A Fungal Assessment of the North Kent Candidate National Nature Reserve

Tiered Tooth *Hericium cirrhatum* © Mark Colvin

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1 INTRODUCTION

A desktop assessment to review the mycological interest of the proposed candidate North Kent Downs National Nature Reserve was commissioned by the Kent Downs National Landscape Unit on behalf of partners within the proposed NNR. The project is funded by National Highway's Lower Thames Crossing designated fund.

Four objectives were drawn up for the desktop assessment:

Which are the known priority species and habitats.

Which are the known priority sites.

What are the overarching management strategies for the key species and habitats.

Identify any specific habitat management for priority sites.

It should be stressed at the outset that the study is based on limited available data for many sites within the study area, and little or no practical field knowledge of the numerous landholdings within the project boundary.

2 THE STUDY AREA

The study area covers approximately 2200 hectares and is situated on the Kent North Downs, lying immediately west of the city of Rochester, with the A228 effectively the eastern boundary. The A2 divides the main southern block of sites from the smaller northern section, the latter clustered around the Shorne Woods Country Park (Figure 1).

Most blocks are obvious and can be located with ease, but Holborough Woodlands (15 on Figure 1) is a complex on the Halling to Trottiscliffe Escarpment SSSI, including Holly Hill, Great Park Wood, Whitehorse Wood and Great Buckland.

3 DESKTOP STUDY

The study is based primarily on a spreadsheet of fungal records kindly supplied by the Kent & Medway Biological Record Centre (KMBRC[1]). The spreadsheet attempted to cover all sites with mycological records across the study area, amounting to some 5280 records, but including the inevitable duplicated entries, alongside a few questionable records and records of species well outside of the known geographical range. Further documents pertaining to mycological and other surveys from within the study area were supplied by White Horse Ecology[2], but little mycological data was found amongst them. However, useful habitat and ecological data was available in several reports supplied, particularly those compiled by National Highways/Atkins under the Lower Thames Crossing Environment and Wellbeing Designated Fund Scheme (National Highways/Atkins 2022, 2022[1], 2022[2], 2022[3]).

[1] https://www.kmbrc.org.uk/
[2] https://whitehorseecology.co.uk/

Checks were made on the British Mycological Society's Fungal Records Database of Britain & Ireland (FRDBI[3][4]), and available online documents concerning mycological Red Listing and other conservation status were reviewed.

Online checks were made on available websites for the various landholdings within the study area and these often provided useful information on habitat. SSSI citations were checked where applicable, but none referred to on-site fungi.

The Magic Map application[5] was checked for detailed site names and locations.

There are many fungal records on the KMBRC spreadsheet referring to Cobham Park Wood. It is believed that this is a combination of various sites within the potential NNR. The grid reference for Cobham Park Wood is TQ700633 which appears to be a point close to the boundaries of Cobham Wood, 'Leisure Plots' and Ranscombe Farm, and might also take in the Rochester and Cobham Park Golf Club and Cobham Hall School. Unfortunately, it is not possible to separate fungal records from the data set into these individual sites.

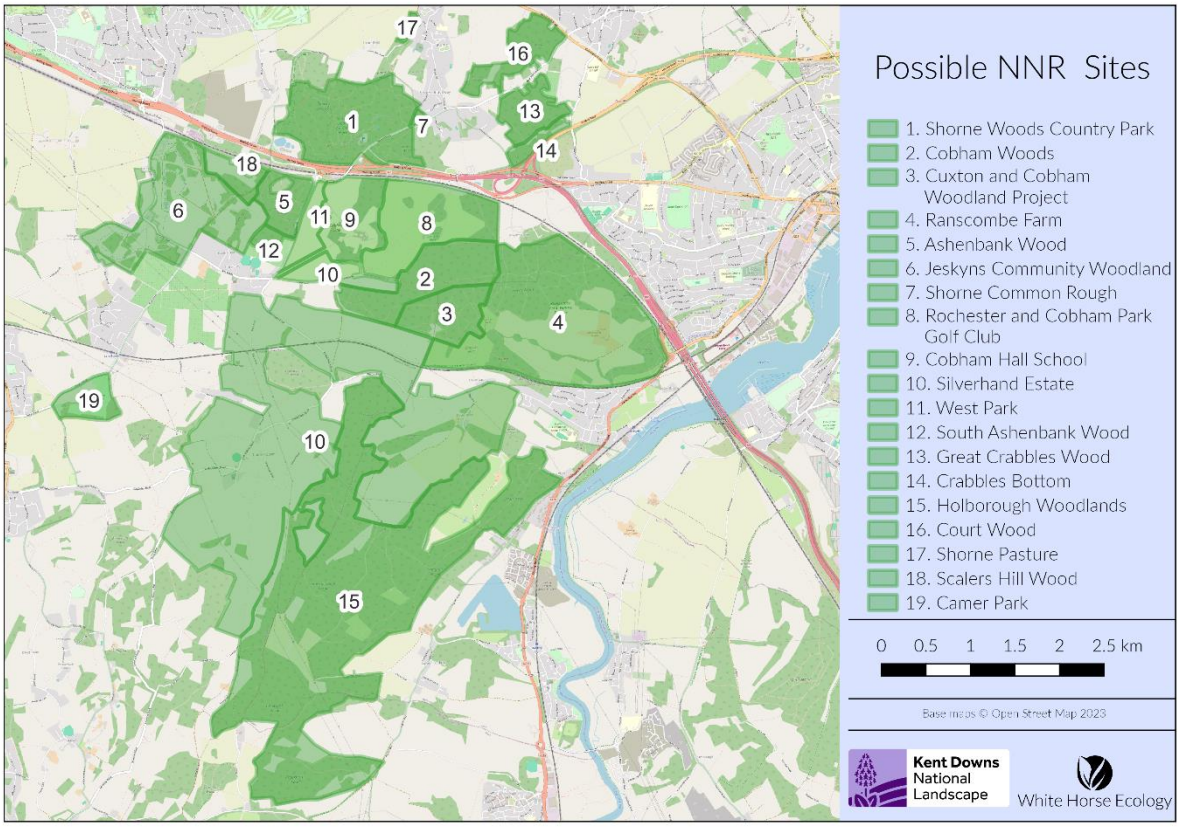

Figure 1. Location

[3] https://basidiochecklist.science.kew.org/BritishFungi/FRDBI/FRDBI.asp
[4] https://www.frdbi.org.uk/
[5] https://magic.defra.gov.uk/magicmap.aspx

4 ASSESSING THE MYCOLOGICAL IMPORTANCE OF THE STUDY AREA

Methodology and conservation assessment of fungi and fungal communities are still evolving, primarily due to the anomalies inherent in taxonomy and species concepts, alongside difficulties in assessing fungal size and distribution. Consequently, most species inevitably fall into the Data Deficient category (Dahlberg & Mueller 2011). Provisional Red Lists have been available since 1992 (Ing, B. 1992) for UK, and 1993 for European Fungi (Ing, B. 1993). A revised and much reduced UK Red List then superseded the original (Evans, S. 2006). UK Biodiversity Action Plans are available for a limited group of fungal species and assemblages (JNCC 2012). A recent Red List has been put forward for species of the *Boletaceae*, the first such list of UK fungi based objectively on IUCN criteria (Ainsworth et al 2013). A set of UK Fungal Red Lists has also been produced by the Fungus Conservation Trust[6], but these are not recognised by JNCC.

During the present century attempts have been made to describe fungal communities considered of prime importance in the UK. These have included reports on waxcap grasslands (Evans, S. 2003), Beech dead wood fungal indicators (Ainsworth, A.M. 2004[1]), and stipitate hydnoid ('hedgehog or tooth') fungi (Marren, P. 2000).

Taking these reports to the next level, in 2019, JNCC produced the 'Guidelines for the Selection of Biological SSSI's (Bosanquet et al 2018). Chapter 14 covers non-lichenised fungi, which includes, amongst others, the waxcap grassland community, **beech** *Fagus sylvatica* and **oak** *Quercus robur* & *Q. petraea* associated dead wood fungi, and stipitate hydnoid fungi[7]. These three communities are to a greater or lesser degree relevant to the study area.

In addition to specific fungal communities, consideration is given in the report to sites within the study area that support large numbers of mycorrhizal fungal species, as these can indicate woodland quality and antiquity.

Various restraints are inevitable when surveying for fungi. Most species depend on favourable weather conditions for successful fruiting. Weather in the UK is unpredictable and will vary significantly across years. Therefore, sites with multiple recording visits over multiple seasons can be considered to have reliable data. To put into context, Tudeley Woods Nature Reserve in West Kent now has over 1250 fungal records from over 30 years of annual recording, with the total increasing each new visit year by year. From the data supplied I suspect that Shorne Woods Country Park would fall into this category, with well over one thousand species recorded over an extended time period.

Another recent development in mycology has been the increasing use of DNA barcoding, following the availability of the Bentolab[8], a portable DNA sequencing 'laboratory', now used by several county fungus study groups. This has been a game-changer for accurate identification of cryptic species, particularly in the difficult genera *Cortinarius* (**webcaps**) and *Entoloma* (**pinkgills**). As a consequence, species new to a county, a country, or even newly described are being discovered on a regular basis.

[6] https://www.fungustrust.org.uk/

[7] JNCC Guidelines for the Selection of Biological SSSIs: Chapter 14, Non-lichenised Fungi.

[8] https://bento.bio/

Whether these should be added to red lists is debatable as they might prove widespread with further sequencing.

Assessing the mycological importance of the study area needs to take all these factors into account. It should be noted that Ascomycetes (cup fungi and allies) and other micro-fungi have not been evaluated as they are currently taxonomically in disarray. It would be difficult to prioritize these fungi within current knowledge of species and distribution. The exception would be the one or two species known as dead wood indicators, such as the common beech associate **spiral tarcrust** *Eutypa spinosa*.

5 KNOWN PRIORITY SPECIES AND HABITATS

Priority species have been initially selected from the red listing process and are presented in Table 1. 44 species are included, although several of those found within the Kent Red Data Book (Waite, A. 2000) would now be considered frequent and should be removed from any revised and updated list. Included in these would be **veined bonnet** *Delicatella integrella,* **steely bonnet** *Mycena pseudocorticola* and **brownflesh bracket** *Trametes gallica*, all now with increased records across south-east England. **Greyshank bolete** *Leccinum cyaneobasileucum*, listed as Data Deficient on the IUCN list is now thought to be widespread in England, possibly more common than **brown birch bolete** *L. scabrum*, and previously much confused with it.

The IUCN red list includes a good number of relatively common UK species and apart from those specifically linked to priority UK habitats, have been excluded.

Species	Kent Red Data Book	UK Red List[9]	UKBAP	IUCN[10]	Location
Amanita submembranacea	VU				Holly Hill Ashenbank Wood
Aspropaxillus giganteus	VU				Ashenbank Wood
Aurantiporus (Pappia) fissilis	EN				Cobhambury Wood
Aureoboletus gentilis	En	NT		NT	Wingate Wood Shorne CP
Cortinarius osmophorus	En	VU			Whitehorse Road
Cuphophyllus colemannianus				VU	Cobham Park Wood*
Daldinia fissa	VU				Ranscombe Farm Cobham Park Wood
Delicatella integrella	En				Holly Hill, Cuxton, Shorne CP, Randalls Wood
Entoloma cf bloxamii	En	Annex	Yes	VU	Cobham Park Wood*
Faerberia carbonaria	VU				Cobham Park Wood*

[9] https://www.britmycolsoc.org.uk/field_mycology/conservation/red-data-list/rdl-taxa

[10] https://www.iucnredlist.org/search?query=Fungi&searchType=species

Fuscoporia torulosa	En	NT			Cobham Park Wood*
Ganoderma resinaceum	En				Shorne CP
Hericium cirrhatum	En				Ashenbank Wood
Hericium erinaceus	VU	Annex	Yes	LC	Cobham Park Wood*
Hydnellum aurantiacum		VU	Yes		Shorne CP
Hydnellum concrescens		NT	Yes		Shorne CP
Hydnellum ferrugineum		NT	Yes		Cobham Park Wood*
Hygrocybe punicea				VU	Cobhambury Wood
Hypsizygus ulmarius	En				Ashenbank Wood
Lactarius citriolens	En				Shorne CP
Lactarius mammosus	En				Shorne CP
Lactarius zonarius	En				Wingate Wood
Leccinum cyaneobasileucum		DD		DD	Shorne CP
Leucoagaricus badhamii	VU				Cobham Park Wood*
Leucoagaricus georginae	En				Shorne CP
Lycoperdon echinatum	VU				Cobhambury Wood Ashenbank Wood
Mycena corynephora	En				Cobhambury Wood Holly Hill, Cobham Park Wood
Mycena pseudocorticola	En				Holly Hill
Mycoacia nothofagi		NT			Shorne CP
Pluteus aurantiorugosus	En				Cobhambury Wood
Porpolomopsis calyptriformis	VU	Annex	Yes	VU	Shorne CP
Rheubarbariboletus armeniacus	VU			DD	Ashenbank Wood
Rubinoboletus rubinus	En	VU		VU	Ashenbank Wood
Russula alnetorum	En				Randalls Wood
Russula aurea	En				Wingate Wood
Terana caerulea	Rare				Great Crabbles Wood
Thelephora caryophyllea	En				No3 Pit Cuxton
Trametes gallica	Rare				Whitehorse Road, Camer CP, Holly Hill
Tricholoma acerbum	VU			VU	Shorne CP Randalls Wood
Tricholoma equestre	En				Shorne CP
Tricholoma psammopus	En				Great Buckland Shorne CP
Tricholoma sejunctum	En				Great Park Wood Holly Hill
Tulostoma brumale	VU				Higham area

Xerocomus chrysonemus				DD	Wingate Wood

Table 1. Known Priority Species occurring within the study area

***Cobham Park Wood. See comment under desktop study above for an explanation of this combined recording area.**

Two priority habitats occur within the study area. These are ancient beech and oak woodland and wood pasture collectively, and the waxcap grassland community. Tables 2 and 3 list priority species present in the deadwood habitats along with their locations. Table 3 is included for species of Pluteus. This genus is mostly representative of old woodland and a high number present will indicate priority woodland habitat. Waxcaps are listed in Table 4.

Species	Beechwood	Oakwood	Location
Aurantiporus fissilis	*		Cobhambury Wood
Ceriporiopsis gilvescens	*		Cobham Park Wood
Daedalea quercina		*	Widespread (9 sites)
Eutypa spinosa	*		Widespread (7 sites)
Fistulina hepatica		*	Widespread (9 sites)
Fuscoporia torulosus		*	Cobham Park Wood
Ganoderma pfeifferi	*		Holly Hill, Great Park Wood
Ganoderma resinaceum		*	Shorne Woods Country Park
Grifola frondosa		*	Cobham Park Wood, Ashenbank Wood, Shorne Woods Country Park
Gymnopus fusipes		*	Great Park Wood, Shorne Woods Country Park, Ashenbank Wood, Holly Hill, Woods above Upper Halling
Hericium cirrhatum	*		Ashenbank Wood
Hericium erinaceus	*		Cobham Park Wood
Hymenochaete rubiginosa		*	Widespread (12 sites)
Laetiporus sulphureus		*	Widespread (9 sites)
Mycena inclinata		*	Widespread (11 sites)
Mycoacia nothofagi	*		Shorne Woods Country Park
Ossicaulis lignatilis	*		Cobham Park Wood, Ashenbank Wood
Phleogena faginea	*		Ashenbank Wood, Cobham Park Wood, Shorne Woods Country Park
Pseudoinonotus dryadeus		*	Cobham Park Wood, Cobhambury Wood
Trametes gallica	*		Holly Hill, Cobham Park Wood, Camer CP, Whitehorse Road
Volvariella bombycina	*		Cobham Park Wood

Table 2. Beech and Oak Deadwood Indicator Species

Species	Location
Pluteus aurantiorugosus	Cobhambury Woods
Pluteus cervinus	Widespread – common everywhere
Pluteus chrysophaeus	Badgsell Wood, Cobham Park Wood, Shorne CP, Ashenbank, Holly Hill, Cuxton
Pluteus hispidulus	Holly Hill, Cuxton/Ranscombe
Pluteus leoninus	Cobham Park Wood, Shorne CP, Ashenbank, Cobhambury Wood
Pluteus petasatus	Shorne CP, Randalls Wood
Pluteus phlebophorus	Ashenbank Wood, Cobham Park Wood, Cuxton/Ranscombe, Rochester and Cobham Park Golf Club
Pluteus plautus	Cobham Park Wood
Pluteus romellii	Great Park Wood, Shorne CP, Holly Hill, Randalls Wood
Pluteus salicinus	Cobhambury Woods, Randalls Wood,Ashenbank, Cobham Park Wood, Shorne CP, Great Crabbles Wood
Pluteus semibulbosus	Randalls Wood
Pluteus umbrosus	Cobham Park Wood, Holly Hill

Table 3. Pluteus (Shield) Species recorded within the study area

5.1 Beech & Oak Deadwood Indicators

Deadwood species are intricately linked to their habitats. According to the recent SSSI guidelines for fungi, a site supporting 15 or more deadwood fungi on beech should be considered for notification. For oakwoods a total in excess of 8 species would warrant consideration. Top sites for the beech deadwood habitat in Southern England can be found in the New Forest, Hampshire, and at Ebernoe Common, West Sussex.

None of the study area beechwoods attain the target of 15, but nevertheless several sites support important species of fungi. The top site within the study area is Cobham Park Wood with 7. Further field study may well increase the total. For the oakwood target, Cobham Park Wood, along with Shorne Woods Country Park, both meet the criteria of 8 species. The oakwood indicators tend to be more widespread than those of beech and can frequently be found in ones and twos at many 'minor' sites, hence several species are shown as widespread in the table.

One important oak species at Cobham Park Wood is **tufted bracket** *Fuscoporia (Phellinus) torulosa*, with around just 20 UK records, nearly all from southern counties. Cobham Park Wood comes up trumps again with the highest number of recorded **shield** *Pluteus* species, 7, followed closely by Shorne with 6. Cobham Park Wood supports further rare or scarce beech deadwood fungi including **bearded tooth** *Hericium erinaceus*, **mealy oyster** *Ossicaulis lignatilis* and **pink porecrust** *Ceriporiopsis gilvescens*.

5.2 The Waxcap Grassland Community

Waxcap grasslands are perhaps the most studied of the mycological communities, research going back to the early 2000's. The UK is certainly important for these fungi, especially along the western seaboard. There are several species present in the UK that are rare and red listed across mainland Europe. The community is also the first to have been given a scoring system to indicate importance and is based on the number of species recorded from the four main groups of fungi present: *Clavariaceae* (clubs and corals), *Hygrocybe* (waxcaps), *Entoloma* (pinkgills) and *Geoglossaceae* (earthtongues). These give each studied sites a 'CHEG' rating. A fifth grassland genus, *Dermoloma* (crazed caps), is usually included in the assessment (Evans, S. 2003).

The most representative sites for waxcaps in Kent can be found at Kent & Sussex Cemetery at Tunbridge Wells (Allison, M. 2015[1]), and at Benenden Hospital (Allison, M. 2023), both with communities of international importance. There are many other known locations in the county, several of which are of national importance.

The waxcaps are found primarily on old grassland sites, particularly on well-established lawns surrounding old and often protected properties such as those owned or managed by the National Trust. Most importantly the grassland will consist of short turf and will not have received artificial fertilisers. For natural grasslands, the South Downs of East Sussex support some important sites (McLay, K, Whitman, J. 2023); (Allison, m. 2015), whereas there are few known sites along the Kentish North Down escarpment, and hence the relative paucity of species within the current study area.

However, within the study area there are uncommon to rare species present, **toasted waxcap** *Cuphophyllus colemannianus* at Cobham Park Wood and **pink waxcap** *Porpolomopsis calyptriformis* at Shorne Woods Country Park being two such fungi. **Crimson waxcap** *Hygrocybe punicea*, recorded from Cobhambury Wood, is also a waxcap grassland indicator species. These few records might indicate the tip of the iceberg as waxcaps occur gregariously and surveying in a good season weatherwise could increase the species numbers significantly.

Species	IUCN	Location
Clavaria argillacea		Shorne Woods Country Park
Clavulinopsis luteoalba		Shorne Woods Country Park
Clavulinopsis helvola		Cobham Hall school grounds
Cuphophyllus colemannianus	VU	Cobham Park Wood
Cuphophyllus fornicatus		Heysdown/Luddesdon, Great Buckland
Cuphophyllus pratensis		Great Park Wood
Cuphophyllus virgineus		Shorne Woods Country Park, Randalls Wood, Crockham Wood, Ashenbank
Hygrocybe acutoconica		Great Buckland
Hygrocybe chlorophana		Cobham Hall school grounds
Hygrocybe coccinea		Cobham Hall school grounds
Hygrocybe punicea	VU	Cobhambury Wood
Porpolomopsis calyptriformis	VU	Shorne Woods Country Park

Entoloma cf bloxamii	VU	Cobham Park Wood
Entoloma cyanulum		Lunsford Lane (Leybourne)
Entoloma sericellum		Holly Hill
Entoloma sericeum		Shorne Woods Country Park
Dermoloma phaeopodium		Holly Hill

Table 4. Fungi of the Waxcap Grassland Community within the study area

5.3 Stipitate Hydnoid (Hedgehog or Tooth) Fungi

Another important group of fungi are those known as stipitate hydnoids or tooth fungi and are included in the guidelines for fungal SSSI selection (Bosanquet, S. et. Al. 2018). These fungi display fine spines on the underside of the cap rather than the normal gill or pore structures of other terrestrial species. They tend to be found growing in communities of mixed tooth fungi species, and in Southeast England favouring the more acid soils of the Kent & Sussex High Weald. Important sites are Tudeley Woods and Mereworth Woods in West Kent.

Within the study area only three tooth fungi species have so far been identified. These are **mealy tooth** *Hydnellum ferrugineum* (Cobham Park Wood), **zoned tooth** *H. concrescens* and **orange tooth** *H. aurantiacum* (Shorne Woods Country Park). Orange tooth is a species of the Scottish Caledonian pine forests and has presumably been recorded in error. Neither orange tooth nor mealy tooth appear on the FRDBI database for Kent. The habitat for mealy tooth is under **pine** *Pinus sp*. on sandy soil, so again I would suspect this to be an erroneous record. Zoned tooth from Shorne Woods Country Park is considered a valid record. As mentioned, these species tend to form communities and where one is found then others can be searched for.

6 KNOWN PRIORITY SITES

Table 5 lists the sites within the study area supporting the highest number of red-listed fungal species. Further consideration should be given to those sites with dead wood indicator species and waxcap grassland fungi (Tables 2-4), along with significant numbers of mycorrhizal fungi (Table 6).

In all cases, Shorne Woods Country Park tops the lists and can be considered the most important mycological site overall within the study area, based on current knowledge. Cobham Park Wood runs a close second. Significantly these sites support extensive numbers of ancient and veteran trees, with 223 at Shorne Woods. The combined sites within Cobham Park Wood support 126 at Cobham Wood, and 360 at Ranscombe Farm (Highways England/Atkins various site reports; Wider Cobham Tree Survey Sites). Additionally, both are large sites at 184ha and 235ha respectively and are therefore capable of supporting important dead wood fungi and rich mycorrhizal communities.

Cobham Park Wood supports a few local or rare waxcap species, including two classed as Vulnerable, presumably in areas of parkland and calcareous or acid grassland. Shorne Woods Country Park supports five waxcap grassland species, including the red listed **pink waxcap.** A site with a few waxcap grassland species should normally be recommended for further recording visits as more are quite likely to be present.

Two sites worthy of further study are Holly Hill and Ashenbank Wood, the latter supporting 131 ancient trees and several uncommon dead wood fungi. The former sits within the Halling to Trottiscliffe Escarpment SSSI (shown as Holborough Woodlands in Figure 1). This extensive 648.4ha stretch of downland includes open grassland, beech woods, and coppice with standards and has the potential to be rich mycologically across all habitats present, although current available data appears somewhat limited. Holborough Woods supports an impressive 177 veteran trees making it worth further investigation.

Site	KRDB	UK RED LIST	UKBAP	IUCN
Shorne Woods Country Park	10	5	3	4
Cobham Park Wood	10	4	3	4
Ashenbank Wood	7			2
Holly Hill	6			
Cobhambury Wood	4			1
Wingate Wood	3	1		1

Table 5. Top sites in the study area for red listed fungi (some species will fall into more than one category)

Site	Webcaps *Cortinarius*	Brittlegills *Russula*	Milkcaps *Lactarius*	Fibrecaps *Inocybe*	Boletes *Boletus etc.*
Shorne Woods Country Park	27	42	23	7	19
Randalls Wood	13	29	15	11	9
Holly Hill	4	25	14	10	8
Ashenbank Wood	0	21	12	3	10

Table 6. number of known mycorrhizal fungi from selected genera.

7 RECOMMENDATIONS FOR THE MANAGEMENT OF IMPORTANT FUNGAL HABITATS

7.1 The Waxcap Grassland Community

There is now considerable information available for the conservation management of grassland for fungi. Two advisory leaflets published by Plantlife for the Fungus Conservation Forum (Fungus Conservation Forum 2004) summarise the best grassland fungal sites as:

- Often well-drained

- Have a short turf
- Are poor in nutrient and usually unfertilised
- Often have plenty of moss present
- Are not necessarily rich in flowering plants

Management recommendations for waxcap grasslands include the following prescriptions:

- Grassland should be kept well mown so that the turf remains short
- Clippings should be removed wherever possible
- Reduce or stop mowing by early-October (weather dependent)
- Maintain drainage
- Avoid fertilizers, fungicides and moss-killers

Grassland conservation managers will often concentrate on the restoration and management of the floristic element, sometimes to the detriment of the fungi that may be present. Issues can therefore arise over mowing regimes, grazing (including over-fertilisation from animals), sward height and potential sward disturbance. Consideration is therefore needed in any decision as to which should take priority when drawing up management prescriptions, and if possible, a fungal audit should be attempted before any final decision.

7.2 The Woodland, Wood pasture and Parkland Fungal Communities

Two tables are presented below. These refer to management prescriptions for both dead wood fungi and for the general woodland fungal community. They form part of the Woodland Wildlife Toolkit[11] developed by a multi-partnership including Forestry Commission, Natural England, RSPB and the Woodland Trust. The text for the fungal sections of the toolkit was compiled by the present author Martin Allison (Sylvan Consultancy) and Martyn Ainsworth (Kew). The prescriptions are aimed at anyone who manages, or oversees the management, of woodland in the UK. These are the original texts, and they might have received slight modifications at a later date as the toolkit allows updates to be added.

It will be noted that the bulky deadwood fungi prescriptions highlight **oak polypore** *Piptoporus quercinus* and toothed *Hericium* species, but the recommendations cover management for all deadwood fungal saprotrophs, including those mentioned in this report.

[11] https://community.rspb.org.uk/ourwork/farming/b/farming-blog/posts/the-woodland-wildlife-toolkit---a-tool-to-help-with-woodland-management

7.2.1 Bulky Deadwood Fungi

Area and Status

Oak polypore *Piptoporus quercinus* is restricted to oak and is estimated to be occupying the heartwood of 200-250 trees in England with just a few occupied oaks in E. Wales and S. Scotland. The world stronghold, over 100 occupied trees, is likely to be in Windsor Great Park and Forest, Berkshire. The remainder of the English population is scattered wherever the habitat is suitable.

The toothed *Hericium* species have a wider distribution and are found on old trees within and outside of the high forest habitat. The majority of records are from beech. The New Forest is a nationally important site for dead wood fungi specialists on beech, including the *Hericium* species. Bearded tooth is virtually restricted to old deciduous woodland in southern and south-western England.

Woodland type:

Lowland Broadleaved Woodland, Plantation Woodland, Wood-pasture, and Parkland

Preferred habitat niches:

Oak polypore is usually seen fruiting in July and August in open-grown mature and/or ancient English oak woods (maidens or pollards) in parkland, wood pasture, or former wood pasture, where trees have exposed heartwood and branches are allowed to fall and decay *in situ*. It is restricted to deadwood, living in the dead central heartwood core of oak (always *Quercus robur*) and fruiting where heartwood is exposed, or overlying sapwood has died. Most frequently seen fruiting on veteran oaks with hollow trunks and fallen main branches on large diameter limbs. Oak polypore occupies the same habitat as the two much more familiar oak-associated bracket fungi: chicken of the woods *Laetiporus sulphureus* and beefsteak fungus *Fistulina hepatica,* but the latter two are far more widespread and can be found on sweet chestnut as well as oak.

The *Hericium* species fruit in late summer to autumn and are saprotrophic on standing or fallen dead parts of trunks and large branches of broadleaved trees, most notably beech. Bearded tooth's preference is for damaged areas of old standing beech trees (wounds, branch stubs etc.), but may also fruit on fallen limbs. They may be found on trees deep within the forest, including PAWs sites.

Potential habitat management issues associated with decline:

- Loss of woodland and wood pasture habitat
- Large gaps in age structure of oak and beech

- Other trees (holly, maiden oak) outcompeting occupied oak pollards
- Removal and destruction of occupied heartwood and dead wood
- Fragmentation of fallen branches during mechanical bracken management and forestry operations
- Fires
- Health & Safety concerns

Potential habitat management solutions:	
Prescription	*Comment*
Manage the woodland with fungi in mind	Refer to the generic woodland fungal community management guidelines.
Allow occupied wood to produce fruit bodies (brackets)	Leave all standing and fallen dead wood in situ, with main large diameter fallen branches uncut and in situ where they fall. Do not remove large dead branches still attached to the tree. Do not create wood piles on top of fallen limbs. Control surrounding trees if necessary, by removing those which are crowding the host tree, thus creating a "halo" around the oak or beech. Removal of surrounding dense stands should be by gradual phased felling. Any operational machinery needs to avoid damaging the ground and the fallen tree limbs.
Prolong life of oldest trees on site to lessen effects of age gap	For oak polypore, bring lapsed pollard oaks back into pollard cycle or at least reduce canopy weight.
Woodland continuity	Ensure the woodland is regenerating and thus providing a range of age classes amongst the oaks and beeches. Planting should be a last resort. Protection of young trees from deer browsing may be needed. Ensure some mature healthy trees are left during harvesting operations to develop into future veterans.
Grazing	Where grazing is present as a management tool in wood pasture it should keep surrounding vegetation down and prevent overgrowth of occupied fallen branches, but oak and beech regeneration may need protection.
Fires	There should be no fire sites near to old trees.
Managing public pressure	Wherever possible, divert footpaths away from veteran trees rather than making the tree safe.

7.2.2 Woodland Fungal Communities

Area and Status	Rich fungal communities or individual rare species can potentially exist in any wooded habitat across the UK. As a generalisation, large contiguous blocks of semi-natural ancient woodland supporting diverse tree, shrub and herb cover offer the most opportunities, but plantations on ancient woodland sites, sweet chestnut coppice and other lesser priority habitats can also support important assemblages of fungi, including BAP species.
Woodland type:	Upland Broadleaved Woodland, Lowland Broadleaved Woodland, Plantation Woodland, Wet Woodland, Wood Pasture.
Preferred habitat niches:	Woodland fungi requirements do not always fit comfortably with either commercial forestry or conservation management practices. Fundamentally, the fungi need moist, undisturbed low light areas of woodland to thrive, so that any prescriptions for major ride, glade, coppicing, thinning/felling and PAWs restoration works can have at least a short-term detrimental effect on fruiting, and possibly cause long-term damage to underground mycelia through compaction and desiccation. Minimal managed semi-natural ancient woodland that supports mature and veteran trees will offer the best niche for mycorrhizal fungi and for saprotrophic litter and dead wood species. Softwood plantations will sometimes support diverse communities of fungi, with those mixed with broadleaves offering the best opportunities. In any woodland, regeneration of the native canopy trees and shrubs is vital. Many woodland fungi associate with a particular tree or shrub species, or form intimate links to various species of tree, creating a symbiotic relationship that is necessary for the continued health of both tree and associated fungi. The smaller fungi found on a host of vascular woodland plants should not be ignored.

Potential habitat management issues:

- Lack of knowledge of presence and distribution of fungi
- Woodland loss and fragmentation
- Management promoting permanent open space and leading to extra light source to forest floor
- Deer presence
- Loss of standing and fallen dead wood
- Commercial picking

Potential habitat management solutions:	
Prescription	*Comment*
Organise mycological surveys	Perhaps the most important aspect of fungal conservation is the lack of knowledge surrounding presence and distribution of fungal species. The main issue is that the fungi exist unseen in the substrate most of the year, and then may only fruit fitfully in some years. However, it is important to undertake mycological surveys, especially if management is planned, as these will begin to identify suites of species present and will also allow an assessment of the potential for the site to support significant fungal assemblages. Ideally, a survey over three seasons is recommended to allow for climatic variation. Long-term monitoring is particularly valuable. Many woodland owners now encourage annual surveys which start to build up a picture of the importance, or not, of a particular woodland for fungi.
Maintain woodland cover	Woodland fungi, with few exceptions, fruit poorly when exposed to high levels of light and warmth, such as follows coppicing or other woodland clearance. Edge effect of fragmented woodland blocks has the same detrimental impact. A regular traditional coppice cycle (hazel, sweet chestnut) is not considered permanently damaging, as regrowth is usually rapid over a short number of seasons and ground flora lacks the capacity to fully dominate. Derelict mixed coppice with standards is an important niche habitat for many mycorrhizal fungi and management should be approached with caution in these stands, leaving some compartments uncut for the long term. Ensure that the woodland is regenerating so that trees and shrubs are self-perpetuating. Restocking is a last resort. Management prescriptions allowing for long term open ground, such as wide rides and large glades will have a detrimental effect on most but not all woodland fungi present. There will be increased light alongside increased competition from vascular plants. Regular maintenance of the open areas usually requires some form of cutting or mowing which again may cause damage to fungi. Knowledge of the distribution of fungi before planning new rides and glades will limit the impact on mycologically valuable hotspots.
Protect important fungal assemblages during harvesting	All harvesting operations have the potential to permanently damage fungi. Heavy plant driven over the forest floor will cause compaction and deep rutting which can damage underground mycelia, possibly severing the link between tree and fungus. If the presence of important fungi is known then extraction routes should be planned to avoid them. During harvesting, ensure that selected mature trees are retained to grow on as veterans. These need to be healthy individuals with assured longevity to survive, rather than weak or damaged trees.

	Large brash fires in close proximity to each other should be avoided in areas known to support key fungi. Occasional fires on carefully chosen sites can add to fungal diversity as some species grow specifically on burned ground and charred wood. Large piles of unburnt brash do not offer significant habitat for fungi, and can restrict fruiting beneath the heaps. Where practical, brash is better left scattered on the woodland floor. A percentage of softwood species should be retained during PAWs restoration projects. Biomass harvesting is of particular concern as it has the potential to cause regular damage with heavy cutting and extraction machinery. The short cutting rotation typical of biomass operations prevents the formation of a closed canopy and thus creates exposed permanent open space dominated by vigorous vascular plants.
Control and monitor deer populations	Deer browsing potentially causes problems for fungi, depending on its severity. Heavy browsing of a particular shrub or plant will have a negative impact on any fungal species specifically dependant on the browsed plant, especially if the plant is ultimately unable to regenerate. Heavy browsing can lead to drying out of the forest floor by allowing higher light levels through the canopy, and ground compaction from concentrated browsing and resting areas.
Retain standing and fallen dead wood	Standing and fallen dead wood should be left in situ unless health & safety considerations dictate otherwise. If dead wood needs to be removed it should be carefully transferred wholesale to an area of forest in close proximity rather than cut up and removed off site. Wind-throw, tall snagged stumps, large trunks and whole fallen limbs provide superior fungal habitat compared to stacked log wood and brash piles. Tree surgery of damaged tree limbs should be avoided.
Commercial picking	Some forests are targeted by commercial pickers supplying the restaurant trade. The long-term effects of this practice on fungi are not known but this type of collection should be monitored and discouraged. There are issues around ground compaction in frequently visited areas. Commercial pickers will often collect indiscriminately, removing unidentified fungi from the wood where others will sift through for edible species, discarding the rest. This removes considerable fungal biomass from the woodland for little gain, whilst destroying a valuable food source and habitat for a host of woodland invertebrates.

8 SUGGESTIONS FOR FURTHER MYCOLOGICAL SURVEY

There is a difficulty in assessing good fungal habitats as many sites within the study area have few or only common fungal records. It is not known whether this is a result of surveys finding few species, sites representing poor fungal habitat, or the sites have had very few visits by mycologists, due perhaps to private or sensitive sites with no public access.

Within the study area two sites stand out as being mycologically rich. These are Shorne Woods Country Park and Cobham Park Woods. Further general recording is probably not a priority here as they have been surveyed frequently since at least the early 1990's. However, along with Ashenbank Wood, these sites support significant numbers of ancient and veteran trees, but the list of dead wood fungal indicators is surprisingly sparce. A targeted survey of the dead wood habitat is therefore recommended. From the little available data on veteran trees across the study area, it appears that beech might be quite scarce across these sites, which would go some way to explaining the lack of beech dead wood fungi. Oak and sweet chestnut make up the bulk of the older trees.

Sites with records of stalked tooth fungi (Shorne Woods Country Park, Cobham Park Woods) should be visited to search for further species of this community of fungi, where several species will often be found in close proximity.

Apart from Holly Hill, there are relatively few fungal records from the large Holborough Wood complex. This might be due to difficulties with access onto private land. Sampling across this landscape at selected points should prove worthwhile.

There is little evidence of important waxcap grassland communities present within the study area, but there are scattered records of important species. One potential search area on the SSSI escarpment would be Ladd's Farm. The Ladd's Farm Chalk Grassland management plan states that 'no fungal surveys have been undertaken on site – a study of this area would be welcomed' (Wileman, T. 2011). It is not known whether this was pursued. Other grassland sites within the chalk escarpment SSSI complex would be worth visiting, as would any site within the study area with waxcap records. As stated, these fungi grow together communally, and further species can often be added with new visits.

In summary, it is pertinent to quote from the woodland management guidelines above: '*Perhaps the most important aspect of fungal conservation is the lack of knowledge surrounding presence and distribution of fungal species.'* Unfortunately, this lack of knowledge is reflected across all SSSI citations consulted for this report, and all reports prepared for the designated fund scheme, where there is not one reference to fungal presence. In a wider UK context, this same situation is reflected in many conservation management plans.

Much emphasis has been put on European Protected Species (EPS) in the UK planning process. Undoubtedly these species are important and need to be protected. However, often other less studied but equally rare taxa and assemblages go un-recorded and, consequently, are sometimes unwittingly damaged or destroyed (Hall &Gibson 2021).

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APPENDICES

Appendix 1. English names of all species mentioned, where available

Species	Common name where applicable[12]
Aurantiporus (Pappia) fissilis	Greasy Bracket
Amanita submembranacea	Olive Amanita
Aspropaxillus giganteus	Giant Funnel
Auroboletus gentilis	Gilded Bolete
Ceriporiopsis gilvescens	Pink Porecrust
Clavaria argillacea	Moor Club
Clavulinopsis helvola	Yellow Club
Clavulinopsis luteoalba	Apricot Club
Cortinarius osmophorus	Sweet Webcap
Cuphophyllus colemannianus	Toasted Waxcap
Cuphophyllus fornicatus	Earthy Waxcap
Cuphophyllus pratensis	Meadow Waxcap
Cuphophyllus virgineus	Snowy Waxcap
Daedalea quercina	Oak Mazegill
Daldinia fissa	
Delicatula integrella	Veined Bonnet
Dermoloma phaeopodium	
Entoloma cf. bloxamii	Big Blue Pinkgill
Entoloma cyanulum	
Entoloma sericellum	Cream Pinkgill
Entoloma sericeum	Silky Pinkgill
Eutypa spinosa	Spiral Tar Crust
Faerberia carbonaria	Firesite Funnel
Fistulina hepatica	Beefsteak Fungus
Fuscoporia torulosa	Tufted Bracket
Ganoderma pfeifferi	Beeswax Bracket
Ganoderma resinaceum	
Grifola frondosa	Hen of the Woods
Gymnopus fusipes	Spindle Toughshank
Hericium cirrhatum	Tiered Tooth
Hericium erinaceus	Bearded Tooth
Hydnellum aurantiacum	Orange Tooth
Hydnellum concrescens	Zoned Tooth
Hydnellum ferrugineum	Mealy Tooth
Hygrocybe acutoconica	Persistent Waxcap
Hygrocybe chlorophana	Golden Waxcap
Hygrocybe coccinea	Scarlet Waxcap
Hygrocybe punicea	Crimson Waxcap
Hypsizgus ulmaruis	Elm Leech
Hymenochaete rubiginosa	Oak Curtain Crust
Lactarius citriolens	

[12] https://www.britmycolsoc.org.uk/resources/english-names

Lactarius mammosus	Pap Milkcap
Lactarius zonarius	
Laetiporus sulphureus	Chicken of the Woods
Leccinum cyaneobasileucum	Greyshank Bolete
Leucoagaricus badhamii	Blushing Dapperling
Leucoagaricus georginae	
Lycoperdon echinatum	Spiny Puffball
Mycena corynephora	
Mycena inclinata	Clustered Bonnet
Mycena pseudocorticola	Steely Bonnet
Mycoacia nothofagi	Fragrant Toothcrust
Ossicaulis lignatilis	Mealy Oyster
Phleogena faginea	Fenugreek Stalkball
Pluteus auranteorugosus	Flame Shield
Pluteus cervinus	Deer Shield
Pluteus chrysophaeus	Yellow Shield
Pluteus hispidulus	Fleecy Shield
Pluteus leoninus	Lion Shield
Pluteus petasatus	Scaly Shield
Pluteus phlebophorus	Wrinkled Shield
Pluteus plautus	Satin Shield
Pluteus romelii	Goldleaf Shield
Pluteus salicinus	Willow Shield
Pluteus semibulbosus	
Pluteus umbrosus	Velvet Shield
Porpolomopsis calyptriformis	Pink Waxcap
Pseudoinonotus dryadeus	Oak Bracket
Rheubarbariboletus armeniacus	Apricot Bolete
Rubinoboletus rubinus	Crimson Bolete
Russula alnetorum	
Russula aurea	Gilded Brittlegill
Terana caerulea	Cobalt Crust
Thelephora caryophyllea	Carnation Earthfan
Trametes gallica	Brownflesh Bracket
Tricholoma acerbum	Bitter Knight
Tricholoma atrosquamosum	Dark Scaled Knight
Tricholoma psammopus	Larch Knight
Tricholoma sejunctum	Deceiving Knight
Tulostoma brumale	Winter Stalkball
Volvariella bombycina	Silky Rosegill
Xerocomus chrysonemus	Goldenthread Bolete