks and excavations by boring insects as well as the slime mould positioned both to feed on micro-organisms and to produce spores.

Figure 47. Dog's vomit slime mould *Fulgio septica* (a6).

7. Seasons and weather extremes

In addition to the predictable round of seasons, the study period also included major weather extremes. Storms Arwen in November 2021 and Eunice in February 2022 as well as a prolonged high temperature drought in June and July 2022.

Plant and bird life in Mill Coppice in general followed the changing seasons, with autumn colours (Figure 22) giving way to the bare branches of winter (Figure 11). Early spring flowering included both wind pollinated species such as the goat willow and those attracting early pollinating insects such as wood anemones and violets.

Figure 48. Goat willow catkins, April (e8).

The sequence of spring flowering was particularly apparent among the ground flora within the wood, where the leafing of trees greatly attenuated light levels declining from an average of 50% in late March to 75% in late April and reaching 95% by the end of June (see Appendix 4).

Figure 49. Wood anemones, April (a2).

Storms felled numerous trees and filled parts of the wood with branches and twigs detached from tree crowns. Some trees were snapped off at points of weakness.

Figure 50. Oak snapped in mid trunk. This was through the cavity where bees had lived, see Figure 31 and associated text (a6).

Another common fracture location was at the base of overgrown coppices.

Figure 51. Oak fractured at coppice base (a6).

The storms exacerbated what was a continuing phenomenon in this unmanaged wood, where death, decay and recycling is the fate of most trees. Figures 15 and 17 show earlier examples.

The heat and drought in summer 2022 also affected the wood. Most notable was the almost complete drying out of the wetland at the north-west corner of the wood, where surface water disappeared, and moisture only permeated through the soil (Figure 19).

Some species, such as herb paris, showed the limits of their tolerance, thriving and fruiting in the wettest areas but wilting and dying without setting seed on the better drained north facing slope.

In addition, many of the trees and shrubs had a ‘false autumn’ with some of their leaves turning brown and falling.

Figure 52a. Herb paris in wetland bearing berries (d1). 53b. Herb paris wilting and dying on dryer soils, both July (b3).

Annex
Survey of spurge laurel plants (*Daphne laureola*)

Spurge laurel in typical location, April (a6).

Introduction

This species is relatively infrequent in UK woodlands, but there is a large assemblage of plants at the southern end of Mill Coppice. Its reproduction has been the subject of investigation in Spain and other countries, but comparable studies are not recorded in UK.
In parts of North America, by contrast, it is classified as an alien invader that takes over the forest floor.

Spurge laurel is a perennial woody shrub of woodland floors that rarely grows beyond 1m in height. It has multiple branching stems that are topped by whorls of glossy evergreen leaves. Green flowers appear very early in spring and are followed by black berries present by midsummer.

The studies of Alonso in Spain and co-workers in other parts of mainland Europe have investigated the variations in flower function.[15] They have identified a mix of monoecious plants with both stamens and anthers growing together with female dioecious forms that have suppressed and non-functioning stamens. The latter rely on fertilisation by pollen transported from nearby monoecious flowers. Their field studies have looked at the role of habitats, finding the mix of the two forms becomes more frequent at higher altitudes but not finding any immediate selective advantage in the seedlings arising from the berries of female dioecious plants. Genetic investigations suggest that the female only plants are a product of both nuclear and plastid genes, the latter only passing down maternal lines. Evolutionary pressures will depend on the relative selective advantage from the outbreeding that is inevitable in female dioecious plants in contrast to the higher fertilisation probability from self-pollination in hermaphrodites. This may be habitat dependent. Investigations have indicated that the sexual status of a plant

[15] Alonso C. Herrera C. Neither vegetative nor reproductive advantages account for the high frequency of male-steriles in southern Spanish gynodioecious *Daphne laureola* (Thymelaeaceae). *American Journal of Botany* 2001: 88; 1016-1024.
Alonso C. Herbivores do not discriminate between leaves of female and hermaphrodite individuals of gynodioecious *Daphne laureola* (Thymelaeaceae). *Oikos* 2003: 101; 505-510.
Medrano M. Alonso C. Herrera C. Mating system, sex ration, and persistence of females in the gynodioecious shrub *Daphne laureola* L. (Thymelaeaceae). *Heredity* 2005: 94; 37-43.
Alonso C. Pollination success across an elevation and sex ratio gradient in gynodioecious *Daphne laureola. American Journal of Botany* 2005: 92; 1264-1269.
Alonso C. Herrera C. Back and forth hermaphroditism: phylogenetic context of reproductive system evolution in subdioecious *Daphne laureola. Evolution* 2011: 65; 1680-1692.
Jagrig M. Jarni K. Brus R. Sexual dimorphism and distribution of *Daphne laureola* L. in the Bohor area. *Acta Silvae et Ligni* 2013: 101: 23-32
Sinclair JP. Kameyama Y. Shibata A. Kudo G. Malve-biased hermaphrodites in a gynodioecious shrub, *Daphne jezoensis. Plant Biology (Stuttg.) 2016; 18; 859-867.*

does not influence its palatability to predators. Growth from seeds derived from both forms of flower is similar but there are suggestions that the reproductive performance of plants that grow from self-pollinated seeds is reduced.

This complex and fascinating pattern of reproductive behaviour was a major factor in deciding to study the Mill Coppice population

Studies

Sixty plants were marked and observed at intervals during the first half of 2022. In the course of these studies at least another forty plants were identified, many small seedlings. Flower types and times of opening, the height and number of leaf whorls, the amount of new season's growth and the timing and abundance of berries were all recorded. The 10 m OS grid references for plants were recorded as was their nearness to the wood edges where lighting was stronger as well as more directional. Not all sixty plants could be located for all stages of the project.

1. Location. (Recorded between 14 Jan and 26 Feb)
2. Flowering dates and flower types (Recorded between 14 Jan and 10 March)
3. Abundance of berries (Recorded 13 June)
4. Heights, number of leaf whorls (Recorded between 14 Jan and 26 Feb), new growth (Recorded 13 June)

Location

Plants were almost exclusively found on the west facing slope at the southern end of the wood (zone a). This is capped by limestone and well drained. They were growing along both upper and lower boundaries as well in the middle zone of the wood. A few plants were present at the top of the north facing slope (zone 3b).

Flowering

Spurge laurel flowers very early. By the end of January up to 60% of flower buds were fully open.

Spurge laurel in flower, January.

By late February 100% were open on the majority of plants and by 20th March around half the flowers were over. Smaller plants and those that seemed to be suffering from deep shade and competition had fewer or no flowers.

Flowers were checked to determine if they had functioning stamens. All plants in flower had them and no gynodioecious flowers were found.

Close up of hermaphrodite flower with pollen loaded stamens, February.

Berries

The number of berries in each cluster was assessed. They varied markedly from total absence, with just the remains of dead flowers, up to ten. Most had fully ripened by 13 June but some were still green.

Berries formed below whorls of new leaves, June.

Growth forms

Plants surveyed were between 30 and 110 cm in height. In addition, and subsequent to the initial survey, significant numbers of seedlings were identified. These were from 5-30 cm, had a single stem and whorl of leaves and did not bear flowers or berries. As some were located distant from other plants they indicate that the mature plants were setting fertile seeds.

		14 1 && 30 1			26 2			*13 6*
Location	Notes	Height	Whorls	%in flower	% in flower	Light – Lux	New leaves	Number new leaves top whorl=N Number of berries/cluster=B
a1upper	3 plants	60	18	20%	100%	7200	33%	L8 B2
a1lower	6 plants	78	43	23%	100%	4850	66%	L9 B 4.8
a2	16 plants	64	5.8	36%		3700	63%	L7 B 2.5
a3	15 plants	50	4.5	24%		7900	42%	L9.4 B 4.3 max
a4	2 plants	55	26	15%	100%	4300	50%	unobserved
a5	7 plants	81	11	38%	100%		70%	unobserved
a6	15 plants	52	4.2	57%	90%	3000	0 %	L12 B4.4 (max)
a7	No plants							

Summary table of seasonal observations on Mill Coppice spurge laurels.
Locations - see Figure 8
Location data were used to look for any boundary effects, perhaps relating to light levels and to see if there are changes between the southern and northern boundaries of the area of interest. Numbers are small and no attempt has been made to look at probabilities of differences arising by chance.

Multi-branch growth in centre of wood, February

Multi-stem growth at wood edge, February

There was considerable variation in the overall growth patterns. Some, especially in the centre of the wood, where there is space to grow in all directions branch repeatedly and have many whorls of leaves, each at the top end of a branch. In other situations there are multiple adjacent stems coming from the ground, often in a line, with little branching. These plants are among the tallest and are common in the hedge lines at the wood edge but are also seen within the wood where there is competition between plants for space. The number of whorls per plant varies from one to over 100, with the largest number being on plants with multiple stems.

New season's growth is easily visible as it is above the flower line and is lighter in colour (see image of berries above). The most vigorous plants have up to 15 new leaves, while those that are less well placed may only have 2-3.

Plants suffered several forms of damage. One was uprooted (cause unknown). Several showed signs of leaf damage from predation while two had extensive aphid infestation, those in the western hedge were cut about by a tractor mounted hedge-cutter in January but appeared to recover well. Bark had been stripped off some stems close to ground level. During the prolonged dry period in June-August leaves drooped, especially on those plants in direct sunlight, and older lower leaves were shed.

The pattern of progressive leaf growth up the stem means that, unless it branches, a plant must get taller as it gets older. What determines the maximum height of plants is unclear, as is any sign that older larger plants become senescent.

Observations were quantified, initially to see if there was a mix of hermaphrodite and gynodioecious plants. All flowers appeared to be hermaphrodite, other observations are summarised below.

Observed interzonal trends:

1. Taller plants at edge of wood. This could arise from the need to compete with other hedgerow species.
2. More whorls at eastern boundary. There has been regular grazing along this boundary and more plants here are of the multi-stem growth form.
3. More early flowers in zone a2. No explanation
4. Earlier leaf development at wood edges. May relate to light levels, but measured levels are unhelpful and vary with time of day and year.
5. No clear trends in other observations.

<u>Conclusions</u>

Mill Coppice has a large population of spurge laurel plants. All plants appear to be hermaphrodites. There are minor variations in vegetative form and in the timing of leaf and flower growth, but these do not show any very clear correlation with the differing habitat zones of the wood. The absence of plants from the both the lower parts of the north facing slope and from the flat area north of the cross path could indicate one or more of the following: their need for early spring sun prior to canopy leaf development; dependence on soils derived from limestone, or intolerance of damp conditions.

Commentary

Mill Coppice shows great biodiversity within a small area. It has enjoyed a period of benign neglect over the last half-century or more and this has contributed to its value as a site where patterns of nature can be both experienced and studied.

Our group has only made a start on recording the wildlife of the wood. Much more could be done and, as we have found, this can be both rewarding and fun. There is potential for study of individual life forms, as presented here for spurge laurel. There is also scope for more detailed investigations of woodland ecosystems and the relationships between species and their habitats.

Increasing footfall in recent years and perhaps even more in the future, should nearby housing proposals be realised, may endanger the wood and the richness of habitats that it provides. This needs to be considered and action taken.

The diversity of such a small wood is amazing, from a dry stony ridge to a, sometimes inaccessible, wetland all within five acres. This can be traced to the geological features of the coppice and is mirrored by the ways in which wildlife differs in different areas. Historic human interventions have enhanced this. Active tree management one to two hundred years ago has provided the canopy, while the differing effects of grazing and hedgerow maintenance can be seen at the wood edges. This is especially notable along the managed western border where there is very diverse plant life.

Cycles of nature are apparent, from the geological changes since the marine fossils lived in a warm sea hundreds of millions of years ago, through the multi-century lifetime of trees, to the annual cycle of spring growth and flowering followed by autumn recycling and fungal sporing.

Given the compact presentation of so many aspects of woodland ecology, Mill Coppice has the potential, if it is sensitively managed, to not only provide pleasure and be a site for study but also become an educational setting for local schools and for all those who want to know more woodlands.

Mill Coppice is an asset to be cherished.

Appendix 1

Soil sampling

Soils from five parts of the wood were sampled and analysed. Pooled auger samples from each location were used. Two separate investigations were undertaken in early spring, one to assess the texture of the soil based on a decision tree that used physical properties of the soil to classify the dominance of fine and coarser particles and their adhesiveness. The second was to collect samples for laboratory analysis for mineral content. At all sites dry matter in samples was 68-75%.

A formal sampling framework was used for the collection of samples for chemical analysis, with multiple samples taken from a 10m area, mixed and divided to give a single representative sample for sending to the laboratory.

1. Southern end of wood, over limestone. SO 76517 47880 (a1).
2. Base of west facing slope, over shale. SO 76477 47968 (a5).
3. West end of north facing slope, over shale. SO 76501 48168 (b1).
4. Flat area north-west corner of wood over mudstone. SO 76562 48211 (c2).
5. For textures – East end of north facing slope. SO 76562 48150 (b3)
   For analysis – boundary of west facing and north facing slopes below quarried area. SO76517 48095 (a6).

Site	Texture	NO_3 mg/kg	NH_{4+} mg/kg	pH	P mg/l [DEFRA Index]	K mg/l [DEFRA Index]	Mg mg/l [DEFRA Index]	Organics %
1	Loam/sand	8.55	10.83	6.9	6.2 [0]	197[2+]	669 [7]	10.4
2	Silt/loam/clay	5.15	4.92	6.7	4.4[0]	227[2+]	600[6]	8.2
3	Silt/clay/loam	0.96	4.75	5.6	4.6[0]	172[2-]	367[6]	6.8
4	Sand/clay/loam	3.33	2.88	6.2	4.2[0]	182[2+]	451[6]	5.5
5	Loam/silt/sand	6.35	3.51	7.0	3.8[0]	222[2+]	566[6]	8.5

Phosphorus (P) was deficient at all sites, probably secondary to binding with soil calcium. Potassium (K), magnesium (Mg) and organic matter levels were unexceptional. Site 1 had a markedly higher level of nitrates and ammonium. This was both near the entrance to the wood, possibly location for dog urine, and had a badger latrine nearby. Site 3, within the holly thicket, had lower pH, nitrate and magnesium levels. This may reflect patterns of decay of holly leaves.

The DEFRA index is a scale used to identify nutrient deficiencies for agriculture and horticulture. Values above 5 mean that fertiliser need not be applied. Below this value limitations to growth are likely and addition of the relevant mineral will improve output.[16]

[16] https://www.alsenvironmental.co.uk/media-uk/pdf/datasheets/contaminated-land/defra-index-scale_td_uk_2017.pdf

Soil type and analysis did not, in general, correlate either with the underlying rocks or with observed differences in vegetation within the wood.

We are grateful to Dianna Dine, formerly of the geography department of the University of Worcester. She advised and mentored us on methodology and provided the decision aid used for assessing soil texture. When the results were available, she commented on their significance. Laboratory analyses were performed by NRM Laboratories of Bracknell.

Later in the year, when it was more accessible, soil texture and dip stick evaluation was undertaken in the wet alder carr part of the wood. The soil was subjectively far moister and had a high peaty organic content. pH values were similar to the rest of the wood, phosphorus was deficient based on a colourimetry kit. Where trees had been uprooted the underlying soil appearance was of an anoxic green/grey gley.

Appendix 2

Plant species

This table lists plants, their locations within the wood based on the zones shown in Figure 8 and their frequency at each location. Ellenberg indicators, adapted for the UK, of preferred habitats (in terms of light, moisture, pH and nitrogen availability) for each species are noted. These species lists are inevitably incomplete and further species are undoubtedly present. In particular mosses and liverworts have not been assessed.
These tables summarise more detailed mapping exercises undertaken for key species as well as the results of walked transects along the paths in the wood. These noted the changing patterns of layering within the canopy. Additional notes are included on the trees and shrubs present.

Plant species list

Favoured habitat indicator key. L – light, low=1. F-moisture, dry=1. R-acid/alkaline, acid=1. N- nitrogen, low=1. (Ellenberg UK indicators)					Zones a-e and subdivisions 1-7 (see Figure 8, page 10.) Frequency key: D – dominant. A – abundant. F-frequent. O-occasional. R- rare.													
Trees and shrubs	L	F	R	N	a1	a2	a3	a4	a5	a6	a7	b1	b2	b3	c1	c2	d1	E 1-3,8
Ash *Fraxinus excelsior*	5	6	7	6	F	F	F	A	F	D		F	F	A	A	F	F	F
Field maple *Acer campestris*	5	5	7	6	F	A	F	F	F		A			F	F	F	O	F
Holly *Ilex aquifolium*	5	5	5	5		F	F	F	F	A	F	D	F	F			F	O
Large leaved lime *Tilia platyphyllos*	4	5	7	6			F	F		F						O		O
Small leaved lime *Tilia cordata*	5	5	6	5				R										
Oak English *Quercus robur)*	7	5	5	4	Oaks appear to be uniform hybrids between the two species													
Oak sessile *Quercus petraea)*	6	6	3	4	A	F	F	F	D	F	F	A	A	F	A	A	F	F
Wild cherry *Prunus avium*	4	5	6	6	A		F	F					R					F1, O8
Wild service *Sorbus torminalis*	4	5	6	5	A		F	F			R							F1
Wyche elm *Ulmus glabra*	4	5	7	6		O	O	O				O	O	F	F	F		
Yew *Taxus baccata*	4	4	7	5			R					R						
Goat willow *Salix caprea*	7	7	7	7										O				
Sycamore *Acer pseudoplatanus*	4	5	6	6											F			
Alder *Alnus glutinosa*	5	8	6	6									R		O		D	
Silver Birch *Betula pendula*	7	5	4	4											F			
Crab apple *Malus sylvestris*	7	5	6	6			R		R					R				R 3
Hawthorn *Crataegus monogyna*	6	5	7	6	F	F		F	F		O	F	F	F	A	A	C	
Hazel *Corylus avellana*	4	5	6	6	F	F		F	F		F	F	A	A	C	A	C	

Habitat preferences and zones of wood	L	F	R	N	a1	a2	a3	a4	a5	a6	a7	b1	b2	b3	c1	c2	d1	E1-3,8
Rose *Rosa canina*	6	5	7	6	O	F	O				F	F	F				F	A
Rose *Rosa arvensis*	6	4	7	5	F	F	O	F	F		F	O	F				F	A
Bramble *Rubus fructicosa*	6	6	6	6		F	F	F	F	F	F	F	A	A				F
Spindle *Euonymus europaeus*	7	8	6	7	O	O		F	F		O	O		F			O	O
Spurge laurel *Daphne laureola*	4	5	7	5	F	F	F	O		F	O	O	O					F
Elder *Sambucus nigra*	6	5	7	7	R	O		F		F	F		F	F	F	F	F	
Blackthorn *Prunus spinosa*	6	5	7	6	F				F									F
Clematis *Clematis vitalba*	6	4	8	5		O					F	O	F	F		F		O
Guelder rose *Viburnum opulis*	7	6	7	5													R	R
Dogwood *Cornus sanguinea*	7	5	7	6												F		F
Ivy *Hedera helix*	4	5	7	6	F	F	A	A	F	F	A	F	F	D	F	F	F	A
Wild privet *Ligustrum vulgare*	6	5	7	5	O													
Non-woody herbs																		
Wood spurge *Euphorbia amygdaloides*	4	5	6	6		F			F									F2
Bugle *Ajuga reptans*	5	7	5	5										R				
Black Bryony *Tamus communis*	6	5	7	6		F	F	F	F		F	F		F			F	A1, 2
Bluebell *Hyacinthoides non-scripta*	5	5	5	6	F	A		F		F	F			O		F		
Common Dog Violet *Viola riviniana*	6	5	5	4		F		F						F				
Cow Parsley *Anthriscus sylvestris*	6	5	7	7	F		R	F						R				F1,2
Dogs Mercury M*ercurialis perennis*	5	5	5	6	D		D	A		D		A	A	A	A	F	F	F1-3
Enchanters Nightshade *Circaea lutetiana*	4	6	7	6				F				F		R				
Garlic Mustard *Alliaria petiolata*	5	6	7	8		F	R	F			F	F						
Greater Stitchwort *Stellaria holostea*	5	5	6	6	A	F						F						F1-2
Lesser Celandine *Ranunculus verna*	6	6	6	6										F	F	F		
Pendulous Sedge Carex pendula	5	8	7	6						F							D	A8
Primrose *Primula vulgaris*	7	5	6	4			F		F			F						F1-2
Sanicle *Sanicula europaea*	4	5	7	5					F			F						
Stringing Nettle *Urticaria dioica*	6	6	7	8										F	F		F	
Wild Arum *Arum maculatum*	4	5	7	7				F	R	R	F	R			F	F	F	F1-3
Wild Garlic *Allium ursinum*	4	6	7	7		R	R	F	A	F		A	D	D	D	D	A	

Habitat preferences and zones of wood	L	F	R	N	a1	a2	a3	a4	a5	a6	a7	b1	b2	b3	c1	c2	d1	E1-3,8
Wood Anemone *Anemone nemorosa*	5	6	4	4		A	F	F		F		A		F				F1
Wood Avens *Geum urbanum*	4	6	7	7			F	F			F		F	F	F	F		F1,2
Wood Sedge *Carex sylvatica*	4	5	6	5	F	F	F				D	D		F				
Woodruff *Galium odoratum*	3	5	7	6	F	F	F					F		F				
Wood sorrel *Oxalis acetosella*									F									
Yellow Archangel *Lamiastrum galeobdolon*	4	5	7	7	F	F	F		F		F	F		F		F	F	
Herb Robert *Geranium robertianum*	5	6	6	6				F					R				F	F1,2
Hogweed *Heracleum sphondylium*	7	5	7	7				F									F	F2,3
Dandelion *Taraxacum officinale*	7	5	7	7	R													F1
Dock (leaves only) *Rumex sp.*												F						F1-3
Bush vetch *Vicia sepium*	6	5	6	6								F						F1-2
Stinking iris *Iris foetidissima*	5	4	8	5		R								R				
Early purple orchid *Orchis mascula*	6	5	7	4					O									
Herb paris *Paris quadrifolia*	3	6	7	6						F							A	
Male fern *Dryopteris felix-mas*	5	6	5	6						R	F	F	F				F	F8
Broad buckler fern *Dryopteris dilatata*	5	6	4	5								F					A	F8
Hart's tongue fern *Phyllitis scolopendrium*	4	5	8	3													O	
Goose grass/cleavers *Eleusine indica*	6	6	7	8				F										F8
Ground ivy *Glechoma hederacea*	6	6	7	7														F8
Figwort *Scrophularia nodosa*	5	6	7	6														F8
Willowherb *Epilobium sp.*																		F8
Woody nightshade *Solanum dulcamara*	7	8	7	7							F							F 1-3
Kingcup *Caltha palustris*	7	9	6	4													O	
Buttercup *Ranunculus sp.*																		*
Speedwell *Veronica sp.*																		*
Daisy *Bellis perennis*	8	5	6	4														*
Hedge woundwort *Stachys sylvatica*	6	6	7	8											O			*
Rough chervil *Chaerophyllum temulum*	6	5	7	7														*
Self heal *Prunella vulgaris*	7	5	6	4														*

Habitat preferences and zones of wood	L	F	R	N	a1	a2	a3	a4	a5	a6	a7	b1	b2	b3	c1	c2	d1	E1-3,8
Perforate St John's wort *Hypericum perforatum*	7	4	7	5														*
Lady's bedstraw *Galium verum*	7	4	6	2														*
Yarrow *Achillea millefolium*	7	5	6	4														*
Knapweed *Centaurea nigra*	7	5	6	5														*
Marsh thistle *Cirsum palustre*	7	8	5	4														*
Red clover *Trifolium pratense*	7	5	7	5														*
White clover *Trifolium repens*	7	5	6	6														*
Pineapple weed *Matricaria discoidea*	7	5	7	7														*
Wild basil *Clinopodium vulgare*	7	4	7	4														*
Black Mellick *Medicago lupulina*	7	4	8	4														*
Timothy grass *Phleum pratense*	8	5	7	6														*
Stitchwort *Stellaria holostea*	5	5	6	6														*

- From a list of hedgerow plants in zone e1-3 that did not include sub-divisions 1-3 or frequencies

Notes on trees and shrubs

Canopy trees

Oaks

Most of the canopy trees in the wood are overgrown coppices, with evidence that they have undergone several rounds of coppicing. However, there is a population of some fourteen large (>2m) maiden (never coppiced) oaks, a few have a girth of over three metres, suggesting that they are well over two hundred years old.[17] These were presumably the 'standards' - trees grown to be used as sawn timber as distinct from the poles and scantlings derived from the coppices (Figure 3). Oaks over two metres in girth have been mapped. It was hoped to link locations of such trees to crowns identifiable from satellite images but this did not prove to be reliable.

Oaks are found in all parts of the wood except those with standing water. The large maiden trees were in zones a5, b3 and c2. Oak seedlings were only identified on the field edges around the wood.

All oaks have features intermediate between pedunculate and sessile oaks, with no auricles at the leaf bases but without a long petiole on the leaves. Acorns could not be seen in situ to establish if they were sessile or pedunculate. It is possible that the wood was replanted with

[17] Thomas p328.

nursery reared trees in the nineteenth century. The nearby High Wood, also at the time part of the Madresfield estate, has maiden oaks of a similar size and leaf morphology

Ash
The second major canopy tree is ash. All ashes in the wood are overgrown coppices and they are present in all areas except where there is standing water. The crowns are more open and irregular in outline than the oaks. Ash seedlings are abundant, but few are more than 20 cm tall. Clearings were created by recent storms that felled overmature trees. Ash growth is occurring at these sites.

Limes
Lime trees are locally common in zones a3, a6 and e5. Most appear to be large leaved limes. All are coppiced. They are of a similar size and, again may be the result of active woodland management, with similar age lime trees present in High Wood. The areas in which most grow are on or adjacent to limestone and are well drained. There is a single small leaved lime near the upper boundary of the wood in zone a4.

Cherry
Wild cherry coppices are abundant at the southern end of the wood on the west facing Slope (a1). These are surrounded by large numbers of seedlings or suckers. Many of these trees show signs of canker and a number have fallen. The canopy height in this part of the wood is lower and in places these trees form part of the canopy. Coppice cherries and their associated seedlings are not found further north. There is however a single large (2 metre girth) un-coppiced wild cherry at the top of the north facing slope. There is no evidence of seedlings around it, although a few are present along the cross track (e8).

Wild service
Like the limes and cherries, wild service tree is only found in the southern part of the wood. Here it is frequent and can reach the canopy (a1,3,4). There are large numbers of seedlings or suckers around the older trees.

Alder
A dense stand of coppiced alders is dominant and forms the canopy in the wet area at the north-west corner of the wood (d1).

Birch
Three birch trees stand adjacent to each other south of the alders (c1). There are no signs of seedlings and this damp area is a surprising location for this species.

Sycamore
Seedlings adjacent to cross path (c1). No sign of a mature tree as a seed source.

Influence of woodland management
For all the above tree species human intervention may play a part in determining locations and forms of growth. Some seem to be barely influenced by the different aspects and soils such as ash and oak, while others such as cherry, wild service and lime are largely limited to

the drier soils of the lime-rich west facing slope at the southern end of the wood. Conversely alder is found only in the wet areas. The extent to which patterns of planting and timber harvesting or other aspects of woodland management affect distribution is unclear. The species listed below show no evidence of systematic human intervention.

Understory trees and large shrubs

Holly
Holly is a common component of the understory in all but the northern parts of the wood. It forms small thickets at several locations, excluding other species. It becomes the dominant species in the north-western corner of the west facing slope (b1) where it exists under a thin cover of canopy species. Seedlings are common in all areas where holly is present.

Field maple
Field maple is common in the understory throughout the wood, but more frequent at the southern end. It is particularly prevalent along the boundaries of the wood, where it has sometimes been coppiced to form a linear hedging plant (see Figure 3a).

Hazel
Hazel is similarly common in all parts of the wood but reaches its largest size and is most frequent on the north facing slope (b1-3). Here it makes for a jungle-like habitat with many horizontal branches.

Elms
Most of the elm present is wych elm, but there are some examples of smaller leaved varieties. It is never abundant but is frequent as a shrub and occasionally has a distinct trunk that enters the canopy. It is found in all but the wettest parts of the wood.

Hawthorn
Frequent as a small tree throughout the wood, prominent as a hedging plant along the western boundary.

Blackthorn
Commonest at the southern end of the wood but present elsewhere, prominent as a hedging plant along the western boundary (e1-3). Rarely found away from the wood boundaries.

Spindle
Occasional in all parts of wood, most frequent on high ground at southern end. Rarely more than a 2 metre shrub with thin trunks.

Crab apple
Occasional on west facing slope as a shrub or small tree, larger examples flower and bear Fruit (figure 12).

Yew
Two small trees of similar size present in wood, one in middle of west facing slope and one

in the holly thicket at the northern end of slope.

Goat willow
Two trees at opposite ends of cross path through wood, both adjacent to damp areas.

Dogwood
Small plants adjacent to alder grove at north-western corner. Present in western hedgerow.

Guelder rose
Small plants adjacent to alder grove at north-western corner. Occasional in western hedgerow.

Small shrubs and woody climbers

Wild privet
Present at a single location near southern end of wood at top of slope.

Spurge laurel
C 100 plants, all at southern end of wood on west slope or at top of north slope. Subject of separate investigations on growth and flowering (see Annex).

Ivy
Common in all parts of wood. Forms ground cover, sometimes dominant. It climbs most trees, holly being the exception, perhaps because of its year-round deep shade. Seems to have been contributor to tree falls during recent winter storms.

Clematis
Scattered, with massive scrambling stems on north slope (b2,3) and around alder grove (e1). Present in western hedge-line. Surprisingly, for a lime loving plant, it is not present over the limestone at the southern end of the wood.

Appendix 3

Bird life

Three visits were made to the wood in the company of Mike Pullen, who has considerable knowledge of bird song. The identifications listed are thanks to his skill.
The small case letters refer to the zones of the wood in Figure 8.

Species	BTO code	2 February	14 March	26 April
Blackbird	B	a	ab	
Black cap	BC			ab
Blue tit	BT	acd	ac	a
Brambling	BL	b	a	
Buzzard	BZ		ab (above wood)	
Chaffinch	CH	a		
Chiffchaff	CC		c	ad
Coal tit	CT	ace	a	
Cuckoo	CK			e (distant)
Dunnock	D			a
Fieldfare	FF	e (large flocks)	be (fewer)	
Goldcrest	GC	bc	a	
Green woodpecker	G		e (distant)	
Goldfinch	GO	c		e
Gt. Spotted Woodpecker	GS		ad	e
Great tit	GT	bcd	e	ac
Jackdaw	JD	cde	c	a
Jay	J		a	a
Magpie	MG	d	b	
Marsh tit	MT	c	c	
Mistle thrush	M	e	e	
Nuthatch	NH	ac	c	c
Raven	RN		e (high overhead)	
Redstart	RT			e
Redwing	RE	e		
Robin	R	ace	abc	ac
Siskin	SK	a	d	
Skylark	S			e (in meadow)
Song thrush	ST			a
Tree creeper	TC	c	c	
Wood pigeon	WP		abc	
Wren	WR	b	c	abce

Both seasonal and local variations in species, their frequency and behaviour were noted:

- Early in the year there were huge flocks with many hundreds of fieldfares and redwings feeding in the orchards on either side of the wood, where the cider apple crop had not been harvested. Thrushes and chaffinches accompanied these flocks which flew back and forth over the wood. During the March visit numbers were down and the presence of a buzzard above the wood led to flocks sheltering within the cover of the trees.
- There was a greater diversity of birds in zone c, where there were more large oaks and clear flight lines beneath them. This space below the canopy was the site of active territorial and mating behaviour in March and April, with the arrival of summer migrants.
- A redstart was a notable performer during the April visit. Its song included a range of phrases imitating other species.
- Ravens, buzzards, cuckoos and skylarks were not present in the wood or its immediate vicinity. Their calls could be heard from within the wood.
- Apart from these three visits opportunistic observations were made at other times. These included a resting tawny owl being mobbed and driven from its perch by blackbirds.

Appendix 4

Light levels

Levels (in Lux) were measured using an app on an IPad. Two sets of samples were collected. One for spurge laurel plants (see Annex) and one repeated at three dates at set locations while leaves were emerging and maturing in the canopy.

The repeat measurements were all taken with the observer standing to the north of the meter and holding it at waist level. Levels in the wood are related to reference values in adjacent open fields. Days were chosen for sampling that had an evenly overcast sky to avoid shadows.

Locations			
Open field reference	21 3 22	28 4 22	29 6 22
Track to MC 76554780	13000	16000	26000
Orchard path 76484819	17000 (brief sun period)	15700	31000
Benchmark	13000	16000	28000
In wood			
Top of MC under cherries 76524787	7700 59% of benchmark	3700 23%	1500 5%
W slope oak/garlic 76494796	5500 42%	2000 12%	900 3%
Above X path holly 76494817	3700 28%	1200 7%	270 1%
Lower wood on Trias 76564822	6600 50%	4200 26%	230 1%
cross path centre 76544818	10300 79%	9100 56%	2000 7%
N slope central 75504815	5300 40%	3900 24%	500 2%
Clear area west of old quarry 76514809			3700 12%
Mean attenuation	50%	75%	95%