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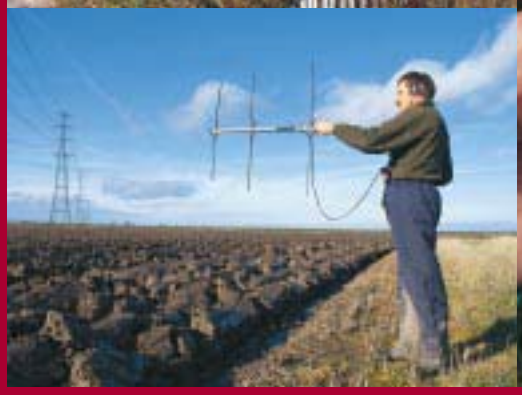

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Developing tools for assessing fungal interest in habitats 1: beech woodland saprotrophs

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Executive summary

Fungal records are available online, with some restrictions, from the British Mycological Society's database (BMSFRD). Although still in its infancy, the database is already highlighting the patchy and intermittent patterns of mycological recording activity. Hence a long list of records or species for a site is not necessarily indicative of the highest conservation value. Furthermore, all-taxa fungal inventories of significant numbers of sites are unlikely to be a practical proposition and experts in the field are familiar with species lists that continue to increase even after decades of recording.

The pragmatic use of fungal indicator species has been tested overseas for several years, largely in regions of boreal conifer forests, and has been incorporated into countrywide surveys to locate 'woodland key habitats' in countries such as Sweden and Estonia. Increasing British and Irish interest in the conservation of waxcap grasslands has resulted in the adaptation and comparison of several assessment methods. Some of these rely on the location and identification of as many taxa as possible within specified genera or families, whilst others use a weighted scoring system in an attempt to recognise conservation value created by rarity and diversity. The use of a manageable subset as indicators of conservation value is also under discussion. Building on this, a short part-time project (September 2003-March 2004) was carried out to extend the concept of fungal indicators into woodland habitats.

Over a decade of personal observations of fungal saprotrophs recycling large diameter beech substrata in Windsor Forest yielded a species list largely in accordance with that independently generated by a pioneering Danish beech forest project. Using these resources as a starting point for a proposed list of indicators, the BMSFRD was interrogated (sites, substrata, frequency, distribution etc) to assess the suitability of each species for use, initially within native beech habitats. Suggested additional species were treated similarly and the proposal was discussed with several field mycologists familiar with this habitat and preliminary aspects were orally presented at an English Nature workshop in Cardiff and a BMS Meeting in Kew.

A British list of 30 indicators is proposed and initially validated using the available historical and modern records for a set of 11 English beech-dominated sites which are well-studied and widely regarded as among the 'best' by fieldworkers. The sites were ranked using the British indicators and also by using a potential European list which is now being tested by the Danish team. The suitability of adopting a single European list is debatable due, for example, to the differing (and dynamic) geographic ranges of the indicators. Nevertheless, by using the European list to grade 126 sites, all 11 English examples were ranked in the top 30. Two New Forest sites (Denny and Wood Crates) were ranked in the top ten, thus supporting the assertion that England has dead beech habitat of international importance.

It is hoped that the indicator list will now be tested more extensively to provide a more objective basis for identifying and grading similar habitats. To assist with this, a recording sheet is appended together with data sheets on all 30 fungi (and some de-selected species) giving numbers of known records on all trees, VC distribution before and since 1960 on all trees (by manually shading the VC map associated with the BMSFRD), some synonyms, English names, tree associates listed in descending order of frequency in BMSFRD (November 2003) and scanned photographs as an identification aid.

The aim is to establish a method by which fungi can be taken into account in the SSSI selection process and thus ensure they are protected on a scientific basis.

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1. Introduction

Over the last decade there has been a dramatic upswing in the profile of fungal conservation in the United Kingdom and Eire. Appropriately enough, it is undergoing a metamorphosis from an inconspicuous mycelium-like state into a rapidly growing and increasingly visible entity.

This report covers some aspects of fungal recording and development of criteria upon which to set priorities for fungal protection and site selection. Two notable milestones along this route were the publication of *A provisional red data list of British fungi* (Ing 1992), which set out to provide the means to grade sites, and *Important fungus areas* (Evans, Marren & Harper 2001), which was a provisional assessment of the best UK sites for fungi. To date, neither has fully reached the desired goal regarding site selection and fungal protection. While the former is currently undergoing a lengthy revision with the latter scheduled to follow, interest is being generated by the possibility of a major role for fungal indicator species.

Following on from an initial British and Irish interest in applying this approach to grassland assessments, this report highlights a woodland focus on deadwood-associated fungi of beech-dominated habitats and development of a suggested list of indicator species. The list has been validated for some English sites believed to be of conservation value in this respect (eg Figures 1, 3 & 4) and these are currently being evaluated in a European context. A blank recording sheet is included in Appendix 3 and it is hoped that many copies of this will be given a thorough field testing *en route* to their eventual role in generating site selection guidelines and site-based dossiers.

A presentation outlining the preliminary ideas for this project was given by the author at the English Nature *Ecology and Conservation of Fungi* workshop held in Cardiff on 14 and 15 May 2003, followed by an article *Fungi as indicators of deadwood habitat quality* in English Nature's *Flora English Nature – Summer 2004* magazine and a presentation *Towards a deadwood Signalarter – route and roots* delivered at the BMS Autumn Taxonomy meeting held at Kew on 15 November 2003.

2. Historical aspects

2.1 Fungi and the long Latin list

UK fungal records have traditionally accumulated from the efforts of individual field mycologists, county naturalists' societies and the British Mycological Society's (BMS) annual programme of fungus forays. This is now being increasingly augmented by fungal recording groups, site- and species-based contract survey work and enhanced by publications such as *British Wildlife*, *Field Mycology* and *ABFG Journal*. Not surprisingly, some sites have yet to receive a mycological visit and contrast starkly with others that have been the focus of intensive recording by various specialists for long periods of time. In England, the relatively small sites of Esher Common, Surrey, (3100 species) and the Slapton Ley area, Devon, (2500 species) are outstanding in this regard (Evans, Marren & Harper 2001). On a larger scale and spanning almost two centuries of collecting, New Forest fungal records have recently been compiled into a volume listing in excess of 2600 species including lichenised forms (Dickson & Leonard 1996). Regardless of whether one considers site-based lists or the entire national checklist, a stream of 'new' species is always being added with the passage of

time. In Scotland, one Caledonian pinewood site was intensively recorded for agarics and boletes for 21 years. When the accumulation of species was plotted on a graph against the number of visits, the curve showed no sign of levelling off. Even with such a prolonged and intense search effort and a total of 502 species recorded, the authors concluded that 21 years was simply insufficient time in which to produce a reliable estimate of the fungal diversity of the site (Tofts & Orton 1998). Given this sobering conclusion and the considerable differences in duration, coverage and intensity of recording activity applied to sites of various sizes and habitat complexity, it does not seem practical to adopt total fungal inventories (even for a single habitat type, let alone an entire site) as the means to compare and rank sites or representative examples of habitat type with a view to prioritising for protection.

The Important Fungus Areas (IFA) project did incorporate species totals in site selection, forming the basis of IFA Criterion B, such that "a site should be considered if it includes at least 500 recorded species". However, the limited and temporary usefulness of this criterion was clearly acknowledged in the accompanying statements about ever-increasing species totals and diversity of habitats, disturbance and site size. It was also acknowledged that the future development of habitat-specific indicator species might provide a more useful criterion, once an updated checklist of British basidiomycetes had been published (Evans, Marren & Harper 2001).

IFA Criterion C rested on "objective assessment of habitat importance", but in practice this is currently more or less limited to a choice of methods for ranking waxcap grasslands. For these, the preferred IFA assessment method was based on species totals for the coral and club family Clavariaceae, the waxcap genus *Hygrocybe* and grassland species of the pink-gilled mushroom genus *Entoloma*. Therefore, instead of recording all fungi that are detectable on a grassland site, there was a focus on certain chosen taxa. However this still encompasses almost 200 fungal taxa for assessment of English grasslands (Evans 2004). As with IFA Criterion B, comparisons are heavily dependent on recorder competence and effort in locating and distinguishing all native species in the chosen groups including some that are relatively poorly-known and challenging. Grassland Clavariaceae and the large genus *Entoloma*, for example, are poorly known and frequently present identification challenges. As the updated checklist is expected to retain a large number of species in these groups, there remains the suspicion that a gross mismatch exists between the demands of the task, the suitably experienced manpower available to carry it out and the time required. The demands of the task include timely coverage of a large number of sites, location of a potentially large number of species, each in its own fruiting season, and species identification with microscopic examination and authoritative confirmation by continental workers where necessary. This would presumably continue for an arbitrary period at each site, taking into account its 'performance' in relation to the existing 'league tables' of other sites. There remain some similarities therefore between this approach and the total inventory approach to ranking entire sites as both require considerable time, organisation, mycological expertise and human resources for effective accomplishment.

A similar approach had been adopted earlier with North American coniferous forest fungi and arose from the 1990 US declaration of the northern spotted owl as threatened in the Pacific Northwest timber region. A series of legal challenges, public debate and an intervention by President Clinton led to the establishment of an ecosystem management team for the diminishing ancient forests. In 1994, the team selected 234 fungi for extensive surveying to find high-priority sites and thereby ushered in a decade of regional surveys (Castellano and others 1999). Whilst it is unquestionably of great mycological and ecological interest to

search for over two hundred poorly known species in a habitat over a ten year period, it may not always be considered as the most appropriate approach from a pragmatic and often financially and time-constrained conservation perspective. Relatively rapid methods of assessment will undoubtedly miss a great deal, but they may have the advantage of preserving some fungi in habitats of value until longer-term thorough investigations yield answers. In reality, there is a pressing need to adopt a workable system of habitat evaluation that is feasible, given the available resources, whilst acknowledging that it may not be the ideal solution.

The foregoing considerations favour the development of indicator-based systems of habitat quality assessment. Having a shortlist of target species to search for will help to make the task more manageable for teams of conservationists working with the small group of fungal specialists available.

2.2 Indicator based work

2.2.1 Waxcap grassland assessments

Recent British and Irish pioneering work on habitat assessment for fungi has been directed towards waxcap grasslands. This has had various benefits in addition to the obvious one of generating momentum for tackling site comparisons with a view to increasing fungal protection where appropriate. For example, waxcaps have colourful and conspicuous fruitbodies which make them attractive flagships for conservation publicity. Secondly, they highlight habitats that are rarely a conservation priority for other organism groups, indeed they may be destroyed by conservation schemes favouring creation of other habitat types. Thirdly, they have demonstrated how ideas develop and progress accelerates once a prototype approach is made widely available for discussion and field testing. For example, an analysis of Scottish waxcap grassland survey data by Newton and others (2003) revealed that a poor correlation existed between the different groups of grassland fungi such that a site recognised as important for *Hygrocybe*, for example, would not necessarily be one of the best *Entoloma* sites. Indeed, grassland method development can be traced from the early rapid assessments based on numbers of fruiting waxcaps *Hygrocybe* spp. (Rald 1985) to the broader-based unweighted (all taxa ranked equally) and weighted (rarities having a higher score) methods covering additional grassland fungal taxa. In the weighted methods, attempts were made to assign members of the different fungal groups to different categories of rarity for use as indicators of habitat quality. For example, high, medium and low categories were used by Rotheroe (1999) and then converted to a score by McHugh and others (2002) to produce weighted scores for Irish grasslands, a habitat for which few survey data existed.

Figure 1 Habitat diversity at important sites for beech saprotrophs: Storm-damaged chalky beech slopes at (A) Norbury Park, with understorey ash, yew and box groves, and (B) Lullingstone Park, a former deer park, contrast with the more unscathed and clay-dominated (C) Nobbscrook area of Highstanding Hill (Windsor Forest), a small valley with good beech regeneration, and (D) The Mens, a former pasture woodland now developing a dense holly understorey. Photographs © Dr Martyn Ainsworth.

One implication of the weighted score approach would seem to be the potential for equivalent scores arising from the presence of either a few high-scoring rarities or an abundance of low-scoring commoner species. Whilst it would seem reasonable that high conservation value is accorded to both rarity and species diversity, it would be desirable to ensure both are represented in the series of protected sites. Moreover, strongholds for rare/scarce species need to be taken into account to ensure that a series of sites with complementary fungal diversity is protected. Hence, although there are advantages to a weighted scoring system, there is still a need to analyse the means by which high scores are achieved to secure adequate representation of the various rare, scarce and otherwise threatened species and of the sites with highest species diversity.

2.2.2 Woodlands and indicators

Swedish woodlands were the focus of a National Board of Forestry initiative which began in 1993 to survey woodland key habitats (WKHs) within 11.7 million hectares of forest. The WKHs were defined as areas with high conservation value with one or more red listed species or a strong likelihood, partially based on detection of indicator species, of such species being present (Anon 2002). In addition, PWKHs were identified which were considered to be potential WKHs within a 10-30 year timescale if managed to promote biodiversity. The survey was estimated to cost 13.2 million euros during the first ten years and spawned a shorter offshoot survey in Estonia from 1999-2002 which involved an estimated 14,800 days of effort (Andersson and others 2003). The importance of mycological (lichenised and non-lichenised taxa) and bryological indicators was recognised in the publication of a high-quality compendium of 22 Swedish woodland habitat types, their indicator species (signalarter) and 130 data sheets on macrofungal species or groups which included distribution maps and allocation of species to three levels of conservation value (Nitare 2000). Some key points emerging from these surveys are:

- The WKHs are notable for containing certain ‘key elements’ which make them suitable for habitat specialist organisms which are mainly Red Data Book species. ‘Key elements’ include biological elements such as old trees, hollow trees, snags (*in situ* broken trunks), fallen branches, exposed heartwood, sun-baked deadwood and damp wood. One of the most important ‘key elements’ was the presence of large pieces of deadwood in different stages of decay. There are also abiotic ‘key elements’, eg landscape, rock or water-related features. However these elements in themselves were not regarded as sufficient to determine WKHs and due prominence was given to indicator species. In particular, the indicators were considered to be particularly useful in assessing habitat quality and role of forest continuity in creation of favourable conditions for habitat specialists.
- For spruce logs, many rare species are found fruiting as decay progresses while earlier stages of decay are characterised by common species with high dispersal ability.
- Oak managed for timber was considered to be a particularly impoverished woodland habitat because the trees were cut and removed at an age (around 130 years) that represents a much smaller proportion of their potential duration in woodland than the corresponding value for other trees such as pine, spruce and alder. Hence a greater number of potential microhabitats and habitat specialists were considered to be absent from these managed woods.
- In 92% of the stands the management recommendation was to do nothing. When management was suggested, it was directed at the removal of highly competitive

shrubs and trees, particularly from around open-grown ancient trees, and creation of buffer zones around small vulnerable sites.

Although it must be recognised that it is not always easy to define precisely what an abundance of indicator species is actually indicating, without recourse to some circularity of argument, the 'signalarter' indicator species were chosen on the following considerations:

- They are not as rare and/or difficult to find and/or identify as the most threatened habitat specialists. This implies that by widening the search from the RDB species to include ones that are less threatened, eg rare and scarce species with less perceived decline, sites supporting (or potentially supporting) the most threatened are more likely to be located more rapidly with less specialised input. This is one of the fundamental assumptions at the heart of the signalarter concept.
- They should be present in sites with ecologically similar species which are harder to find, and/or identify and/or are poorly known (data deficient). This implies that indicators also have a role in highlighting hidden species diversity.
- They are restricted to substrata/ microhabitats rarely found in woodlands. For saprotrophic fungi, this shifts the emphasis from common ephemeral substrata such as leaves, catkins, seeds, bud scales and twigs to larger diameter branches and trunks of each tree species (ie bulky woody substrata including the 'coarse woody debris' of some authors).
- They are apparently or possibly poor colonisers restricted to sites with old dying and dead trees and long ecological continuity.

It was also considered important for useful woodland indicator-based ranking to be modified to suit local habitats and ecosystems. This suggests that ranking of sites should be habitat-specific and highlights the inappropriate comparisons that could be made between indicator totals for sites supporting different tree species and mixtures thereof.

3. Potential saprotrophic beechwood indicators

3.1 Woodland saprotrophs of conservation interest

At the time of writing, an updated British red list is in preparation and so the main fungi of conservation concern currently centre on the chosen BAP species. Those of most relevance in a woodland context are the saprotrophs *Hericium erinaceum* and *Piptoporus quercinus* and the ectomycorrhizal stipitate hydnoids (14 examples BAP listed) and putatively warmth-loving boletes (2 examples BAP listed). Both groups of ectomycorrhizal fungi may have a small enough number of species to be conveniently used for habitat assessment in their entirety, provided the necessary taxonomic issues are addressed. This is not the case however with saprotrophs of bulky elements of deadwood which mainly consist of a few representative species drawn from a large number of genera, (the pink-spored mushroom genus *Pluteus*, see below, is a notable exception). It was therefore considered a priority to focus on generating a list of fungi characteristic of bulky deadwood with an emphasis on those species which have relatively conspicuous, durable and easily identified fruitbodies.

3.2 Bulky dead beech substrata

Beech was chosen as a useful starting point for selection of possible indicators of deadwood quality mainly due to convergence of two independent lines of enquiry. A personal 10 year weekend-based study of fungal communities on large diameter beech on the Berkshire and Surrey Crown Estate lands, (ie the area formerly known as Windsor Forest), and the work of Heilmann-Clausen and Christensen (who began mapping saprotrophs characteristic of Danish beech in 1998) revealed many similarities in the Danish and Windsor beech saprotrophic community. This became apparent during our discussions on beech-related ecology and ultimately prompted a compilation of species that could be used to rank British dead beech habitat. Beech was also chosen as it is a popular and dominant tree across several English landscapes including the Cotswolds, Chilterns, Wye Valley area and North and South Downs. Furthermore it continues to be grown and harvested for timber, a practice which, together with the removal of deadwood, reduces the available habitat for saprotrophs. Indeed, European beech-dominated ecosystems are considered to be among the most exploited forests in the world and constitute a declining habitat in which wood saprotrophs are threatened (Christensen and others 2004). Looking further ahead, especially with regard to climate change, it would also be of interest to compare the saprotrophic fungal indicators of southern and northern, native and non-native beechwoods.

3.3 Evolution of the Danish and British indicator lists

A Danish list of 42 species was proposed (Heilmann-Clausen & Christensen 2000) and interest was subsequently kindled across Europe. This was further fuelled by publicity at the 7th International Mycological Congress in Oslo (Heilmann-Clausen 2002, Heilmann-Clausen & Boddy 2002, Heilmann-Clausen & Christensen 2002). Several additional species were proposed by the original Danish authors and lists of varying length were tested in order to rank a number of European sites.

Fifty species either originally on, or at some time proposed as additions to, the Danish list of indicators are shown in Tables 1-3. The tables are arranged according to whether they are included as British in the BMS fungal records database (BMSFRD as accessed in November 2003) and judged to be potentially useful here (Table 1), British but de-prioritised for use here (Table 2), and not on the current British list and therefore de-prioritised (Table 3). The BMSFRD was queried for all records of each species and, without any further interpretation of the data, the 'snapshot' number of records was entered in the tables and supplemented by a few personal records. The tables also incorporate a column of comments based on the author's interpretation of the associated BMSFRD ecological data entries.

Although based on the best dataset available, this is only a rough and quite possibly misleading guide to fungal distribution and rarity for many reasons including the volume of existing records not yet on BMSFRD; the records' utter dependence on observations of fruiting not mycelial presence (frequently made on a casual rather than a systematic basis); the number of determinations that cannot be verified or taxonomic/nomenclatural changes tracked without material to examine; the inability to recognise records arising from repeated observations of the fruiting of a single mycelium made by a recorder or several recorders during a single year or over a period of several years; and the frequency of incomplete and/or incorrect data entries, particularly with respect to non-standard recording of site details. In addition, and very importantly for this application, there are also many gaps in the data with respect to the identification of associated tree species.

Table 1 British beechwood saprotrophs listed by Heilmann-Clausen & Christensen (2000 or proposed pre-2003) which are potentially useful here as indicators

No.	Species name	BMSFRD records Nov '03	Comments regarding BMSFRD data regarding presence on *Fagus*
	Ascomycetes		
1	*Camarops polysperma*	27	mainly on *Alnus* but 8 recs on old *Fagus* in Surrey, E Sussex, S.Hants
2	*Catinella olivacea*	98	various trees but mostly *Fagus* (poss assoc with other fungi)
3	*Eutypa spinosa*	176	mainly on *Fagus*
4	*Hypoxylon cohaerens*	60	only 13 not naming *Fagus*
	Gilled fungi		
5	*Flammulaster limulatus s.l.*	34	9 with named trees, 6 *Fagus*
6	*Flammulaster muricatus*	17	5 naming *Fagus*
7	*Hohenbuehelia auriscalpium*		Confusion in records between *H. auriscalpium/petalodes/geogenia*
8	*Lentinellus vulpinus*	8	1 naming *Fagus*
9	*Ossicaulis lignatilis*	142	various bdlf trees *Fagus, Ulmus, Fraxinus, Acer* spp., *Carpinus, Betula*
10	*Pholiota aurivella* Golden scalycap	272	often seen on recently dead bdlf trunks almost all *Fagus*, taxon. issues
11	*Pluteus luctuosus*	35	*Ulmus, Fagus* and others
12	*Pluteus pellitus* Ghost shield	56	mainly on *Fagus*
13	*Pluteus phlebophorus* Wrinkled shield	271	mainly on *Fagus*
14	*Pluteus umbrosus* Velvet shield	310	*Ulmus, Fagus* etc
15	*Phyllotopsis nidulans*	19	4 named trees, 3 of which *Fagus*
16	*Volvariella bombycina* Silky rosegill	173	mainly on *Ulmus* and *Fagus*
	Poroid fungi		
17	*Aurantiporus alborubescens*	57	only 4 vice counties (VC) and all on *Fagus* (incl. personal Berks recs)
18	*Aurantiporus fissilis*	115	ca. 56 naming *Fagus*
19	*Ceriporiopsis gilvescens*	181	ca. 112 naming *Fagus*
20	*Ceriporiopsis pannocincta*	66	ca. 44 naming *Fagus* big rise in 10y
21	*Ganoderma pfeifferi*	110	85 naming *Fagus*
22	*Inonotus cuticularis*	125	56 naming *Fagus*, a few on *Acer pseudoplatanus*
23	*Inonotus nodulosus*	19	13 naming *Fagus*
24	*Spongipellis delectans*	57	43 naming *Fagus*
25	*Spongipellis pachyodon*	12	8 naming *Fagus*
	Others		
26	*Hericium cirrhatum* Tiered tooth	214	>80% *Fagus* (Boddy & Wald 2002)
27	*Hericium coralloides* Coral tooth	118	>80% *Fagus* (Boddy & Wald 2002)
28	*Hericium erinaceum* Bearded tooth	269	>80% *Fagus* (Boddy & Wald 2002)
29	*(Gloeo)Hypochnicium analogum*	16	9 on *Fagus*, 4 on *Acer pseudoplatanus*
30	*Henningsomyces candidus*	168	ca. 25% *Fagus* (also *Fraxinus, Betula, Ulmus*)
31	*Phleogena faginea*	116	38 naming *Fagus* (33% on various trees incl live *Quercus* saplings)

Table 2 British beechwood saprotrophs listed by Heilmann-Clausen & Christensen (2000 or proposed pre-2003) which are currently de-prioritised for use as indicators here

No.	Species name	BMSFRD records Nov 2003	Comments regarding BMSFRD data regarding presence on *Fagus*
	Ascomycetes		
32	*Camarops tubulina*	8	all on named trees, none *Fagus*
33	*Nemania atropurpurea*	2	19XX and *Fagus* 18XX, poorly known
34	*Nemania chestersii*	14	various trees 5 *Fraxinus* 4 *Fagus*, poorly known
	Gilled fungi		
35	*Mycena picta*	9	3 name *Fagus* but on wood or litter? (Extinct in Ing 92) need more ecol info
36	*Omphalina epichysium*	4	in *Sphagnum* or soil no *Fagus* listed
37	*Volvariella caesiotincta*	36	mainly *Ulmus*
	Poroid fungi		
38	*Inonotus obliquus*	102	almost all *Betula* no *Fagus*
39	*Ischnoderma resinosum*		many recs on conifs, but confusion with *I. benzoinum* Benzoin bracket
40	*Polyporus durus* (=*badius*) Bay polypore	555	but only ca. 12% name *Fagus*
	Others		
41	*Clavicorona pyxidata* Candelabra coral	1	?extinct
42	*Cristinia gallica*	27	but no *Fagus* pref (?saprotroph)
43	*Stereum subtomentosum* Yellowing curtain crust	385	ca 30% *Fagus* but now on most bdlf
44	*Lentaria delicata/epichnoa/afflata*	4	1 on *Fagus* sawdust but poorly known

Table 3 Beechwood saprotrophs listed by Heilmann-Clausen & Christensen (2000 or proposed pre-2003) which are currently not on the British list and so de-prioritised for use as indicators in Britain

No.	Species name	BMSFRD records Nov 2003
	Ascomycetes	
45	*Discina parma*	0
	Gilled fungi	
46	*Pholiota squarrosoides*	0
	Poroid fungi	
47	*Antrodiella hoehnelii*	0
	Others	
48	*Climacodon septentrionalis*	0
49	*Dentipellis fragilis*	0
50	*Kavinia himantia*	0

Based on a tally of the numbers of BMSFRD records of species on the Danish list and of those species initially under consideration for potential inclusion on a British list, species with records currently approaching or in excess of 400 seemed likely to be those that were too common to be of much value as indicators of habitat quality. Examples of these include *Polyporus durus* (=*P. badius*) and *Stereum subtomentosum*, species commonly found on multiple substrata. Other reasons for current de-prioritisation of Danish listed species were a lack of beech-associated records and possibility of a differing ecology in Britain, eg *Camarops tubulina*, *Omphalina epichysium*, *Inonotus obliquus* and *Volvariella caesiotincta*; a lack of ecological knowledge to confirm that deadwood was the carbon source, eg *Mycena picta* (considered to be extinct in Ing 1992) and *Cristinia gallica*; poorly known taxa which are often inconspicuous and rarely collected here, eg *Nemania atropurpurea* and *N. chestersii*; taxonomic issues and difficulties in interpreting historical records, eg *Lentaria* spp. and *Ischnoderma* spp.; and uncertainty whether the species is still extant in Britain, eg *Clavicorona* (=*Artomyces*) *pyxidata*.

Species not on the BMSFRD (Table 3) at the time of querying were deemed unsuitable for use in this country and although Britain may (or may not) currently be beyond these species' ranges (for unknown reasons), nevertheless they may subsequently be found here in fruiting condition. This emphasizes the transitory nature of some indicator species and their potentially dynamic value in this regard. Fungi are always evolving and responding to environmental perturbation. Major climate change, for example, is expected to have a major impact on their fruiting distribution and on their ecological roles including probable modification of their relationships with trees with attendant landscape and economic implications. Some species may lose their beech indicator value if found fruiting increasingly frequently, spreading across the country and expanding the range of tree species with which they are associated, eg as is potentially the current scenario with *Ceriporiopsis* (=*Gelatoporia*, *Gloeoporus*) *pannocincta*. Conversely, some traditionally elm-associated species such as *Rhodotus palmatus* and *Pluteus aurantiorugosus* are rarely recorded fruiting on beech, but are undergoing a chronic shortage of elm deadwood. For such species currently undergoing a 'bottleneck' in supply of resources capable of supporting fruiting, the historical data becomes slightly misleading and of lesser value in an indicator context, whereas the value of dead beech sites currently supporting fruiting of these species is greatly boosted.

Table 4 comprises species which, based on a combination of personal experience and BMSFRD searches, were thought to be potentially useful in Britain but which were not considered suitable for the original Danish list based on recording experience in Denmark (Heilmann-Clausen pers. comm.). Subsequent incorporation of pan-European views in 2003 did however result in the later addition of *Lentinellus ursinus* and *Mycoacia nothofagi* to the Danish list to create a European list (Christensen and others 2004). Table 4 includes two species with crust-like fruitbodies (corticioid fungi) on the grounds that they are relatively conspicuous, easily identified and smell strongly in the field, ie *Scytinostroma portentosum* (naphthalene, moth-balls) and *Mycoacia nothofagi* (sweet and soapy). These choices are in accordance with the Danish inclusion of the corticioid *Hypochnicium* (=*Gloeohyphochnicium*) *analogum* which is also conspicuous when fruiting and has a strong fruity smell but which after drying or with prolonged exposure on the skin becomes increasingly unpleasant and undesirable. It should be emphasized however that there may be around 400 British corticioid species (based on an unpubl. list made in 2000 by A. Henrici pers. comm.) and many are saprotrophs to be sought on bulky woody substrata. However the inconspicuous nature of most corticioid fruitbodies (resembling paint, cobwebs, crystals or

wax) means that we know relatively little about their distribution and so the majority are reluctantly not recommended for use as indicators by the non-specialist at this time.

Table 4 British beechwood saprotrophs not listed by Heilmann-Clausen & Christensen (2000 or proposed pre-2003) which are suggested as potentially useful indicators of quality beech deadwood habitat in the UK

No.	Species name	BMSFRD records Nov '03	Comments regarding BMSFRD data regarding presence on *Fagus*
	Gilled fungi		
1	*Hohenbuehelia mastrucata* Woolly oyster	15	10 on *Fagus*
2	*Lentinellus ursinus*	22	17 on *Fagus*
	Poroid fungi		
3	*Coriolopsis gallica*	53	ca. 25 naming *Fagus* (also on *Fraxinus*, *Ulmus*)
4	*Oxyporus latemarginatus*	79	42 naming *Fagus* and some *Acer* and *Fraxinus* (*O. corticola* & *obducens* may also be useful)
5	*Phellinus cavicola*		9 incl personal records (in 4 VC, 5 hectads) all except 1 on beech
	Others		
6	*Mycoacia nothofagi*	22	15 naming *Fagus*
7	*Scytinostroma portentosum*	39	17 naming *Fagus*

A synthesis of all the species initially judged to be potential indicators in Britain is shown in Table 5. Inspection of BMSFRD records and personal experience of the pink-spored agaric genus *Pluteus* suggested that this entire genus (with the exception of the most common British representative *P. cervinus* and brown-capped allies) was of indicator value because of its frequent association with large diameter and well-rotted wood. Before the colourful and conspicuous mushrooms of *Pluteus* (see Figure 2) are adopted as 'woodland waxcap equivalents' however, further work is required. Although an easy genus to recognise in the field (pink spores, no bag-like volva at the stem base and gills which do not meet the stem apex), *Pluteus* spp. fruit in relatively warm weather as soon as conditions are damp enough. This may be slightly disadvantageous in that their timing may not coincide with other saprotrophs and their mushrooms can soon decay into an unidentifiable condition. There have also been considerable shifts in species concepts resulting mainly from Dutch work carried out before and since the publication of the standard British work in the *British Fungus Flora* series (Orton 1986). This has led to some uncertainty amongst field mycologists regarding accepted taxa and their circumscription. The forthcoming basidiomycete checklist should help to stabilise matters and hopefully herald a renewed interest in the genus. It is expected that the numbers of accepted British species will diminish considerably if the European view is followed whereby several clusters of species recognised by Orton (1986) are reduced to synonymy. For example, three yellow-capped species recognised by Orton (1986), ie *P. galeroides, luteovirens* and *xanthophaeus*, have now been submerged under the name *P. chrysophaeus* in the BMSFRD (November 2003). The European *P. plautus* provides a more extreme example, now possibly accommodating eight species formerly accepted by Orton (1986), ie *P. boudieri, depauperatus, dryophiloides, gracilis, granulatus, plautus, punctipes,* and *semibulbosus*. A BMS workshop on the genus and its accepted British representatives would stimulate standardised recording and clarify tree associates, frequency

and distribution. This in turn would assist in selecting the best species suitable for use as indicators. In the meantime, *Pluteus* as a whole (with the aforementioned exceptions) is included in the list shown in Table 5. Of all the British species, *P. leoninus* and *pellitus* were included in Ing's (1992) provisional red list and classified as rare and vulnerable respectively.

Figure 2 The genus *Pluteus*, clockwise from top left *P. phlebophorus, aurantiorugosus* (with *Ossicaulis lignatilis* behind), *umbrosus* and *thomsonii*, is an attractive source of woodland indicators. Photographs © Dr Martyn Ainsworth.

Table 5 Thirty species (excl. *Pluteus*) of potential value as indicators of quality beech deadwood in Britain (see Appendix 1 for datasheets) and species initially selected (X) then discarded (see Appendix 2). Ing (1992) categories were based on expert opinion.

Data-sheet No.	Species name	Provisional red data listed (Ing 1992)	BAP or Sched. 8 listed
	Ascomycetes		
1	*Camarops polysperma*		
X	*Catinella olivacea*		
2	*Eutypa spinosa*		
X	*Hypoxylon cohaerens*		
	Gilled fungi		
3	*Flammulaster limulatus s.l.*	Vulnerable	
4	*Flammulaster muricatus*		
5	*Hohenbuehelia auriscalpium*		
6	*Hohenbuehelia mastrucata* Woolly oyster	Rare	
7	*Lentinellus ursinus*	Endangered	
8	*Lentinellus vulpinus*		
9	*Ossicaulis lignatilis*		
X	*Pholiota aurivella* Golden scalycap		
10	*Phyllotopsis nidulans*		
	Pluteus	Rare (1) Vul. (1)	
11	*Volvariella bombycina* Silky rosegill		
	Poroid fungi		
12	*Aurantiporus alborubescens*	Rare	
13	*Aurantiporus fissilis*		
14	*Ceriporiopsis gilvescens*		
15	*Ceriporiopsis pannocincta*	Rare	
16	*Coriolopsis gallica*	Rare	
17	*Ganoderma pfeifferi*		
18	*Inonotus cuticularis*		
19	*Inonotus nodulosus*		
20	*Oxyporus latemarginatus*	Rare	
21	*Phellinus cavicola*		
22	*Spongipellis delectans*	Rare	
23	*Spongipellis pachyodon*	Rare	
	Others		
24	*Hericium cirrhatum* Tiered tooth	Vulnerable	
25	*Hericium coralloides* Coral tooth	Vulnerable	
26	*Hericium erinaceum* Bearded tooth	Vulnerable	BAP & Sch. 8
27	*Hypochnicium analogum*		
X	*Henningsomyces candidus*		
28	*Mycoacia nothofagi*		
29	*Phleogena faginea*		
30	*Scytinostroma portentosum*	Rare	

Further consideration of four species included in Table 5 (labelled X) prompted their subsequent removal from the list on the following grounds:

Catinella olivacea - uncertainty regarding direct association with wood or other fungi.

Hypoxylon cohaerens – visits to important sites for wood saprotrophs indicated that this species is not as well-known and well-recorded as originally suspected, despite having persistent fruitbodies, and it was also observed fruiting on more ephemeral substrata such as small diameter branches.

Pholiota aurivella – uncertainty in the records and current recorders' concepts regarding the circumscription of the species, together with its observed abundant fruiting shortly after the occurrence of freshly exposed beech wood.

Henningsomyces candidus – recording often necessitates time-consuming searches of the undersides of fallen wood using a hand lens to detect the tiny fruitbodies.

In the event that all or some of these are later readmitted to the list, some data on current distributions are included in the datasheets included within Appendix 2.

While this study was underway, the Danish list was pruned from 50 to 21 species and progressed towards becoming a European list following further scrutiny and accommodation of diverse field experience in beech forests across Europe (Christensen and others 2004). The most recently available European list covers species that are described as indicators of 'biotic integrity', (= habitat quality and conservation value) of old grown beech forests. Table 6 shows the suggested British (30) and European (21) lists as of March 2004 alongside those species (4) listed in *Signalarter* (Nitare 2000) and those which were not accepted as British in the BMSFRD as accessed in November 2003 (pending publication of the basidiomycete checklist). Inspection of Table 6 reveals that 5 of the 21 European indicators are thought to be unsuitable for use in Britain. Three of these have not been recorded in Britain according to BMSFRD entries (November 2003) and the remaining two are de-selected for the following reasons:

Camarops tubulina is British but has not been recorded here on beech.

Ischnoderma resinosum is British but more familiarity is required in separating it from *Ischnoderma benzoinum* for reliable use here.

Hence it is important to bear in mind that the maximum possible score for a British site using the European scoring system is 16 indicator species. This highlights an important issue regarding the applicability of a single list across Europe and underlines the differences between the mycota fruiting in different regions. By way of illustration, a project collaborator in eastern Europe has noted the absence of *Aurantiporus alborubescens* (Figure 4) in Slovakia (S. Adamcik in pers. comm. to J. Heilmann-Clausen), whereas the Atlantic-influenced UK and Eire have an absence of *Dentipellis* and *Climacodon*. Although the European workers originally envisaged a European beech league table, they also recognise the value of adopting more local indicator lists based on species that can be found fruiting in each region (J. Heilmann-Clausen pers. comm. and R. Walleyn pers. comm.).

Table 6 British (30) and European (21) indicators (Mar 2004) showing species (4) listed in *Signalarter* (Nitare 2000) and those not listed as British in BMSFRD (November 2003)

Data-sheet No.	Species name	No. on European list of 21 (Christensen and others 2004)	Not British (BMSFRD Nov 2003)	Included in *Signalarter* (Nitare 2000)
	Ascomycetes			
1	*Camarops polysperma*			
	Camarops tubulina	1		
2	*Eutypa spinosa*			
	Gilled fungi			
3	*Flammulaster limulatus s.l.*	2		
4	*Flammulaster muricatus*	3		
5	*Hohenbuehelia auriscalpium*	4		
6	*Hohenbuehelia mastrucata* Woolly oyster			
7	*Lentinellus ursinus*	5		
8	*Lentinellus vulpinus*	6		
9	*Ossicaulis lignatilis*	7		X
	Pholiota squarrosoides	8	X	
10	*Phyllotopsis nidulans*			
*	*Pluteus umbrosus* Velvet shield	9		X
11	*Volvariella bombycina* Silky rosegill			
	Poroid fungi			
12	*Aurantiporus alborubescens*	10		
13	*Aurantiporus fissilis*			
14	*Ceriporiopsis gilvescens*	11		
15	*Ceriporiopsis pannocincta*	12		
16	*Coriolopsis gallica*			
17	*Ganoderma pfeifferi*	13		
18	*Inonotus cuticularis*	14		
19	*Inonotus nodulosus*			
	Ischnoderma resinosum	15		
20	*Oxyporus latemarginatus*			
21	*Phellinus cavicola*			
22	*Spongipellis delectans*	16		
23	*Spongipellis pachyodon*			
	Others			
	Climacodon septentrionalis	17	X	
	Dentipellis fragilis	18	X	X
24	*Hericium cirrhatum* Tiered tooth			
25	*Hericium coralloides* Coral tooth	19		X
26	*Hericium erinaceum* Bearded tooth	20		
27	*Hypochnicium analogum*			
28	*Mycoacia nothofagi*	21		
29	*Phleogena faginea*			
30	*Scytinostroma portentosum*			

* all *Pluteus* (except *P. cervinus* and brown-capped allies) of potential indicator use

Figure 3 *Ganoderma pfeifferi*, a suggested indicator *in situ* on beech at Highstanding Hill, Windsor Forest showing (left) a bracket in its first year of growth with well-developed and characteristic yellow beeswax-like layer coating the fruitbody. The presence of this layer on the upper surface of the bracket can still be demonstrated by cracking its surface with a thumb nail or metal object even when the fruitbody is almost black and several decades old (right) and the mycelium has almost exhausted the available resources (the bracket fell into the litter as the stump collapsed during the following year). Photographs © Dr Martyn Ainsworth.

4. Validation of English indicators

Taking into account personal experience and searches of site entries in BMSFRD (November 2003) and recorded by the Important Fungus Areas project (Evans, Marren & Harper 2001), a selection of 11 English sites was chosen to represent, as far as possible, some of the 'best' beech deadwood sites known over the longest periods of time to the field mycological community (eg Figures 1, 3 & 4). Attempts were made to score each site according to the list of 30 British indicators (Table 7ab) from the data held on BMSFRD, with additional input derived from data held at RBGK and known to several experienced field mycologists familiar with the sites (see Acknowledgements). This was limited to records for which beech was named as the associated tree (regardless of whether the species had been recorded on other trees or on indet. wood at the site) and totals were arbitrarily restricted to include only those records made since 1970, based on the perceived greater likelihood that such records were of fungi that were still extant at the sites. Records dated with no greater precision than 19XX were ignored. Of the 11 sites chosen, eight were visited during the project, ie between September 2003 and March 2004, and the remainder (ie Denny, Mark Ash and Gritnam in the New Forest) were all sites previously visited on several occasions. The main objective of this compilation of records was to attempt to validate the suggested indicator list using what were expected to be mycologically high scoring and well-documented sites.

Table 7a Year of last known beech records of 30 proposed indicators since 1970, of which the 16 also occurring on the European list of 21 indicators are shown in grey

No. on Brit.list	Species name	New Forest Denny Wood Hants	New Forest Mark Ash Wood Hants	New Forest Whitley Wood Hants	New Forest Gritnam Wood Hants	New Forest Wood Crates area Hants	Norbury Park Surrey
	Ascomycetes						
1	*Camarops polysperma*						1999
2	*Eutypa spinosa*	1991	2003	2003	2003	2003	2004
	Gilled fungi (for *Pluteus* see table below)						
3	*Flammulaster limulatus s.l.*	1991					
4	*Flammulaster muricatus*					1998	
5	*Hohenbuehelia auriscalpium*	1999	1999			2003	1992
6	*Hohenbuehelia mastrucata* Woolly oyster						
7	*Lentinellus ursinus*					2003	
8	*Lentinellus vulpinus*						
9	*Ossicaulis lignatilis*	1999	1997	2003	1991	1998	
10	*Phyllotopsis nidulans*						
11	*Volvariella bombycina* Silky rosegill	2000	1975				
	Poroid fungi						
12	*Aurantiporus alborubescens*	2002		2003	2003	2003	1991
13	*Aurantiporus fissilis*	1995	2003		2003	1999	1999
14	*Ceriporiopsis gilvescens*	1999	2003	2003	2003	2003	2000
15	*Ceriporiopsis pannocincta*	1998		2003	2003	2003	1998
16	*Coriolopsis gallica*						1999
17	*Ganoderma pfeifferi*	2002	1999	2003		2003	1989
18	*Inonotus cuticularis*	1999	2003	1993	2003	2003	1999
19	*Inonotus nodulosus*	1981	1981			1998	
20	*Oxyporus latemarginatus*		1999		1990	1992	1999
21	*Phellinus cavicola*			2003			
22	*Spongipellis delectans*	1997	2003	2003	2003	1999	1997
23	*Spongipellis pachyodon*	2000					
	Others						
24	*Hericium cirrhatum* Tiered tooth	1997	1990		1995	1992	1996
25	*Hericium coralloides* Coral tooth	1990		1984			
26	*Hericium erinaceum* Bearded tooth	2001	2003		1999	1998	1998
27	*Hypochnicium analogum*	2000	1999	2003			
28	*Mycoacia nothofagi*			2002		2003	
29	*Phleogena faginea*	1993	1991	2003	1999		1973
30	*Scytinostroma portentosum*						2004
	Site total	**19**	**15**	**13**	**12**	**17**	**16**

Table 7a (cont'd) Known beech records of *Pluteus* (except *P. cervinus* and brown-capped allies) since 1970 (the species on the European list of 21 is shown in grey) and total scores for each site using 16 applicable European indicators

***Pluteus* species**	**New Forest Denny Wood Hants**	**New Forest Mark Ash Wood Hants**	**New Forest Whitley Wood Hants**	**New Forest Gritnam Wood Hants**	**New Forest Wood Crates area Hants**	**Norbury Park Surrey**
aurantiorugosus						Yes
chrysophaeus Yellow shield	Yes	Yes	Yes		Yes	Yes
cinereofuscus						Yes
ephebeus						Yes
hispidulus	Yes				Yes	Yes
leoninus Lion shield						
luctuosus	Yes					Yes
nanus Dwarf shield						Yes
pellitus Ghost shield	Yes					
phlebophorus Wrinkled shield	Yes		Yes		Yes	Yes
plautus Satin shield	Yes	Yes	Yes	Yes	Yes	Yes
podospileus	Yes	Yes			Yes	Yes
romellii Goldleaf shield	Yes					Yes
salicinus Willow shield	Yes	Yes	Yes		Yes	Yes
satur						
thomsonii Veined shield	Yes			Yes		Yes
umbrosus Velvet shield	Yes				Yes	Yes
***Pluteus* total**	**11**	**4**	**4**	**2**	**7**	**14**
Site total using the 16 European indicators (of 21 currently applicable in Britain)	**12**	**7**	**9**	**7**	**13**	**9**

Table 7b Year of last known beech records of 30 proposed indicators since 1970, of which the 16 also occurring on the European list of 21 indicators are shown in grey

No. on Brit. list	Species name	Windsor High standing Hill Berks	Windsor Bears Rails/ Wild Boar area Berks	Ebernoe Common West Sussex	Mens & Cut West Sussex	Lullingstone Park Kent
	Ascomycetes					
1	*Camarops polysperma*					
2	*Eutypa spinosa*	2003	2003	2004	2004	2004
	Gilled fungi (for *Pluteus* see table below)					
3	*Flammulaster limulatus s.l.*					
4	*Flammulaster muricatus*					
5	*Hohenbuehelia auriscalpium*			1997	2000	
6	*Hohenbuehelia mastrucata* Woolly oyster	2000	2004			1989
7	*Lentinellus ursinus*					1984
8	*Lentinellus vulpinus*		2003			
9	*Ossicaulis lignatilis*	2002	2002		1991	
10	*Phyllotopsis nidulans*	*1965				
11	*Volvariella bombycina* Silky rosegill	1994		1994		1983
	Poroid fungi					
12	*Aurantiporus alborubescens*	2003				1994
13	*Aurantiporus fissilis*				1989	1998
14	*Ceriporiopsis gilvescens*	2003	2003	1999	2004	2004
15	*Ceriporiopsis pannocincta*	2003	2002	1997	2001	
16	*Coriolopsis gallica*	1998	2002	1996	1999	2003
17	*Ganoderma pfeifferi*	2003	2003			2004
18	*Inonotus cuticularis*	2003	2003	1998	2004	1993
19	*Inonotus nodulosus*					
20	*Oxyporus latemarginatus*	1999	1998		2001	1995
21	*Phellinus cavicola*	2003				
22	*Spongipellis delectans*	2003	2004			1991
23	*Spongipellis pachyodon*					
	Others					
24	*Hericium cirrhatum* Tiered tooth		2003	1996	1995	
25	*Hericium coralloides* Coral tooth	2003	2003	1998		
26	*Hericium erinaceum* Bearded tooth	1998	1993			1996
27	*Hypochnicium analogum*	2000				
28	*Mycoacia nothofagi*		2004	1998	2001	
29	*Phleogena faginea*	1999		2004	1999	
30	*Scytinostroma portentosum*					1992
	Site total	**17**	**15**	**11**	**12**	**14**

* record too old to be included in totals

Table 7b (cont'd) Known beech records of *Pluteus* (except *P. cervinus* and brown-capped allies) since 1970 (the species on the European list of 21 is shown in grey) and total scores for each site using 16 applicable European indicators

***Pluteus* species**	**Windsor High standing Hill Berks**	**Windsor Bears Rails/ Wild Boar area Berks**	**Ebernoe Common West Sussex**	**Mens & Cut West Sussex**	**Lullingstone Park Kent**
aurantiorugosus	Yes	Yes			
chrysophaeus Yellow shield	Yes		Yes	Yes	Yes
cinereofuscus			Yes		
ephebeus					Yes
hispidulus		Yes			Yes
leoninus Lion shield	Yes			Yes	Yes
luctuosus					
nanus Dwarf shield					
pellitus Ghost shield					
phlebophorus Wrinkled shield		Yes	Yes		
plautus Satin shield			Yes	Yes	Yes
podospileus	Yes		Yes	Yes	
romellii Goldleaf shield					
salicinus Willow shield		Yes	Yes	Yes	
satur			Yes		
thomsonii Veined shield			Yes		Yes
umbrosus Velvet shield	Yes	Yes	Yes		Yes
***Pluteus* total**	5	5	9	5	7
Site total using the 16 European indicators (of 21 currently applicable in Britain)	**10**	**11**	**7**	**6**	**8**

The British scores ranged from 11 to 19 species from a possible maximum of 30 for the 11 sites chosen and this result should now be used as a benchmark by which to assess other sites. To assist with this, a blank recording sheet for use in the field to score the presence of suggested beech indicators is included herein as Appendix 3. It is particularly important to obtain more information for sites widely regarded as good for beechwood fungi, eg Burnham Beeches, Savernake and various Cotswold and Chiltern beechwoods, none of which seemed to present themselves as high scoring areas on cursory inspections of the BMSFRD. Any relationship between the fungi, stand history and commercial use could then be explored.

The chosen sites scored between 6 and 13 species from a current English maximum of 16 (of the 21) species on the European list. Clearly the national absence of certain species is a product of many interacting factors including obvious climatic differences and should not be regarded as indicative of poor quality beech habitat compared to that present in another country. Notwithstanding this, there is a palpable desire to rank beech deadwood sites across Europe according to their scores using a single list of indicators regardless of location. This may be a competition based on some questionable assumptions, but will undoubtedly act as a welcome stimulus to recording and could raise the profile of a neglected ecological group whose strongholds are believed to be in the declining ancient woodlands of Europe. Indeed, recent Woodland Trust campaign material stated that of the little ancient woodland remaining in the 1930s, almost half has already been degraded or destroyed and this irreplaceable habitat now covers a mere 2% of the UK.

In order to explore the European importance of the 11 English sites, bearing in mind the questionable rationale for using a single European indicator suite, Table 8 ranks the English sites according to the British list of 30 indicators and also shows their ranking based on the 16 European indicators judged to be applicable in England. Interestingly, the five sites listed at the top of Table 8 are ranked at different positions but nevertheless are amongst the top five according to both the British and European systems. Divergent ranking becomes more apparent lower down the table.

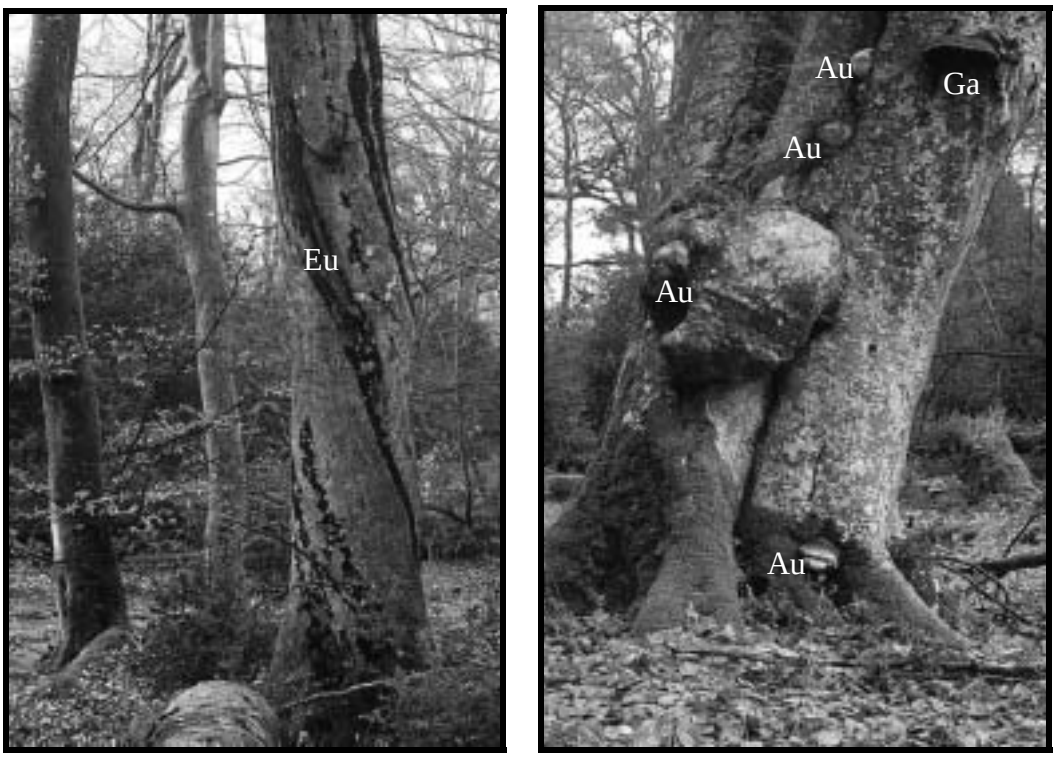

Figure 4 Suggested indicators with *in situ* fruitbodies on beech in open grazed woodland: *Eutypa spinosa* (left) forming black spiral strip cankers (eg labelled Eu) at Ebernoe Common and *Aurantiporus alborubescens* (right) with four pink/white brackets (Au) at Wood Crates, nr. Millyford Bridge, New Forest (with a darker bracket of *Ganoderma adspersum/australe*, Ga, at top right). Photographs © Dr Martyn Ainsworth.

Table 8 English test sites ranked according to British (30) and European (16 of 21) indicator lists showing SSSIs and IFAs listed in Evans, Marren & Harper (2001)

Ranking using British score	Ranking using European score	Site name and representative grid square	European score from 16 possible	British score from 30 possible	*Pluteus* score	IFA	SSSI
1	2	New Forest Denny Wood Hants SU 3306	12	19	11	Yes	Yes
2=	1	New Forest Wood Crates area Hants SU 2608	13	17	6	Yes	Yes
2=	4	Windsor Highstanding Hill Berks SU 9374	10	17	4	No	Yes
4	5=	Norbury Park Surrey TQ 1552	9	16	14	Yes	Yes
5=	3	Windsor Bears Rails/ Wild Boar area Berks SU 9772	11	15	5	No	Yes
5=	8=	New Forest Mark Ash Wood Hants SU 2407	7	15	4	Yes	Yes
7	7	Lullingstone Park Kent TQ 5064	8	14	7	Yes	Yes
8	5=	New Forest Whitley Wood Hants SU 2905	9	13	4	Yes	Yes
9=	8=	New Forest Gritnam Wood Hants SU 2806	7	12	2	Yes	Yes
9=	11	Mens & Cut West Sussex TQ 0223	6	12	5	Yes	Yes
11	8=	Ebernoe Common West Sussex SU 9726	7	11	9	Yes	Yes

The English sites can be compared to those assessed elsewhere in Europe using the European indicator list (Table 9). Further caveats are required regarding the non-standardised data collection, differing site areas, international variation in species concepts and the differing study periods at the different sites. Some information regarding survey duration was supplied by Christensen (pers. comm.) for 126 European sites whose data have been compiled by the project. Survey times range from a year or two (eg the Netherlands ranked >30 and Czech Republic ranked 3=) to over two decades (eg England ranked >6 and Slovakia ranked 1=). However there were no data on how many survey years there were per site nor how many site visits were made per survey year. This also requires some standardisation but will necessarily vary from place to place and year to year depending on weather patterns. During this project, the observation of good fruiting of indicator species in some English locations (eg Windsor and the New Forest) was not a reliable guide to concurrent fruiting at other historically good sites (eg Ebernoe Common, The Mens and Cut, Norbury Park and Lullingstone Park). Single years of recording or single visits per year are both likely to be useless for assessing indicator diversity (high scoring visits excepted). Indeed an autumn or winter day spent at one of the 'best' sites could easily result in nothing more than records of the most durable fruitbodies (eg of *Ganoderma* and *Eutypa*) plus one or two common poroids (eg *Ceriporiopsis gilvescens* and *Inonotus cuticularis*). Trawling a decade or more of BMSFRD records, together with some targeted search, may reveal our most important beech deadwood sites, but each round of indicator monitoring could require several visits per year over a couple of years or more.

Table 9 English beech sites ranked with other European sites according to 21 European indicators showing top site for each country in grey and number of sites surveyed

No. of sites surveyed per country (Total = 126)	Ranked by European score	Country	Site name	European score from 21 possible
4	1=	Slovakia	Stuzica	16
	1=	Slovakia	Rozok	16
1	3=	Czech Republic	Zofin	15
1	3=	France	Fontainebleau (Tillaie and Gros Fouteau)	15
25	5	Denmark	Jægersborg Dyrehave	14
	6=	Slovakia	Havesová	13
14	6=	UK	Wood Crates	13
	8=	Denmark	Suserup	12
	8=	Denmark	Strødam	12
	8=	UK	Denny Wood area	12
11	11=	Slovenia	Rajhenav Rog	11
2	11=	Hungary	Öserdö	11
	11=	UK	Windsor Bears Rails/Wild Boar area	11
	14	UK	Windsor Highstanding	10
	15=	Denmark	Store Bøgeskov	9
13	15=	Sweden	Maltesholm	9
	15=	UK	Whitley Wood	9
	15=	UK	Norbury Park	9
	19=	Denmark	Romsø	8
	19=	Hungary	Kekes	8
	19=	Slovakia	Udava	8
	19=	UK	Lullingstone Park	8
	23=	Denmark	Krenkerup	7
	23=	Sweden	Ivön	7
	23=	Sweden	Skäralid	7
	23=	UK	Mark Ash Inclosure	7
	23=	UK	Gritnam Wood	7
	23=	UK	Ebernoe Common	7
34	23=	Germany	Waldhaus	7
	30=	Denmark	Slagslunde	6
	30=	Slovenia	Krokar	6
1	30=	Poland	Poland Biaskidy E	6
13	30=	Belgium	Kerssellaerspleyn	6
	30=	UK	The Mens and Cut	6
	30=	Germany	Mittelsteighütte	6
7	>30	Netherlands		

5. Conclusion

Table 9 supports the assertion that southern England has some top beech deadwood sites of international importance. The well-known English sites are currently headed by Wood Crates (Millyford Bridge area) and Denny Wood areas of the New Forest in the top 10 and accompanied by Highstanding Hill (Windsor Forest), Bears Rails/Wild Boar area of the Windsor Great Park deer enclosure, Whitley Wood (New Forest), Norbury Park and Lullingstone Park in the top 22 sites from a total of 126 European sites. Significantly, all the English sites are wholly or partly SSSIs, although not all are IFAs (Evans, Marren & Harper 2001), but much remains to be done to document the indicator species and their locations within in each site (are they within the SSSI boundaries?) to permit future monitoring. Noteworthy in this regard is the initial finding from 25 forest reserves in Christensen and others (2004) that the deadwood volume per hectare at a site is only weakly related to the presence of indicator species. Furthermore, these authors believe that the relatively easy monitoring of forest structural components, ie deadwood parameters or indirect attributes, will show "typically on a rather gross scale, how the house is built, but give no information on whether the inhabitants have moved in". This refers in particular to the resultant lack of knowledge about habitat qualities arising from the interplay of the interacting organisms and the prevailing (and episodic) climatic and other abiotic variables with the additional time-dependent qualities of continuity. Continuity can exist on several scales ranging from considerations of stand age to the presence of trees, old trees, old wood that is dead and old wood that has been dead for a long time.

Looking to the future, the removal of beech during forestry operations and lack of regeneration at some English sites remain causes for concern. However there exists the exciting possibility that many other 'top' sites are waiting to be discovered. Hopefully, the indicator list used in this study will be tested, improved and provide some assistance to those seeking to document, assess and protect such sites. Perhaps it will also encourage development of a similar (but probably much shorter) list for oak and possibly an all-encompassing 'broadleaved tree list' which would simplify the choice of list, but require more careful comparison of grossly dissimilar sites.

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(including references for *Hericium* data sheets in Appendix 1)

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Appendix 1 Data sheets on 30 saprotrophic indicators for bulky beech substrata

1 *Camarops polysperma*

Synonyms in recent use:

English name: thick tarcrust (proposed)

BMSFRD records: 27

BMSFRD tree associates in order of decreasing frequency: *Alnus, Fagus*

Fruitbodies of *Camarops polysperma* form in a black blister (stroma) which is tarry and coated with slimy brown spore masses when damp, but shiny when dry (left, on *Alnus*). Developing stromata break through the overlying wood and bark. The surface pimples, seen in strong sunlight (right), are the domed exit holes through which the spores escape. Photographs © Dr Martyn Ainsworth.

Known distribution before 1960

Known distribution 1960 onwards

2 *Eutypa spinosa*

Synonyms in recent use:

English name: spiral tarcrust (proposed)

Known records: 176

BMSFRD tree associates in order of decreasing frequency: *Fagus, Ulmus, Corylus, Fraxinus*

Spiral strip cankers on *Fagus* trunk (left) comprising tiny embedded fruitbodies of *Eutypa spinosa* within a black crust (stroma). Bark section from the edge of a canker (right) revealing the fruitbodies packed into a pale grey layer immediately below the black stromatal crust. The stroma has ruptured the bark (seen intact on the right of the photo) and the black line which extends from the stromatal edge into the bark and wood below demarcates the territorial boundary of the fungus. Photographs © Dr Martyn Ainsworth.

Known distribution before 1960

Known distribution 1960 onwards

3 *Flammulaster limulatus s.l.* (in the broad sense)

Synonyms in recent use: include ***F. limulatus*** *sensu* Orton **(*F. limulatus* var. *litus*), *F. limulatus*** *sensu* Watling **(*F. limulatus* var. *limulatus*), *F. limulatoides*** *sensu* Orton **(*F. limulatus* var. *limulatus*), *F. novasilvensis*** *sensu* Orton **(*F. limulatus* var. *novasilvensis*), *Flocculina limulata***

English name: golden powdercap (proposed)

Known records: 34

BMSFRD tree associates in order of decreasing frequency: *Fagus, Quercus, Betula, Pinus*

Fruitbodies of *Flammulaster limulatus sensu lato* (ie in the broad sense) showing (right) the characteristic powdery/granular cap surface. Photographs © Morten Christensen.

Known distribution before 1960

Known distribution 1960 onwards

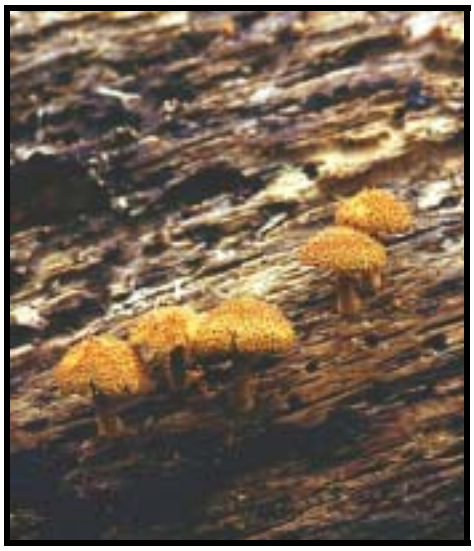
4 *Flammulaster muricatus*

Synonyms in recent use:

English name: toothed powdercap (proposed)

Known records: 17

BMSFRD tree associates in order of decreasing frequency: *Fagus*

Scaly fruitbodies of *Flammulaster muricatus* showing the characteristic conical (pointed) scales covering the cap surface and (left) toothed margin of cap.
Photographs © Peter Thompson (left) and © Morten Christensen (right).


Known distribution before 1960


Known distribution 1960 onwards

5 *Hohenbuehelia auriscalpium*

Synonyms in recent use: *H. petaloides* *sensu* new checklist (Dennis, Orton & Hora 1960), ***Geopetalum petaloides***

English name: spatula oyster (proposed)

Known records: uncertain, due to confusion with ***H. geogenia*** *sensu* new checklist (Dennis, Orton & Hora 1960) which is now known as ***H. petalodes* var. *petalodes***, but estimated around **20 - 40**

BMSFRD tree associates in order of decreasing frequency: *Fagus, Quercus, Fraxinus*

Group of buff/pale brown fruitbodies of *Hohenbuehelia auriscalpium* on mossy fallen beech trunk (left) and close up (right) showing gills running down the flattened spatula-like stem. *Hohenbuehelia* species capture and prey on nematode worms.
Photographs © Dr Martyn Ainsworth.

Unknown distribution before 1960

Known distribution 1960 onwards

6 *Hohenbuehelia mastrucata*

Synonyms in recent use:

English name: woolly oyster

Known records: 13 (plus 2 in BMSFRD originally as *H. atrocaerulea* now as *cf mastrucata*, post 1960 VC 17 & 62)

BMSFRD tree associates in order of decreasing frequency: *Fagus, Corylus*

Highly gelatinised clustered fruitbodies (left) of *Hohenbuehelia mastrucata* showing gills and absence of stem (right). *Hohenbuehelia* species capture and prey on nematode worms. Photographs © Dr Martyn Ainsworth.

Known distribution before 1960

Known distribution 1960 onwards

7 *Lentinellus ursinus*

Synonyms in recent use:

English name: bear cockleshell (proposed)

Known records: 22 (possibility of some confusion with ***L. vulpinus***)

BMSFRD tree associates in order of decreasing frequency: *Fagus, Salix*

Two-toned fruitbody of *Lentinellus ursinus* showing rust-spotted saw-edged gills (left) and close up (right) of reddish brown tufts of hairs which produce a striking brush-like central cap texture contrasting markedly with the smooth and paler margin.
Photographs © Dr Martyn Ainsworth.

Known distribution before 1960

Known distribution 1960 onwards

8 *Lentinellus vulpinus*

Synonyms in recent use:

English name: fox cockleshell (proposed)

Known records: 8 (possibility of some confusion with ***L. ursinus*** and ***L. cochleatus* var. *inolens***)

BMSFRD tree associates in order of decreasing frequency: *Ulmus, Fagus, Pinus*

Young pinkish brown fruitbody (left) of *Lentinellus vulpinus* showing saw-edged gills and scurfy/woolly cap texture which with age (right) becomes smoother and ribbed.
Photographs © Dr Martyn Ainsworth.

Known distribution before 1960

Known distribution 1960 onwards

9 *Ossicaulis lignatilis*

Synonyms in recent use: *Pleurotus lignatilis, Nothopanus lignatilis, Clitocybe lignatilis, Pleurocybella lignatilis*

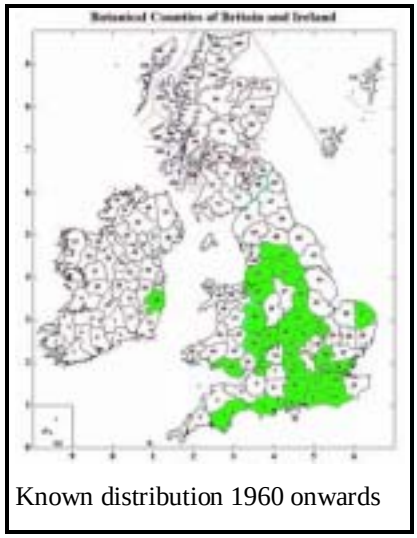
English name: mealy oyster (proposed)

Known records: 143

BMSFRD tree associates in order of decreasing frequency: *Ulmus, Fagus, Fraxinus, Acer, Sambucus, Carpinus, Populus, Quercus, Aesculus, Betula, Castanea, Crataegus, Salix*

Characteristically clustered fruitbodies of *Ossicaulis lignatilis* inside a hollow trunk with associated brown rot showing cubical cracking across the grain.
Photograph © Dr Martyn Ainsworth.

Known distribution before 1960



Known distribution 1960 onwards

10 *Phyllotopsis nidulans*

Synonyms in recent use: *Panellus nidulans, Crepidotus nidulans*

English name: orange oyster (proposed)

Known records: 19

BMSFRD tree associates in order of decreasing frequency: *Fagus, Salix*


Phyllotopsis nidulans showing tiers of orange-yellow fruitbodies, becoming darker when wet, with velvety/hairy caps which have an inrolled margin when viewed from below. The sulphurous smell has been compared to onions, garlic, cabbage and coal gas.
Photographs © Morten Christensen (left) and © Christian Lange (right).


Known distribution before 1960


Known distribution 1960 onwards

11 *Volvariella bombycina*

Synonyms in recent use:

English name: silky rosegill

Known records: 175

BMSFRD tree associates in order of decreasing frequency: *Ulmus, Fagus, Acer, Populus, Fraxinus, Betula, Aesculus, Quercus, Tilia, Crataegus, Malus*

Volvariella bombycina fruitbodies are characterised by the yellowish silky fibres on the cap surface, the brownish pink spores and the bag-like basal volva which encloses the young mushroom, as if in an egg, and is torn open by the expanding cap and stem.
Photograph © Dr Martyn Ainsworth.

Known distribution before 1960

Known distribution 1960 onwards

12 *Aurantiporus alborubescens*

Synonyms in recent use: *Tyromyces alborubescens* (in literature also as ***Aurantioporus***)

English name: pink bracket (proposed)

Known records: 57 (almost 90% New Forest)

BMSFRD tree associates in order of decreasing frequency: *Fagus*

The sappy bracket-like fruitbodies of *Aurantiporus alborubescens* are white then pale pink with a tufted surface (left) becoming darker and wetter as they mature (right).
Photographs © Dr Martyn Ainsworth.

No known distribution before 1960

Known distribution 1960 onwards

13 *Aurantiporus fissilis*

Synonyms in recent use: *Tyromyces fissilis* (in literature also as ***Aurantioporus***)

English name: greasy bracket (proposed)

Known records: 115

BMSFRD tree associates in order of decreasing frequency *Fagus, Betula, Quercus, Fraxinus, Malus, Aesculus, Liriodendron, Populus, Tilia, Ulmus*

The sappy and greasy-textured white bracket-like fruitbodies of *Aurantiporus fissilis* may become tinted a very pale pink, but are generally smoother above and show less reddening than the rarer *A. alborubescens*. The pores are shown in the view from beneath (right). Photographs © Dr Stuart Skeates.

Known distribution before 1960

Known distribution 1960 onwards

14 *Ceriporiopsis gilvescens*

Synonyms in recent use: *Tyromyces gilvescens*

English name: pink porecrust (proposed)

Known records: 181

BMSFRD tree associates in order of decreasing frequency: *Fagus, Quercus, Betula, Fraxinus, Acer, Ulmus, Alnus, Castanea, Pinus, Salix*

The fruitbodies of *Ceriporiopsis gilvescens* have a layer of pores, white becoming tinged a characteristic brownish pink, which are often in tiered rows but they do not develop a bracket-shaped projecting shelf-like cap. Photograph © Dr Martyn Ainsworth.

Known distribution before 1960

Known distribution 1960 onwards

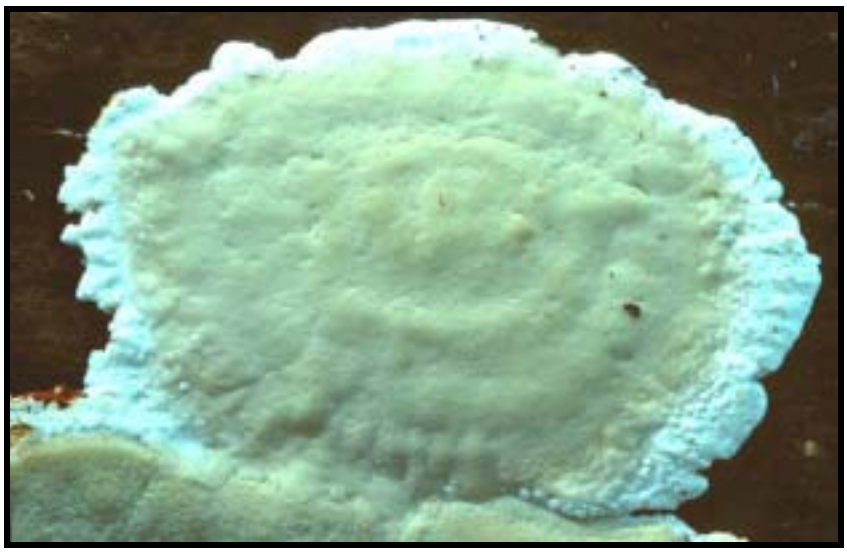
15 *Ceriporiopsis pannocincta*

Synonyms in recent use: *Gelatoporia pannocincta*, *Gloeoporus pannocinctus*

English name: green porecrust (proposed)

Known records: 66

BMSFRD tree associates in order of decreasing frequency: *Fagus, Acer, Alnus, Fraxinus, Ulmus, Quercus, Betula, Salix*



Young fruitbody of *Ceriporiopsis pannocincta* showing the actively growing white margin and the central yellow-green area which is becoming wrinkled and beginning to develop into a layer of pores. Bracket-shaped projecting shelf-like caps are not produced.
Photograph © Nick W. Legon.

No known distribution before 1960

Known distribution 1960 onwards

16 *Coriolopsis gallica*

Synonyms in recent use: *Funalia gallica*

English name: brownflesh bracket (proposed)

Known records: 53

BMSFRD tree associates in order of decreasing frequency: *Fagus, Fraxinus, Ulmus, Quercus*

Brackets of *Coriolopsis gallica* have a brown hairy matted cap surface and the underlying cap flesh is also entirely brown. Photograph © Dr Martyn Ainsworth.

Known distribution before 1960

Known distribution 1960 onwards

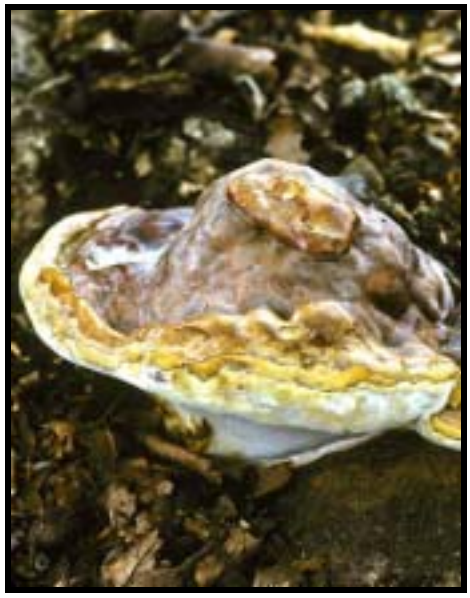
17 *Ganoderma pfeifferi*

Synonyms in recent use:

English name: beeswax bracket (proposed)

Known records: 110

BMSFRD tree associates in order of decreasing frequency: *Fagus, Quercus*



Woody brackets of *Ganoderma pfeifferi* are visible all year round, have a dark brown flesh within and the maroon reddish surface is coated with a characteristic yellow beeswax-like crust (sometimes thick enough to impart a texture resembling hammered lead) although it often lies hidden beneath a thick dull brown spore deposit.
Photographs © Dr Martyn Ainsworth.

Known distribution before 1960

Known distribution 1960 onwards

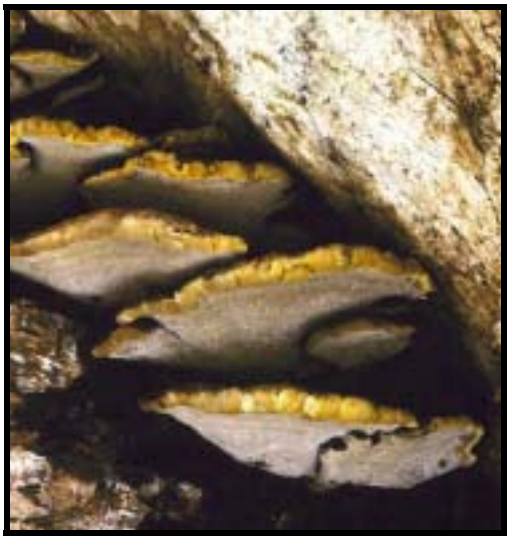
18 *Inonotus cuticularis*

Synonyms in recent use:

English name: clustered bracket (proposed)

Known records: 125

BMSFRD tree associates in order of decreasing frequency: *Fagus, Acer, Quercus, Carpinus, Fraxinus, Salix*



Brackets of *Inonotus cuticularis* are usually clustered, initially bright rusty brown and yellow with hairy matted surfaces, but often become darker brown, wet and sponge-like with age. Photographs © Dr Martyn Ainsworth.

Known distribution before 1960

Known distribution 1960 onwards

19 *Inonotus nodulosus*

Synonyms in recent use:

English name: silvery porecrust (proposed)

Known records: 19

BMSFRD tree associates in order of decreasing frequency: *Fagus, ?Betula, ?Rosa*

Fruitbodies of *Inonotus nodulosus* consist of a silvery brown layer of pores which develop a lumpy (nodulose) texture and, on vertical surfaces, sometimes produce tiers of yellow brown projecting bracket-like caps.
Photographs © Gordon Dickson.

Known distribution before 1960

Known distribution 1960 onwards

20 *Oxyporus latemarginatus*

Synonyms in recent use: *Chaetoporus ambiguus*

English name: frothy porecrust (proposed)

Known records: 79 (possible confusion with ***O. corticola***)

BMSFRD tree associates in order of decreasing frequency: *Fagus, Acer, Fraxinus, Aesculus, Pinus, Salix, Tilia*

Fruitbodies of *Oxyporus latemarginatus* have a layer of white pores, which may cover a metre or more of wood, but they do not develop a bracket-shaped projecting shelf-like cap. There is a white margin without pores which may appear bluish and waxy.
Photograph © Dr Martyn Ainsworth.

Known distribution before 1960

Known distribution 1960 onwards

21 *Phellinus cavicola*

Synonyms in recent use: included within ***P. umbrinellus*** for some authors

English name: cave artist (proposed)

Known records: 9

BMSFRD tree associates in order of decreasing frequency: *Fagus, Quercus*

Fruitbodies of *Phellinus cavicola* have very fine pores and lack a bracket-shaped projecting shelf-like cap. The photographed specimen is on wet wood temporarily removed from its characteristic location lining the inside of a hollow beech trunk. Microscopic characters need checking to confirm that records are not of the more common *Phellinus* species.
Photograph © Dr Martyn Ainsworth.

No known distribution before 1960

Known distribution 1960 onwards

22 *Spongipellis delectans*

Synonyms in recent use: *S. bredelecensis*

English name: spongy mazegill (proposed)

Known records: 57 (possibility of confusion with ***S. pachyodon***)

BMSFRD tree associates in order of decreasing frequency: *Fagus, Acer, Aesculus, Fraxinus, Populus*

Bracket-shaped fruitbodies of *Spongipellis delectans* have cream-tinted hairy surfaces (left) and strikingly patterned lower surfaces (right) which have maze-like pores at first (top) which split into irregular plates and teeth with age (bottom).
Photographs © Dr Martyn Ainsworth.

23 *Spongipellis pachyodon*

Synonyms in recent use:

English name: toothed mazegill (proposed)

Known records: 12 (possibility of confusion with ***S. delectans***)

BMSFRD tree associates in order of decreasing frequency: *Fagus, Quercus, Fraxinus*

Bracket-shaped fruitbodies of *Spongipellis pachyodon* are similar to those of *S. delectans* but they are usually narrower, more elongated and slope downwards (right, shown in side view after bracket sliced at right angles to the wood surface), the pores are more likely to split into flattened leathery teeth (left, side view of pore layer revealed when the bracket was removed from the tree) and the overlying layer of white cap flesh is very thin (left and right). Spore measurements are useful in separating the species. Photographs © Dr Martyn Ainsworth.

Known distribution before 1960

Known distribution 1960 onwards

24 *Hericium cirrhatum*

Synonyms in recent use: *Creolophus cirrhatus*

English name: tiered tooth

Known records: 214

BMSFRD tree associates in order of decreasing frequency: *Fagus, Betula, Quercus, Acer, Ulmus, Fraxinus, Carpinus, ?Pinus*

Bracket-shaped fruitbodies of *Hericium cirrhatum* are warty-spiny above and creamy white when young (left) with similarly coloured downward-pointing spines beneath (right). With age, the whole fruitbody becomes increasingly brown (right, on *Quercus* log).
Photographs © Dr Martyn Ainsworth.

Known distribution before 1960

Known distribution 1960 onwards

25 *Hericium coralloides*

Synonyms in recent use: *H. clathroides, H. ramosum*

English name: coral tooth

Known records: 118

BMSFRD tree associates in order of decreasing frequency: *Fagus, Fraxinus, Ulmus*

Fruitbodies of *Hericium coralloides* are irregular coral-like masses of rubbery white branches, bearing combs of downward-pointing spines beneath. With age, the whole fruitbody becomes increasingly pinkish brown. Photographs © Dr Martyn Ainsworth.

Known distribution before 1960

Known distribution 1960 onwards

26 *Hericium erinaceum*

Synonyms in recent use:

English name: bearded tooth

Known records: 269

BMSFRD tree associates in order of decreasing frequency: *Fagus, Quercus, Carpinus, Fraxinus, Populus*

Fruitbodies of *Hericium erinaceum* are irregular rounded white masses of downward-pointing rubbery spines which become brownish with age. When mature, the spines are longer than in the other two species and there are no shelf-like brackets (unlike *H. cirrhatum*) and no visible coral-like branches (unlike *H. coralloides*). Photographs © Dr Martyn Ainsworth.

Known distribution before 1960

Known distribution 1960 onwards

27 *Hypochnicium analogum*

Synonyms in recent use: *Gloeohypochnicium analogum*

English name: fruity crust (proposed)

Known records: 17

BMSFRD tree associates in order of decreasing frequency: *Fagus, Acer*

Fruitbodies of *Hypochnicium analogum* are dull pinkish-orange smooth or lumpy crusts with a contrasting white margin when actively growing. The fruitbody surface can cover several metres of wood and becomes more powdery with age. It produces a distinctive and powerful fruity smell which lingers on the skin after contact, although the fruity component diminishes and the odour becomes more unpleasant. The fruitbodies retain the smell after drying Photographs © Morten Christensen (left) and © Nick W. Legon (right).

Known distribution before 1960

Known distribution 1960 onwards

28 *Mycoacia nothofagi*

Synonyms in recent use:

English name: fragrant toothcrust (proposed)

Known records: 22

BMSFRD tree associates in order of decreasing frequency: *Fagus, Betula*

Crust-like fruitbodies *Mycoacia nothofagi* have crowded 'teeth' projecting from their lower surface which is initially white then yellowish brown (left) developing rusty tints with age (right) and a powerful sweet soapy/oily smell which may be detectable from several metres away. Photographs © Dr Martyn Ainsworth.

No known distribution before 1960

Known distribution 1960 onwards

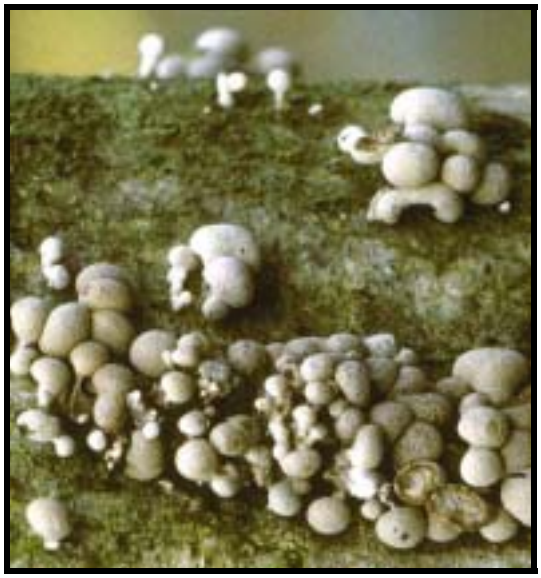
29 *Phleogena faginea*

Synonyms in recent use:

English name: fenugreek stalkball (proposed)

Known records: 116

BMSFRD tree associates in order of decreasing frequency: *Fagus, Quercus, Alnus, Ulmus, Salix Acer, Fraxinus, Betula, Corylus, Carpinus, Crataegus, Malus, Picea, Tilia*



Fruitbodies of *Phleogena faginea* are formed in swarms and consist of a small rounded head and stem. The underlying wood usually smells of fenugreek (curry powder).
Photograph © Dr Martyn Ainsworth.

Known distribution before 1960

Known distribution 1960 onwards

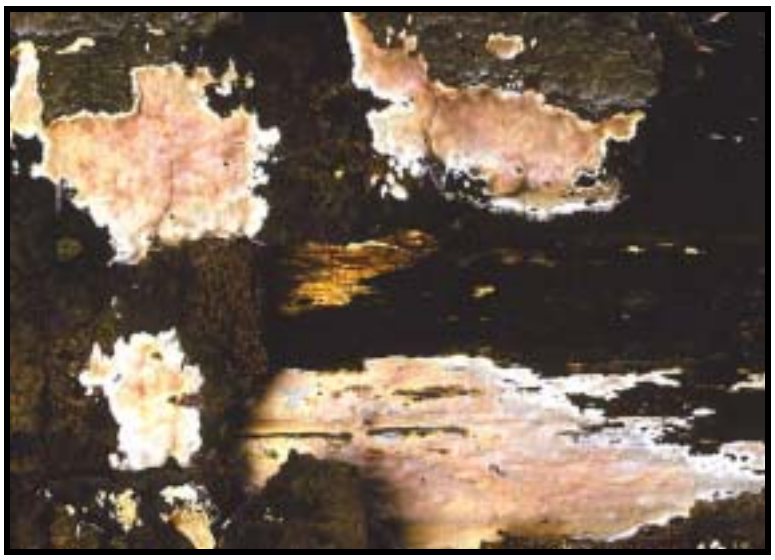
30 *Scytinostroma portentosum*

Synonyms in recent use:

English name: mothball crust (proposed)

Known records: 42

BMSFRD tree associates in order of decreasing frequency: *Fraxinus, Fagus, Acer, Alnus, Ulmus, Quercus, Betula, Salix*



Fruitbodies of *Scytinostroma portentosum* are wax-like smooth crusts with a striking pinkish tone when young and powerful naphthalene (mothballs) smell.
Photograph © Dr Martyn Ainsworth.

No known distribution before 1960

Known distribution 1960 onwards

Appendix 2 Data sheets on four de-selected saprotrophic indicators for bulky beech substrata

Catinella olivacea

Synonyms in recent use:

English name: none

Known records: 98

BMSFRD tree associates in order of decreasing frequency: *Fagus, Ulmus, Fraxinus, Populus, Acer, Betula, Alnus* (but ?associated with other fungi)

Well-decayed wet wood with dark olive green disc-shaped fruitbodies of *Catinella olivacea* showing contrasting yellow margins (with white crust-like fruitbodies of *Subulicystidium longisporum*). Photograph © Dr Martyn Ainsworth.

Known distribution before 1960

Known distribution 1960 onwards

Hypoxylon cohaerens

Synonyms in recent use:

English name: none

Known records: 60

BMSFRD tree associates in order of decreasing frequency: *Fagus, Betula, Corylus, Fraxinus*

Black knobbly *Hypoxylon cohaerens* fruitbodies in 'swarm' on fallen *Fagus* trunk. Photograph © Dr Martyn Ainsworth.

Known distribution before 1960

Known distribution 1960 onwards

Pholiota aurivella

Synonyms in recent use: *P. cerifera*

English name: golden scalycap

Known records: 274 (possibility of confusion with ***P. jahnii***, which for some includes ***P. adiposa*** as it is used in New Check List 1960. Further confusion could arise because ***P. aurivella*** has recently been reduced to a synonym of ***P. adiposa*** by Holec)

BMSFRD tree associates in order of decreasing frequency: *Fagus, Fraxinus, Alnus, Betula, Salix, Ulmus, Populus, Tilia, Corylus, Acer, Aesculus, Quercus, Robinia, Sambucus*

Characteristically clustered fruitbodies of *Pholiota aurivella* with brown scales on a slimy cap surface and gills which become rusty brown as the spores mature.
Photograph © Dr Martyn Ainsworth.

Known distribution before 1960

Known distribution 1960 onwards

Henningsomyces candidus

Synonyms in recent use: ***Solenia candida***

English name: none

Known records: 169

BMSFRD tree associates in order of decreasing frequency: *Fagus, Betula, Ulmus, Fraxinus, Quercus, Salix, Acer, Corylus, Castanea, Larix, Picea, Pinus*

Tiny clustered fruitbodies of *Henningsomyces candidus*, each of which consists of a single white downwardly-directed tube rarely exceeding 1mm in length (hand lens required). Photograph © Dr Martyn Ainsworth.

Known distribution before 1960

Known distribution 1960 onwards

Appendix 3 Sheet for recording suggested beech indicators and thumbnail images of all 30 species

Recorder's name:			
MAP REF.	NAME OF LOCATION	COUNTY	VC

BEECH RECORDS ONLY

No.	Species	English name	Date
	Ascomycetes		
1	*Camarops polysperma*	Thick tarcrust	
2	*Eutypa spinosa*	Spiral tarcrust	
	Gilled fungi (*Pluteus* to be listed below)		
3	*Flammulaster limulatus s.l.*	Golden powdercap	
4	*Flammulaster muricatus*	Toothed powdercap	
5	*Hohenbuehelia auriscalpium*	Spatula oyster	
6	*Hohenbuehelia mastrucata*	Woolly oyster	
7	*Lentinellus ursinus*	Bear cockleshell	
8	*Lentinellus vulpinus*	Fox cockleshell	
9	*Ossicaulis lignatilis*	Mealy oyster	
10	*Phyllotopsis nidulans*	Orange oyster	
11	*Volvariella bombycina*	Silky rosegill	
	Poroid fungi		
12	*Aurantiporus alborubescens*	Pink bracket	
13	*Aurantiporus fissilis*	Greasy bracket	
14	*Ceriporiopsis gilvescens*	Pink porecrust	
15	*Ceriporiopsis pannocincta*	Green porecrust	
16	*Coriolopsis gallica*	Brownflesh bracket	
17	*Ganoderma pfeifferi*	Beeswax bracket	
18	*Inonotus cuticularis*	Clustered bracket	
19	*Inonotus nodulosus*	Silvery porecrust	
20	*Oxyporus latemarginatus*	Frothy porecrust	
21	*Phellinus cavicola*	Cave artist	
22	*Spongipellis delectans*	Spongy mazegill	
23	*Spongipellis pachyodon*	Toothed mazegill	
	Others		
24	*Hericium cirrhatum*	Tiered tooth	
25	*Hericium coralloides*	Coral tooth	
26	*Hericium erinaceum*	Bearded tooth	
27	*Hypochnicium analogum*	Fruity crust	
28	*Mycoacia nothofagi*	Fragrant toothcrust	
29	*Phleogena faginea*	Fenugreek stalkball	
30	*Scytinostroma portentosum*	Mothball crust	
	Pluteus umbrosus	Velvet shield	
	List any other *Pluteus* spp.		

1 *Camarops polysperma* (asco)

Thick tarcrust (Photo © Dr Martyn Ainsworth)

2 *Eutypa spinosa* (asco)

Spiral tarcrust (Photo © Dr Martyn Ainsworth)

3 *Flammulaster limulatus s.l.* (gilled)

Golden powdercap (Photo © Morten Christensen)

4 *Flammulaster muricatus* (gilled)

Toothed powdercap (Photo © Peter Thompson)

5 *Hohenbuehelia auriscalpium* (gilled)

Spatula oyster (Photo © Dr Martyn Ainsworth)

6 *Hohenbuehelia mastrucata* (gilled)

Woolly oyster (Photo © Dr Martyn Ainsworth)

7 *Lentinellus ursinus* (gilled)

Bear cockleshell (Photo © Dr Martyn Ainsworth)

8 *Lentinellus vulpinus* (gilled)

Fox cockleshell (Photo © Dr Martyn Ainsworth)

9 *Ossicaulis lignatilis* (gilled)

Mealy oyster (Photo © Dr Martyn Ainsworth)

10 *Phyllotopsis nidulans* (gilled)

Orange oyster (Photo © Morten Christensen)

11 *Volvariella bombycina* (gilled)

Silky rosegill (Photo © Dr Martyn Ainsworth)

12 *Aurantiporus alborubescens* (poroid)

Pink bracket (Photo © Dr Martyn Ainsworth)

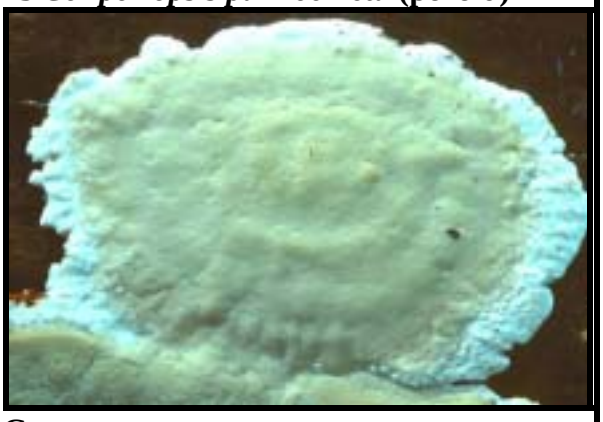
13 *Aurantiporus fissilis* (poroid)

Greasy bracket (Photo © Dr Stuart Skeates)

14 *Ceriporiopsis gilvescens* (poroid)

Pink porecrust (Photo © Dr Martyn Ainsworth)

15 *Ceriporiopsis pannocincta* (poroid)



Green porecrust (Photo © Nick W. Legon)

16 *Coriolopsis gallica* (poroid)

Brownflesh bracket (Photo © Dr Martyn Ainsworth)

17 *Ganoderma pfeifferi* (poroid)

Beeswax bracket (Photo © Dr Martyn Ainsworth)

18 *Inonotus cuticularis* (poroid)

Clustered bracket (Photo © Dr Martyn Ainsworth)

19 *Inonotus nodulosus* (poroid)

Silvery porecrust (Photo © Gordon Dickson)

20 *Oxyporus latemarginatus* (poroid)

Frothy porecrust (Photo © Dr Martyn Ainsworth)

21 *Phellinus cavicola* (poroid)

Cave artist (Photo © Dr Martyn Ainsworth)

22 *Spongipellis delectans* (poroid)

Spongy mazegill (Photo © Dr Martyn Ainsworth)

23 *Spongipellis pachyodon* (poroid/tooth)

Toothed mazegill (Photo © Dr Martyn Ainsworth)

24 *Hericium cirrhatum*

Tiered tooth (Photo © Dr Martyn Ainsworth)

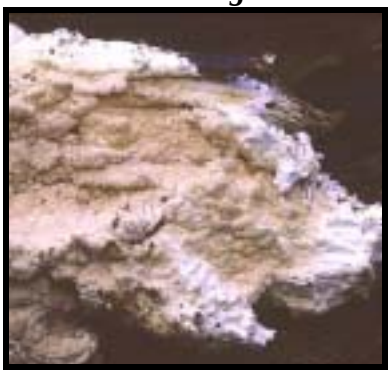
25 *Hericium coralloides*

Coral tooth **(Photo © Dr Martyn Ainsworth)**

26 *Hericium erinaceum*

Bearded tooth **(Photo © Dr Martyn Ainsworth)**

27 *Hypochnicium analogum*



Fruity crust **(Photo © Morten Christensen)**

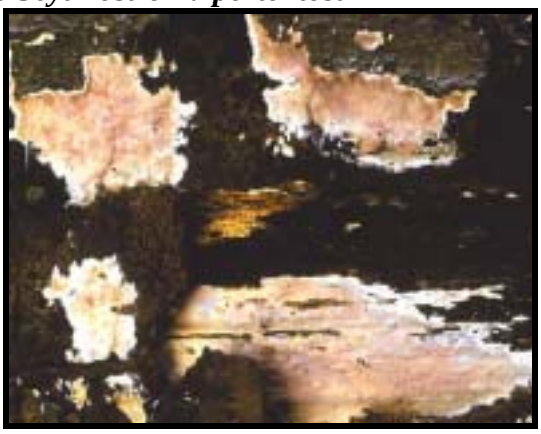
28 *Mycoacia nothofagi*

Fragrant tooth **(Photo © Dr Martyn Ainsworth)**

29 *Phleogena faginea*

Fenugreek stalkball **(Photo © Dr Martyn Ainsworth)**

30 *Scytinostroma portentosum*



Mothball crust **(Photo © Dr Martyn Ainsworth)**

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