

Macrofungi of the Hafod Estate and its Environs

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1 INTRODUCTION

This report combines the results of a three-year survey aimed at listing all the macrofungi and their ecology in a series of recording visits. It set out to encompass all geographic areas of the Estate as well as all the different habitats encountered.

Firstly, therefore, it is by way of being a compilation of the results of that three-year survey of the larger fungi of the Hafod Estate. Secondly, in 2001, the final year of the project recording visits were not confined within the boundaries of the current Hafod Estate, now owned by the Forestry Commission. This is because 200 years ago the estate covered a very much larger area than does the present one. Preliminary investigations were therefore extended to the estate's 'environs' – adjoining areas many which would almost certainly have formed part of the Hafod Estate *sensu lato*. in its heyday.

The areas concerned were Cae'r y-Meirch, now a Site of Special Scientific Interest, which covers a large area mainly to the north of the present estate; and also the very recently opened Pwllpieran Trail, off the Cwmystwyth road to the east.

It was felt that, since both these areas include some habitats lacking within the present Hafod Estate boundaries, each warrants an individual report, especially since the managements of the two sites has in many ways been quite different from that of the main estate.

However, since we are starting from the standpoint of regarding all three sites as part of what was a whole ecosystem, a summary of the wider area is included. This approach is very much in keeping with the thinking behind English Nature's concept of "Natural Areas" (Anon, 1999). (Under this scheme EN have divided England into a series of Natural Areas whose boundaries are based on the distribution of wildlife and natural features, land use patterns and human history of each area. They do not follow administrative boundaries, but relate instead to variations in the character of the landscape.)

2 BACKGROUND

2.1 Hafod and its Environs occupy a large area of the upper Ystwyth valley, much of which is still devoted to upland grazing, mainly by sheep. It is situated to the south of Devil's Bridge in the vice-county of Cardiganshire. The current county name is Ceredigion

2.2 Hafod Estate.

Two hundred years ago the house and grounds of Hafod were one of the wonders of Wales (Whittle, 1992). The estate was designed in the late 19th century in the "picturesque" style by Thomas Johnes, entrepreneur, scholar and idealist.

For more than half a century Hafod became an essential destination for visitors touring Wales in search of 'wild nature' (Whittle, 1992). This is scarcely surprising since Johnes planted five million trees in the valley and created dramatic views and water features in what was an uninspiring treeless setting. Set in the middle of a barren, wilderness landscape it was a surprise to all who entered its domain. Small wonder that it was described by delighted visitors of the time as "a paradise in a profound desert" and "a second paradise from a newly-subsidised chaos" (Whittle, 1992).

2.3 Hafod Today

Two mansions built by Johnes were burnt down (the latest as recently as the 1930's). And today it is difficult to imagine Hafod in its heyday, since most of the estate is covered with coniferous plantations maintained, via Forest Enterprise, by the current owners, the Forestry Commission. And many of the water features and monuments added by Johnes have disappeared or fallen into a sad state of decay.

"But there is still something about the ethos of Hafod that remains: the natural beauty of the valley and the 'paradise' have not entirely disappeared" (Whittle, 1992). And Forest Enterprise, in collaboration with Hafod Trust is in the process of restoring many of the original features

The extensive 'lawns' surrounding the former mansion present a fine example of "ancient grassland" – unimproved, traditionally managed and grazed by sheep. (It is mainly because of the high conservation quality of this grassland that Hafod Estate has been included by Plantlife in its new document "Important Fungus Areas: A provisional assessment of the best sites for fungi in the United Kingdom" [Evans et al, 2002]).

The areas to the south of the river Ystwyth are occupied mainly by large plantations of

conifers, mainly larch (*Larix*). However here also are fine examples of mature oak (*Quercus*) and beech (*Fagus*), growing in some parts in substantial numbers.

The area downhill from the visitors' car park (Area numbered 1105) contains substantial stands of noble fir (*Abies procera*) as well as other planted conifers such as Norway spruce (*Picea abies*) and western hemlock (*Tsuga heterophylla*).

To the west, in Area 1117, the hillside is dominated by young beech amongst older conifer plantings.

2.3 Cae'r y-Meirch

This SSSI occupies some 83.5 hectares (206.3 acres) to the north of Hafod Estate and is a working farm in private ownership (Chater, 1994). Chater and his colleagues, who carried out a mainly botanical survey there starting in 1981, describes the site as "the best known example of a traditionally managed farm unit in Ceredigion". He explains that the site covers both sides of the small Nant Lledwennau valley, rising from an altitude of 150 metres to 350 metres on the wooded ridge of Cefn Dyrys.

His description goes on: "Its unimproved meadows and pastures contain an exceptionally good range of damp and dry grassland communities, including the largest area of neutral grassland in the district.

"The site is also notable for its remarkable collection of locally scarce plant species, its rich assemblage of woodland breeding birds and its invertebrates."

He adds that part of the site lies within the Cambrian Mountains Environmentally Sensitive Area. (Sketch maps of Cae'r y-Meirch from Chater, 1994, are reproduced on the cover of Appendix IV, showing the division of the site into areas by him and his fellow surveyors.)

2.4 The Pwllpeiran Trail (ADAS)

A new, seven kilometre "permissive" trail was opened to the public in October, 2001, the opening having been delayed by the foot and mouth epidemic. Formerly part of the Hafod Estate, it played an historic role as a pioneering agricultural upland Welsh enterprise before moving into public ownership in 1955.

Its brochure states: "Today Pwllpeiran is an ADAS Research Centre with a wide range of activities, as our countryside is now being managed for multiple objectives where effective partnerships with all its users are of great importance."

The trail crosses a range of grassland habitats passing some ancient woodland and wetland. In many places it fringes conifer plantations as well as tracts of natural more recent woodland.

3 METHODS FOR THE 2001 SURVEY

In general these followed the methods outlined in previous reports.

Fieldwork for the Hafod Estate survey was carried out mainly the months of October and November, when a weekly series of recording visits were made. These were supplemented with a single visit in July and two visits in September. The timing of the visits was chosen to coincide with what was thought to be the most favourable environmental conditions for fungal fruiting, ie several days after rainfall. The visits, which lasted approximately four hours on average, aimed to cover the estate geographically, including as many different habitats as possible. On some occasions particular habitats were subject to more intensive investigation, when fruiting in those areas was more abundant.

During this time a number of occasional incursions were made into parts of Cae'r y-Meirch.

The Pwllpeiran Trail was visited on one occasion only, when the author led a public foray of a dozen employees or friends of ADAS.

3.1 Mycorrhiza

Certain anomalies in mycorrhizal patterns observed towards the end of the 2001 survey, led the author to pay particular attention to this ecological phenomenon at the sites being investigated.

As outlined in earlier reports, many fungi form a symbiotic relationship with higher plants, known as mycorrhiza – which is of benefit to both partners.

Today, an estimated 90% of the world's plants are mycorrhizal. However most of these associations, perhaps as many as 75%, are in a form known as **endomycorrhizas**, which comprise many obscure and little understood groups (Merryweather, 2001) and are not dealt with in this survey.

But 25% of the mycorrhizal fungi are **ectomycorrhizal** with the roots of trees. They include the larger toadstool genera such as boletes, milk-caps, Russulas, and the Cortinariales. These fungi play a major part in supplying their tree hosts with scarce nutrients such as phosphates, thus ensuring more vigorous and faster growing trees.

Some ectomycorrhizal fungi are able to form a relationship with only a single species of tree – such as the Elegant Bolete (*Suillus grevillei*) with larch – while others are less specific and can form mycorrhizas with many different host species.

3.2 Assessment of Conservation Value

No systematic methodology exists for the quantification of conservation value of woodland habitats from a mycological point of view. (Although lists of fungal associates of various tree species have been compiled, as have lists of fungal indicators of ancient woodland.) Assessments were therefore made in the light of the author's observations and experience, taking into account considerations outlined in the Introduction above.

Grassland: Conservation of this habitat has been the subject of intensive study in recent years, in both Britain and Europe and the resultant data provided a well-documented context against which to evaluate the Hafod findings.

The data relating to grasslands were analysed using the methodologies proposed by Rald [1985], Rotheroe *et al* [1996], Rotheroe [1997] and Rotheroe [1999]. These methods are summarised in Appendix I.

4 RESULTS

Full lists of species recorded during the survey are given in the Appendices. Appendix II refers to all those species recorded in 2001, the final year of the survey. Appendix III is a cumulative list of all finds during the three years of the project. (It should be noted that a small number of species listed under the heading 1999, were in fact recorded in previous years also.

The Cae'r y-Meirch and Pwllpeiran lists (Appendices IV & V) refer only to records from 2001, of course.

4.1 Hafod Woodland

A number of new species to the Hafod list were recorded in 2001. Notable among these was *Boletus aestivalis*, the summer bolete, growing with a single oak near the grassland.

This find was unusual in the fact that it is usually regarded as an early fruiting species (The Hafod record was made in September), that it is a thermophile, mainly known from southern England, and that it was fruiting in a relatively high upland area.

Other unusual boletes included: *B. trisporus*, a three-spored form of the Cep, *B. edulis*, (which seems to be more frequently recorded in recent years and is thought by some to be the true *B. edulis*); and *B. pulverulentus*, the Powdered Bolete, an uncommon fungus

which was found growing in profusion in July – not, as the literature indicates, under broadleaved trees, but in bare grass at the southern end of the grassland – at least 50 yards from the nearest tree!

Re-found for the second year running in the same spot at the side of the forestry drive in Area 1116, was the rare British Red Data list species *Amanita lividopallescens*. the pale livid *Amanita*. Again a single specimen only. Hafod is the only site Welsh site for this species.

The most productive area of woodland was undoubtedly that in Area 1115, through well-worn paths down hill from the visitors' car park to the waterfall below, and just beyond. Here fruiting was much more predictable and prolific, even to the end of November, when in other areas fungal fruit bodies were not to be found. Here was found in September *Amanita porphyria* (the purplish *Amanita*), an uncommon species and a first county record for Ceredigion. It is similar to the common *Amanita citrina*, but has a purplish cap. This was only the third Welsh record. The BMS database contains only two previous records of the species from the Principality. The first was recorded by 'anon' in 1924 in 'Hafod Woods' (sic), Clwyd and the second in 1950 (again anon) at Bettws y Coed, Gwynedd. The Hafod collection is therefore the first British record for more than half a century!

Also in this area was a collection of *Amanita muscaria* f. *aureola* (the orange fly agaric). This, as the name implies, has an orange, not red, cap, and has no white scales, which are so typical of the fly agaric. Thus it is extremely easy to identify in the field. It is very rarely recorded and there are only two records in the BMS database, one from Sussex in 1926, the other from S.E. Yorkshire in 1999. It is obviously, therefore, a new Welsh record and will appear on the revised Welsh Red Data List (in prep.).

Controversy exists over the status of the fungus, some literature describing it as a species in its own right. The current British view seems to be that it is merely a form of the fly agaric.

4.1.1. The Pattern of Mycorrhiza at Hafod

To the author's surprise the fly agaric (and its orange form) was found growing in the noble fir (*Abies procera*) plantation in Area 1105. The literature, both popular and academic, has always claimed the fly agaric to be strictly mycorrhizal birch, only occasionally being found with pine. (A subsequent examination of the BMS database revealed that among the hundreds of records of the fly agaric, birch and pine were listed as the main mycorrhizal

partners, though there were a handful of records associating the fungus with several other tree species, both broadleaved and coniferous. However, none of the records indicated an association with noble fir.)

This observation led the author to examine more closely the presumed mycorrhizal fungi associated with noble fir in this area. It quickly became obvious that most of the mycorrhizal fungi fruiting at Hafod in 2001 were associated with noble fir.

This raises a number of questions and suggests some answers. If a tree is raised from seed then it can bring none of its own natural mycorrhizal associations with it. On the other hand, trees taken from nature as saplings will invariably carry mycorrhizas on their roots.

The author is not fully acquainted with the history of tree planting at Hafod, although it is well known that Johnes's plantings were from seed nurtured in his own nurseries. Thus most of the trees he planted would have none of their own individual mycorrhizas with them.

This may account for the relative paucity of mycorrhizal fungi with the vast numbers of larch planted by Johnes and also with many other tree species. Whether Forest Enterprise and its predecessors use seed rather than native saplings is not known. Saplings are, of course, more expensive than seed (and the nurseries which sell them may well have grown them from seed, too). The provenance of Hafod's trees deserves further investigation.

As to the noble fir, it is not known why fruiting with this species should be so prolific. Are the mycorrhizal associations 'natural' or have the firs picked up and taken over existing mycorrhizas already in the soil. At all events, it is clear that the most active mycorrhizal tree at Hafod is noble fir. Since it dominates Area 1105 from the car park downwards, it may account for the relative richness of this area compared with others and that this is the area where mycorrhizal activity at Hafod is at its peak.

The larch, for example, usually a very active mycorrhizal tree, has been disappointing over the past two years in particular. (In 2001, for example, not a single sample of the elegant bolete (*Suillus grevillei*) was seen. This is a very common fungus and normally grows in troops along the verges of larch plantations.)

Likewise, the mature oaks and beeches on the south side of the river only exceptionally were accompanied by mycorrhizal fruit bodies. (One notable exception being *Cortinarius bolaris*, an indicator of ancient woodland, found in the year 2000.)

It might be suggested that these ancient trees are past their prime and younger

specimens might display more mycorrhizal activity. However, the grove of young beech on the hillside to the west in Area 1117, referred to above, which is south facing, proved equally disappointing.

4.1.2 Box Rust

It may be recalled that in Rotheroe, 2001, an important record of the rare and unusual box rust (*Puccinia buxi*) was emphasised. Perhaps it would be useful to repeat the text used in that report.

QUOTE: "*Puccinia buxi*, Box Rust. British gardens and estates have, since Tudor times, used box (*Buxus sempervirens*) as an ornamental plant. It also grows naturally in the south-east of England.

"But, in spite of very large quantities of its host, box rust is rarely recorded and, in fact, most mycologists are unaware of its existence. This may be because it is such a benign pathogen, whereas most rusts can be regarded as a serious form of disease. It is an oddity in more ways than one. The symptoms are slight. A few leaves may show a smattering of tiny, orange-coloured "pips" on the upperside. From a distance there is no obvious effect. Unlike most of its kind it has no alternative host, which means that it grows on box - and only box. However it is very choosy about which box trees it invades. It is confined to very old trees and bushes, which have been little disturbed. It is mainly found, therefore, on box bushes at stately homes or estates. In fact a map of its distribution, would be a map of old country houses, stately homes - plus the areas where it occurs in the wild. It has been reported from Powis Castle while I, having been alerted to existence, have seen it at Levens Hall, Erddig and Aberglasney.

"Now it has turned up at Hafod - on old, overgrown bushes in the garden of Hawthorn Cottage."

Last year, however, renovation of Hawthorn Cottage was begun and workmen found it necessary to cut down the box tree to the right of the front of the house in order to gain access to their building work. All that remains of that tree now are several two-foot high stumps, with no sign of the box rust on the few remaining leaves. However, this might not be the tragedy it first appeared. Box regenerates readily and the box tree to the left of the cottage has scarcely been damaged and the rust is thriving on that specimen. In addition there is a line of relatively mature box trees running alongside the track which leads alongside the river from near the ice house to the walled garden. One of these trees had a few leaves with evidence of the rust and more may be found on other trees there on closer examination.

4.2 Hafod Grassland Results

4.2.1 Background

As with many vascular plants, certain species of macrofungi are largely confined to – and are therefore indicative of – traditionally managed grasslands. For this reason such habitats have been described by mycologists as “*Hygrocybe* grasslands” [Feehan & McHugh, 1992] or “Waxcap Grasslands” [Rotheroe *et al.*, 1996]. The genus *Hygrocybe* (Waxcaps) is not the only indicator in this fungal grassland community. Waxcaps are often accompanied by Fairy Clubs (clavarioid fungi); pink-spored species of the genus *Entoloma* (Pink-gills); and Earth Tongues (family Geoglossaceae). Many of the taxa in these groups feature in the British and European Red Data Lists (RDLs) of threatened or endangered fungi [Ing, 1992, 1993]. Several are also listed in many of the 11 published national RDLs in Europe. According to Arnolds & de Vries [1993], all European species of *Clavaria* (Fairy Clubs) are included on a Red Data List somewhere in Europe, while 67 per cent of another grassland Fairy Club genus, *Clavulinopsis*, feature on at least one European RDL. Figures for other genera are: *Hygrocybe*, 89 per cent and *Entoloma s.l.*, 97 per cent.

4.2.2 Analysis of Data Obtained

The very high conservation value of Hafod's grassland is now well known and well publicised. But three new species were added to the list of ancient grassland indicators in 2001. These were *Entoloma (Leptonia) serrulatum*; another fairy club, *Ramariopsis kunzei*; together with the first record of an Earth Tongue, ie *Geoglossum fallax*.

These additions change the “CHEG profile” of Hafod grassland, of course. An explanation of which is summarised in Appendix I. ie C = Fairy Clubs; H = Waxcaps; E = Pink-gills; G = Earth Tongues.

Thus the CHEG evaluation for Hafod becomes C5 H30 E7 G1. (Note *Entoloma clypeatum* is not a waxcap grassland indicator and is therefore omitted from the score.)

The CHEG can be compared with other Welsh grasslands for which data is available, as shown in Table 1 below.

**Table 1: Cumulative list of indicator species recorded at important Welsh sites
(Conservation values assigned according to Rald [1985] as adapted
by Vesterholt *et al* [1999])**

Location	C	H	E	G	Conservation Value
Hafod Estate	5	30	7	1	(International Importance)
Garn Ddyrys, Tumble	3	28	0	5	(International Importance)
Llanerchaeron (NT)	6	23	7	2	(International Importance)
Gillfach Farm, Rhayader	3	23	0	0	(International Importance)
Waun-las Farm, Middleton	4	22	7	0	(International Importance)
Carreg Cennen SSSI	4	19	4	0	(National Importance)
'Talley' SSSI	2	16	14	0	(Regional Importance)
Pwll Edrychiad SSSI	3	11	3	1	(Regional Importance)
St David's College lawns, Lampeter	2	9	3	3	(Regional Importance)
Dinefwr Park (NT)	1	9	0	0	(Regional Importance)

According to the Scandinavian interpretations, therefore, Hafod is one of only five Welsh grasslands of International Importance. It is also clearly the second most important site in Wales. (The Scandinavian concepts have in the past proved equally valid for Britain [pers. observations and pers. comm. by various mycologists])

4.2.3 Evaluation using the Rotheroe [1999] formula (see APPENDIX I)

Rapid Assessment values of Welsh grasslands according to the "Top Twenty-four" formula proposed by Rotheroe [1999] and explained more fully in Appendix I. Note: A's score higher than B's and the sites are listed in order of their estimated mycological importance and therefore are intended to reflect the quality of the species included in the general list. From the results below the seven sites may be judged to have shown their high conservation value (extremely high in a UK context).

**Table 1: Rapid Assessment values for Waxcap Grasslands in present survey
using "Top Twenty-four" scores**

Location	Conservation Value
Llanerchaeron Estate (NT)	A7 B4
Hafod Estate	A4 B9
Gillfach Farm, Rhayader	A4 B4
Garn Ddyrys, Tumble	A3 B10
Waun-las Farm, Middleton	A3 B5
Maestir Churchyard, Lampeter	A3 B2
'Talley' SSSI	A1 B5

5 MANAGEMENT FOR THE CONSERVATION OF FUNGI AT HAFOD ESTATE

5.1 Grassland: It may be stating the obvious but perhaps it is worth repeating advice given in an earlier report ie QUOTE: "Since the open parkland, the grazed unimproved grasslands, have been shown to be of the highest mycological conservation value at Hafod, clearly the management history which produced this high-quality habitat should be examined, in order to maintain the status quo. This involves continued grazing and no application of

fertilisers. Many conservationists would baulk at the relatively high levels of grazing by sheep on the site. But the conclusions emerging from the three surveys drawn upon in this study are that the group of Waxcap-grassland indicator species can tolerate much higher levels of grazing intensity than might previously have been imagined. (Incidentally, sheep and rabbits are being identified in the study as being the ideal grazing domestic animals for the conservation of Waxcap grasslands, in preference to cattle, horses, deer etc.) "

Perhaps because of problems caused by foot and mouth disease the numbers of sheep grazing at Hafod appeared to have been reduced last year. This resulted in the sward on many parts of the grassland being much longer. Longer sward inhibits fungal fruiting and it was clear that these areas were less productive than in previous years.

5.2 Woodland: In general management of the woodland seems to favour the fruiting of fungi. However, in the clearly important noble fir plantation in area 110's5, a large number of ground covering weeds have grown up in places (eg brambles) and these, too, discourage fungal fruiting. Hence the largest number of collections were made on the edges of drives or footpaths.

6 CAE'R Y-MEIRCH

This is an extensive working farm, as described above. Only a few visits were possible and only a small number of the areas marked on the map in Appendix II were covered. However, these preliminary sorties proved to be very successful.

The most significant collection was that of *Lactarius lignyotus* (the wood-loving milkcap), so called because it is often found growing on wood — most unusual for a mycorrhizal member of the Russulales. It is a rare species in Britain and is likely to appear on the revised red data list, now in preparation.

This specimen was found growing on the exposed root of a mature Norway spruce (*Picea abies*), just inside the boundary of area G (Cefn Dyrys Wood) on the map, adjacent to the disused quarry.

The collection is all the more remarkable because the same species had previously been found on the Hafod Estate, again on *Picea*, near the river in area 1115.

Areas F and N proved unrewarding. However a small marsh site, marked (by the author) as CM1, which was not covered in the flowering plant survey conducted by Chater *et al*, was particularly interesting mycologically.

Two rare and unusual 'witches' brooms' — species of *Taphrina* — were collected here too. The best-known witches' broom, *Taphrina betulina* is an extremely common parasite on birch, particularly in Wales. Its appearance — like a ball of 'scraggy hair' — makes it very easy to identify from a considerable distance and it was found on this occasion in Area N. In the CM1 area, however, it was growing on hornbeam, of which there are several mature examples at Cae'r y-Meirch. I had personally never seen the broom on this host before, but my companion on this trip, Arthur Chater, said he had seen an example of, *Taphrina carpini*, several years ago in the grounds of St David's College, Lampeter. It would appear that the Cae'r y-Meirch specimen was probably the second Ceredigion record.

Even rarer was the witches' broom of Tormentil (*Potentilla erecta*) which was found in a wetter part of CM1. This broom, (*Taphrina tormentillae*) causes extreme distortion of the stems and leaves of the Tormentil. Arthur Chater (pers. comm.) said he had never seen it before, even though Tormentil is so common. No records for south Wales exist for this species, with only a handful of records from north Wales (pers. comm. Bruce Ing).

The sclerotia of ergot (*Claviceps purpurea*) is not an uncommon disease of grasses and cereals in Britain. (The ergot of rye contaminating bread caused "St Anthony's Fire" in the Middle Ages). However the sclerotia are usually found in ones and two, or small clumps on the same species. It came as a great surprise, therefore, when Arthur Chater collected sclerotia from four different grass species, growing within a six foot circle. The hosts were *Dactylis*, *Lolium*, *Molinia* and *Anthoxanthum*.

ERRATUM: In an earlier report which concentrated on the pathogenic fungi in particular, it was stated that Ostoy's Honey Fungus (*Armillaria ostoyae*) was a relatively benign fungus, compared with its lethal cousin, *Armillaria mellea*. It has now been found, in fact, that Ostoy's Honey Fungus is very much as virulent and every bit as much a killer of trees.

This was very evident among the rows of Hornbeam in CM1. Ostoy's Honey Fungus had caused devastation to these trees, having killed about a third of them. The fungus was fruiting in profusion. Clearly attitudes to this pathogen will have to be reviewed. It is now realised that it played an important part in the death of the giant beech in area 1115 - which was then attributed only to the Giant Polypore, *Meripilus giganteus*.

7 PWLLPEIRAN TRAIL (ADAS)

A half day fungus foray hardly does justice to this seven kilometre upland walk. But with the help of a jeep, a dozen keen collectors soon showed its mycological richness. Three areas were concentrated on: Parc Vicarage Wetland; Bwlch yr Oerfa; and the Hafod Arch area;

The first find of note at the wetland was *Scutellinia pseudotrechispora*, one of the eyelash fungi - so called because it takes the form of a little red cup, about half a centimetre across, encircled with short black hairs. It is interesting to observe that the British Mycological Society Database (BMSFRD) has only five previous records of this species recorded from Wales. All these five were collected in 1973 and all in the county of Glamorganshire. (It seems likely that these records were connected with a BMS workshop or annual foray, and some may be duplicates, as often happens at these events.)

A number of fairy clubs were also collected in this wetland enclosure, and no fewer than ten *Hygrocybe* (Waxcap) species. This was a high score for what is a relatively small area.

Part of Bwlch yr Oerfa is bounded by a fenced plantation of sitka spruce (*Picea sitchensis*). This tree is probably the least favoured of all plantation species by biologists of all persuasion. Certainly sitka spruce plantations are not regarded as happy hunting grounds by most mycologists. (Although it must be pointed out that a survey by Alexander & Watling (1987) recorded more than 80 species of macrofungi growing in these plantations.) At all events it was a surprise to find specimens of the fly agaric (*Amanita muscaria*) growing inside the plantation - in view of the comments above. Equally surprising farther along the same plantation was a perfect specimen of the orange fly agaric (*Amanita muscaria* f. *aureola*).

On the bank verging the plantation several other species of waxcap were recorded.

The area around the Hafod Arch produced additional waxcap species. If the Pwllpeiran Trail as a whole is regarded as a single unit then it must be regarded as a high quality waxcap grassland, the profile totalling C3 H13 E2 G0.

The observations above concerning the mycorrhizal activities of noble fir were reinforced at the Arch, where the fly agaric was found growing under a single, isolated specimen of the tree. Clearly it was too far away from other trees to have associations with them.

But perhaps the find of the day was at the Arch. Growing in bare grass at the side of the entrance was a perfect specimen of the scarlet caterpillar fungus (*Cordyceps militaris*). All that can be seen from the surface is a red club-like structure about three inches high. A good trowel is needed to find out what it is growing on. In fact it is parasitic on insect pupae or larvae. The mycelium of the fungus kills its host and eventually sends up a fruit body. The species is, incidentally another indicator of grassland of high conservation value.

8 COMPARISONS WITH OTHER ESTATES

It would be invidious to compare Cae'r y-Meirch or the Pwllpeiran Trail with other sites since insufficient time was spent there to make a reasonable estimate of their full mycotas. It is a great pity, for example, that there was not time to visit what Chater (1994) describes as "the largest area of neutral grassland in the district" at Cae'r y-Meirch. All that can be said at present is that both these sites show great mycological potential.

The grassland at Hafod Estate on the other hand can easily be compared with that of other sites, as the data given above proves. The CHEG profile shows that Hafod is probably the

most important in Wales – and is likely to be amongst the top five in the British Isles.

Similar quantitative methods are not available for woodland but one only has to note the number of rare, endangered and threatened species recorded there to judge its mycological richness.

9 CONCLUSIONS

Taken as a whole the sites of the upper Ystwyth valley must be judged to be of great conservation value. Plantlife (Anon, 2002) has already declared Hafod Estate to be an Important Fungus Area. In view of the results of this survey, they should be approached and asked to include all the upper Ystwyth valley to be thus designated.

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APPENDIX I: Summary of Methodologies used in this Study to Evaluate Conservation Value of Nutrient-poor Grasslands (Waxcap Grasslands) (after Rotheroe [1999])

Workers in Norway and Denmark have proposed that *Hygrocybe* (Waxcap) species, together with the other characteristic unimproved grassland fungi, should be used as indicator organisms for judging the conservation value of a given locality. Several different formulae for grading the relative habitat quality of a site have been proposed and perhaps the simplest of these is that of Rald, 1985, amended by Vesterholt *et al* 1999.

Conservation value

Total number of *Hygrocybe* species listed

Of international importance	22+ (15 or more during a single visit)
Of national importance	17-21 (11-14 a single visit)
Of regional importance	9-17 (6-10 during a single visit)
Of local importance	4-8 (3-5 during a single visit)
Of no importance	1-3 (1-2 during a single visit)

In assessing results using the Rald formula, additional weight can be given to sites which contain species which feature on the British Red Data List of Endangered Fungi (Ing, 1993) and the Red List of Endangered European Macrofungi (Ing, 1994).

Rotheroe *et al*, 1996, suggested that the Waxcap profile of a site, for comparison purposes, could be expressed in a shorthand using the following code letters:

- C (Clavarioid fungi – Fairy Clubs)
- H (*Hygrocybe* s.l. – Waxcaps)
- E (grassland species of the Entolomataceae – Pink-gills)
- G (Geoglossaceae – Earth Tongues)
- and D (*Dermoloma* – Floury False Waxcaps).

Thus a site with survey records of eight waxcaps, two fairy clubs, two earth tongues and one species of *Leptonia*, would be described as: C2, H8, E1, G2. The shorthand system has been used in the present study, except that, in the interests of simplicity, *Dermoloma* and *Porpoloma* are merged with H. This is legitimate, since they have the same ecological affinities and *Porpoloma* was, until recent taxonomic revisions, traditionally included in the genus *Hygrophorus* (as was *Hygrocybe*), while the current classification places *Dermoloma* in the tribus Hygrocybeae. (The effect of this minor departure from the Rald criteria is insignificant.) That author therefore interpreted Rald in this fashion and also referred to the 'CHEG profile' as a means of making easy quantitative assessments for comparison of different sites and to suggest their relative conservation value. The combined use of Rald criteria and CHEG profiles has proved successful in making comparative assessments of sites during the first three years of the BMS Waxcap-grassland Survey – a long-term study of grasslands being carried out throughout the British Isles. (NOTE: In using these numerical formulae a variety record is given equal weighting to that of a species. Thus the numbers refer to taxa, rather than species.)

A further system of weighting is proposed by Rotheroe (1999). His "Top Twenty-four" formula for evaluation of conservation value of Waxcap Grasslands relies heavily on the presence of certain waxcap species, but not exclusively so. It includes the presence of five other indicator species of unimproved grassland. A total of 24 species is listed as representing indicators of the highest quality Waxcap Grassland. The species selected are as follows:

Category A

Hygrocybe punicea (Crimson Waxcap, European Red Data List species)
Hygrocybe ovina (Sheep Waxcap, European Red Data List species)
Hygrocybe ingrata (Spindle-shank Waxcap, European Red Data List species)
Hygrocybe lacmus (Lacquered Waxcap)
Hygrocybe splendidissima (Splendid Waxcap)
Hygrocybe nitrata (Nitrous Waxcap, European Red Data List species)

Non-Waxcap species

Entoloma bloxamii (Bloxam's Pink-gill, British Red Data List species)
Microglossum olivaceum (Olivaceous Earth Tongue, British Red Data List species)
Trichoglossum walteri (Walter's Earth Tongue)
Entoloma incanum (Mousy Pink-gill)
Porpoloma metapodium (Reddening False Waxcap, British Red Data List species)
Clavaria zollingeri (Zollinger's Fairy Club, British Red Data List species)

Category B

Hygrocybe spadicea (Date-coloured Waxcap, British Red Data List species)
Hygrocybe citrinovirens (Lemon-green Waxcap, European Red Data List species)
Hygrocybe intermedia (Intermediate Waxcap, European Red Data List species)
Hygrocybe calyptriformis (Pink Meadow Waxcap, British Red Data List species)
Hygrocybe flavipes (Yellow-footed Waxcap)
Hygrocybe helobia (Garlic Waxcap)
Hygrocybe colmanniana (Colman's Waxcap)
Hygrocybe quieta (Tranquil Waxcap, European Red Data List species)
Hygrocybe fornicata (Arched Waxcap, European Red Data List species)
Hygrocybe aurantiosplendens (Orange Splendid Waxcap)
Any other species in the Geoglossaceae, except *G. fallax* (Deceptive Earth Tongue)
Hygrocybe unguinosa (Slippery-eel Waxcap, European Red Data List species)

The species are listed in order of their value as indicators of the highest conservation value. This is the criterion in making the list. (Some in the list are, in fact, rather common, i.e. *Hygrocybe punicea*. However, this species above all is an indicator of the best waxcap sites. It is said by Boertmann to fruit only in localities with eight or more *Hygrocybe* species.)

A profile can thus be applied to any location in the following way: A location which has two species in the A category and three in the B category would be termed an A2 B3 site.

The value of this method of assessment is that the potential conservation value of a grassland can be predicted if any of the above species are found to occur, even if total numbers recorded on any or several occasions are few, for one reason or another. (Because presence or absence of a species can be noted only if it fruits, it often takes several years for the complete mycota of a site to emerge.)

APPENDIX II: Fungus species recorded at Hafod Estate in 2001

Species	"n" denotes new record	Area	AssOrg	Medium	Ecosystem	Notes	MR Ref
AGARICALES							
(MUSHROOMS & TOADSTOOLS)							
<i>Agaricus campestris</i>		1105	Poaceae	Soil	Estate grassland		
<i>Amanita citrina</i> v <i>alba</i>		1105	?	soil, litter	Mixed estate woodland		
<i>Amanita fulva</i>		1105	<i>Betula</i>	soil, litter	Mixed estate woodland		
<i>Amanita muscaria</i>		1105	<i>Abies procera</i>	soil, litter	Mixed estate woodland		
<i>Amanita muscaria</i> f. <i>aureola</i> "n"		1105	<i>Abies procera</i>	soil, litter	Mixed estate woodland	New Welsh record	
<i>Amanita porphyria</i> "n"		1105	?	soil, litter	Mixed estate woodland	3rd Welsh record	MR01202
<i>Amanita rubescens</i>		1105	?	soil, litter	Mixed estate woodland		
<i>Amanita rubescens</i> v <i>annulosulphurea</i>		1105	?	soil, litter	Mixed estate woodland		
<i>Amanita spissa</i> "n"		1105	?	soil, litter	Mixed estate woodland		
<i>Clitocybe bresadoliana</i> "n"		1105	Poaceae	Soil	Grassland	1st Welsh record?	MR01250
<i>Clitopilus prunulus</i>		1104	?	soil, litter	Mixed estate woodland		
<i>Conocybe tenera</i>		1104	Poaceae	Soil	Estate grassland		
<i>Coprinus comatus</i>		1105	Poaceae	Soil	Estate grassland		
<i>Entoloma serrulatum</i>		1104	Poaceae	Soil	Estate grassland		
<i>Hygrocybe coccinea</i>		1104	Poaceae	Soil	Estate grassland		
<i>Hygrocybe glutinipes</i>		1104	Poaceae	Soil	Estate grassland		
<i>Hygrocybe laeta</i>		1104	Poaceae	Soil	Estate grassland		
<i>Hygrocybe ochraceopallida</i>		1104	Poaceae	Soil	Estate grassland		
<i>Hygrocybe persistens</i>		1104	Poaceae	Soil	Estate grassland		
<i>Hygrocybe pratensis</i>		1104	Poaceae	Soil	Estate grassland		
<i>Hygrocybe psittacina</i>		1104	Poaceae	Soil	Estate grassland		

APPENDIX II: Fungus species recorded at Hafod Estate in 2001

Species	"n" denotes new record	Area	AssOrg	Medium	Ecosystem	Notes	MR Ref
<i>Hygrocybe punicea</i>		1104	Poaceae	Soil	Estate grassland		
<i>Hygrocybe reai</i>		1104	Poaceae	Soil	Estate grassland		
<i>Hygrocybe reidii</i>		1104	Poaceae	Soil	Estate grassland		
<i>Hygrocybe splendidissima</i>		1104	Poaceae	Soil	Estate grassland		
<i>Hygrocybe unguinosa</i>		1104	Poaceae	Soil	Estate grassland		
<i>Hypholoma fasciculare</i>		1104	?	Wood, dead, stump	Mixed estate woodland		
<i>Micromphale perforans</i> "n"		1104	Abies procera	needles, dead	Mixed estate woodland		
<i>Panaeolus rickenii</i>		1104	Poaceae	Soil	Estate grassland		
<i>Panaeolus sphinctrinus</i>		1104	Poaceae	Soil	Estate grassland		
<i>Pluteus cervinus</i>		1105	?	Wood, dead	Estate coppice		
<i>Psilocybe subcrophila</i>		1104	Sheep	dung	Estate grassland		
<i>Stropharia semiglobata</i>		1104	Poaceae	Soil	Estate grassland		
<i>Tricholoma fulvum</i>		1104	?	soil, litter	Mixed estate woodland		
<i>Tricholomopsis platyphylla</i>		1105	Coniferae	soil, litter	Mixed estate woodland		
APHYLLOPHORALES							
(BRACKETS, FAIRY CLUBS)							
<i>Clavulinopsis helvola</i>		1104	Poaceae	Soil	Estate grassland		
<i>Daedalea quercina</i>		1116	Quercus	Wood, dead	Estate woodland		
<i>Hydnum repandum</i>		1105	?	soil, litter	Mixed estate woodland		
<i>Inonotus radiatus</i>		1105	Betula	Wood, dead	Estate coppice		
<i>Laetiporus sulphureus</i>		1116	Quercus	Wood, dead, standing tree	Estate woodland		
<i>Laetiporus sulphureus</i>		1115	?Coniferae	Wood, dead, old log	Estate woodland		

APPENDIX II: Fungus species recorded at Hafod Estate in 2001

Species	"n" denotes new record	Area	AssOrg	Medium	Ecosystem	Notes	MR Ref
<i>Ramariopsis kunzei</i> "n"		1104	Poaceae	Soil	Estate grassland		
<i>Trametes versicolor</i>		1115	?Betula	Wood, dead, stump	Estate woodland		
BOLETALES							
(BOLETES etc)							
<i>Boletus aestivalis</i> "n"		1104	?	soil, litter	Mixed estate woodland		
<i>Boletus badius</i> "n"		1105		soil, litter	Mixed estate woodland		
<i>Boletus calopus</i> "n"		1105	Abies procera	soil, litter	Mixed estate woodland		
<i>Boletus edulis</i>		1105	Quercus	soil, litter	Mixed estate woodland		
<i>Boletus erythropus</i>		1105	Quercus	soil, litter	Mixed estate woodland		
<i>Boletus lanatus</i>		1105	?	soil, litter	Mixed estate woodland		
<i>Boletus pulverulentus</i> "n"		1104	?	Soil	Grassland	NOT with trees!	
<i>Boletus trisporus</i> "n"		1105	?	soil, litter	Mixed estate woodland		MR01201
<i>Xerocomus chrysenteron</i>		1105	?	soil, litter	Mixed estate woodland		
<i>Xerocomus spadiceus</i>		1105	?	soil, litter	Mixed estate woodland		
<i>Xerocomus subtomentosus</i>		1105	?	soil, litter	Mixed estate woodland		
CANTHARELLALES							
(CHANTERELLES)							
<i>Cantharellus amethysteus</i>		1105	?	soil, litter	Mixed estate woodland		
<i>Cantharellus cibarius</i>		1105	Abies	soil, litter	Mixed estate woodland		

Species	"n" denotes new record	Area	AssOrg	Medium	Ecosystem	Notes	MR Ref
RUSSULALES							
(MILKCAPS and BRITTLE-CAPS)							
Russula fellea		1105	Abies procera	soil, litter	Mixed estate woodland		
Russula ionochlora		1105	Quercus	soil, litter	Mixed estate woodland		
Russula nigricans		1105	Abies	soil, litter	Mixed estate woodland		
Russula ochroleuca		1105	Coniferae	soil, litter	Mixed estate woodland		
GASTEROMYCETES							
(PUFFBALLS, EARTHBALLS,							
STINKHORNS etc.)							
Phallus impudicus		1105	?	soil, litter	Mixed estate woodland		
ASCOMYCETES							
(CUP FUNGI, FLASK FUNGI etc							
Geoglossum fallax "n"		1104	Poaceae	Soil	Estate grassland		
Xylaria multiforme		1116	Fagus	Wood, dead, fallen tree	Estate woodland		

APPENDIX III:

Cumulative List of Species Recorded at Hafod Estate, December, 2001

	A	B	C
1	Fungus Name	Compartment Number	Years Recorded
2	<u>Agaricales (Mushrooms & Toadstools)</u>		
3	<i>Agaricus campestris</i>	1104, 1105	1999, 2000, 2001
4	<i>Agaricus macrosporus</i>	1105	1999
5	<i>Agrocybe praecox</i>	1105	2000
6	<i>Agrocybe sphaleromorpha</i>	1104	1999, 2000
7	<i>Amanita citrina</i> var <i>alba</i>	1105, 1115, 1116, 1117	2000, 2001
8	<i>Amanita fulva</i>	1103, 1105, 1116, 1118, 1120	1999, 2001
9	<i>Amanita lividopallescens</i>	1116	2000, 2001
10	<i>Amanita muscaria</i>	1102, 1103, 1105, 1121	1999, 2000, 2001
11	<i>Amanita muscaria</i> forma <i>aureola</i>	1105	2001
12	<i>Amanita porphyria</i>	1105	2001
13	<i>Amanita rubescens</i>	1105, 1103, 1115, 1120	1999, 2000, 2001
14	<i>Amanita rubescens</i> var <i>annulosuophurea</i>	1105	2001
15	<i>Amanita spissa</i> (<i>excelsa</i>)	1105, 1116, 1117	1999, 2000, 2001
16	<i>Amanita vaginata</i>	1105	2000
17	<i>Armillaria lutea</i>	1115, 1118, 1119, 1120	1999, 2000
18	<i>Armillaria mellea</i> , sensu <i>stricto</i>	1102	2000
19	<i>Armillaria ostoyae</i>	1102, 1103, 1104	1999
20	<i>Calocybe carnea</i>	1104	1999
21	<i>Calocybe gambosa</i>	1104	2000
22	<i>Clitocybe bresadoliana</i>	1105	2001
23	<i>Clitocybe clavipes</i>	1115, 1116, 1121	1999
24	<i>Clitocybe flaccida</i>	1115, 1121	1999, 2000
25	<i>Clitocybe fragrans</i>	1104	1999, 2000
26	<i>Clitocybe metachroa</i>	1115, 1120	1999, 2000
27	<i>Clitocybe vibecina</i>	1115, 1120, 1121	1999, 2000
28	<i>Collybia aquosa</i>	1115	1999
29	<i>Collybia butyracea</i>	1115, 1116	1999
30	<i>Collybia confluens</i>	1115	1999
31	<i>Collybia dryophila</i>	1105, 1115, 1118, 1120, 1121	1999, 2000
32	<i>Collybia fusipes</i>	1115	1999
33	<i>Collybia peronata</i>	1105, 1115, 1119	1999, 2000
34	<i>Conocybe tenera</i>	1104, 1105	2000, 2001
35	<i>Coprinus comatus</i>	1105	2001
36	<i>Coprinus lagopides</i>	1115	2000
37	<i>Coprinus narcoticus</i>	1104	1999
38	<i>Coprinus plicatilis</i>	1104	1999, 2000
39	<i>Cortinarius bolaris</i>	1116	2000

APPENDIX III:

Cumulative List of Species Recorded at Hafod Estate, December, 2001

	A	B	C
40	Cortinarius cinnamomeus	1105	1999
41	Cortinarius junghuhni	1105	1999
42	Cortinarius obtusus	1105	1999
43	Crepidotus mollis	1105	2000
44	Cystoderma amianthinum	1104	1999, 2000
45	Cystoderma jasonis	1115	1999
46	Entoloma atrocaeruleum	1104	
47	Entoloma caesiointinctum	1104	1999
48	Entoloma chalybaeum	1104	1999
49	Entoloma clypeatum	1104	1999, 2000
50	Entoloma griseocyaneum	1104	1999
51	Entoloma papillatum	1104	1999
52	Entoloma porphyrophaeum	1104	1999
53	Entoloma serrulatum	1104	2001
54	Flammulina velutipes	1115	1999
55	Gymnopilus hybridus	1115, 1119, 1120	1999
56	Gymnopilus stabilis	1115	1999
57	Hygrocybe calyptriformis	1104	1999
58	Hygrocybe cantharellus	1104	1999
59	Hygrocybe ceracea	1104	1999
60	Hygrocybe chlorophana	1104	1999, 2000, 2001
61	Hygrocybe citrinovirens	1104	1999
62	Hygrocybe coccinea	1104	1999, 2001
63	Hygrocybe conica	1104	1999
64	Hygrocybe flavipes	1104	1999
65	Hygrocybe fornicata	1104	1999
66	Hygrocybe glutinipes	1104	1999, 2001
67	Hygrocybe helobia	1104	2000
68	Hygrocybe insipida	1104	1999
69	Hygrocybe intermedia	1104	1999
70	Hygrocybe lacta	1104	1999, 2001
71	Hygrocybe miniata	1104	1999, 2000
72	Hygrocybe persistens	1104	1999, 2001
73	Hygrocybe pratensis	1104	1999, 2000, 2001
74	Hygrocybe pratensis var pallida	1104	1999
75	Hygrocybe psittacina	1104	1999, 2001
76	Hygrocybe psittacina var perplexa	1104	1999
77	Hygrocybe punicea	1104	1999, 2001
78	Hygrocybe quieta	1104	1999, 2000, 2001
79	Hygrocybe reai (mucronella)	1104	
80	Hygrocybe reidii	1104	1999, 2000, 2001
81	Hygrocybe splendidissima	1104	1999, 2000, 2001

APPENDIX III:

Cumulative List of Species Recorded at Hafod Estate, December, 2001

	A	B	C
82	<i>Hygrocybe unguinosa</i> (<i>irrigata</i>)	1104	1999, 2000, 2001
83	<i>Hygrocybe virginea</i>	1104	1999
84	<i>Hygrocybe virginea</i> var <i>fuscescens</i>	1104	1999
85	<i>Hygrocybe virginea</i> var <i>ochraceopallida</i>	1104	1999, 2001
86	<i>Hygrophoropsis</i> <i>aurantiaca</i>	1102, 1117	1999, 2000
87	<i>Hypholoma fasciculare</i>	1105, 1115, 1116, 1120	1999, 2000, 2001
88	<i>Inocybe rimosa</i>	1105	2000
89	<i>Inocybe tabecina</i>	1105	2000
90	<i>Laccaria amethystina</i>	1115, 1116, 1118, 1120	1999, 2001
91	<i>Laccaria bicolor</i>	1105	1999, 2000
92	<i>Laccaria laccata</i>	All compartments	1999, 2000, 2001
93	<i>Macrolepiota rhacodes</i>	1115	1999
94	<i>Marasmius androsaceus</i>	1115, 1116, 1119, 1120	1999, 2000
95	<i>Marasmius ramealis</i>	1116	1999, 2000
96	<i>Marasmius rotula</i>	1116, 1120	2000
97	<i>Mycena amicta</i>	1103	2000
98	<i>Mycena arcangeliana</i>	1105, 1116	1999
99	<i>Mycena flavoalba</i>	1104	1999
100	<i>Mycena galericulata</i>	1102, 1103, 1115, 1117, 1120, 1121	1999, 2000
101	<i>Mycena galopus</i>	1105, 1116, 1119, 1120, 1121	1999, 2000
102	<i>Mycena inclinata</i>	1115, 1118	1999
103	<i>Mycena haematopus</i>	1116, 1118, 1121	
104	<i>Mycena leptcephala</i>	1115	1999, 2000
105	<i>Mycena pura</i>	1116	2000
106	<i>Mycena sanguinolenta</i>	1116, 1120	1999, 2000
107	<i>Oudemansiella mucida</i>	1115, 1116	1999, 2000, 2001
108	<i>Oudemansiella radicata</i>	1115, 1116	1999, 2000
109	<i>Panaeolus ater</i>	1104	1999, 2000
110	<i>Panaeolus foenisecii</i>	1104	1999, 2000, 2001
111	<i>Panaeolus rickenii</i>	1104	1999, 2000, 2001
112	<i>Panaeolus sphinctrinus</i>	1104	1999, 2001
113	<i>Pholiota mutabilis</i>	1116	2000
114	<i>Pholiota squarrosa</i>	1116	1999, 2000, 2001
115	<i>Porpoloma metapodium</i>	1104	1999
116	<i>Psathyrella candolleana</i>	1105	2000
117	<i>Psathyrella spadicea</i>	1116	2000
118	<i>Psilocybe semilanceata</i>	1104	1999, 2000, 2001

APPENDIX III:

Cumulative List of Species Recorded at Hafod Estate, December, 2001

	A	B	C
119	Psilocybe subcoprophila	1104	2001, 2000
120	Rickenella fibula	1104	1999, 2000
121	Rickenella swartzii	1104	1999, 2000
122	Strobilurus esculentus	1117	2000
123	Strobilurus tenacellus	1117	2000
124	Stropharia cyanea	1104	1999
125	Stropharia semiglobata	1104, 1105	1999, 2000, 2001
126	Tricholoma fulvum	1102, 1103, 1104, 1118, 1120	1999, 2000, 2001
127	Tricholomopsis platyphylla	1105, 1115, 1116, 1119, 1120, 1121	1999, 2000, 2001
128	Tricholomopsis rutilans	1105, 1115, 1118, 1121	1999, 2000, 2001
129	Tricholomopsis terreum	1102, 1119, 1120	1999
130	<u>Aphylllophorales (Brackets, Fairy Clubs)</u>		
131	Bjerkandera adusta	1104	1999, 2000
132	Chondrostereum purpureum	1102, 1103	1999, 2000
133	Clavaria cristata	1116, 1117, 1119	1999, 2000
134	Clavaria zollingerii	1104	1999
135	Clavulinopsis corniculata	1104	1999, 2000
136	Clavulinopsis fusiformis	1104	1999, 2000
137	Clavulinopsis helvola	1104	1999, 2001
138	Coriolus versicolor	All compartments	1999, 2000, 2001
139	Daedalea quercina	1105, 1116	1999, 2000, 2001
140	Daedaleopsis confragosa	1117	2000
141	Fuscoporia (Phellinus) ferrea	1115	1999, 2000
142	Fuscoporia (Phellinus) ferruginosa	1115	1999, 2000
143	Heterobasidion annosum	1104	1999, 2000
144	Hydnum repandum	1105	2000, 2001
145	Hymenochaete rubiginosa	1116	1999, 2000
146	Inonotus hispidus	1105	2000
147	Inonotus radiatus	1105	2001
148	Lactiporus sulphureus	1105, 1115, 1116	1999, 2000, 2001
149	Phaeolus schweinizii	1105	1999
150	Piptoporus betulinus	1105, 1115, 1118, 1121	1999, 2000, 2001
151	Polyporus squamosus	1115	1999, 2000
152	Postia stiptica	1116	2000

APPENDIX III:

Cumulative List of Species Recorded at Hafod Estate, December, 2001

	A	B	C
153	Pseudotrametes gibbosa	1115	1999, 2000
154	Ramariopsis kunzei	1104	1999, 2001
155	Stereum hirsutum	All compartments	1999, 2000, 2001
156	Stereum rugosum	1102	2000
157	<u>Boletales (Boletes, etc)</u>		
158	Boletus aestivalis	1104	2001
159	Boletus badius	1105, 1121	1999, 2001
160	Boletus calopus	1105	2001
161	Boletus edulis	1101, 1105	1999, 2001
162	Boletus erythropus	1103, 1105, 1116	1999, 2000, 2001
163	Boletus lanatus	1105	2001
164	Boletus porosporus	1116	1999
165	Boletus pulverulentus	1104	2001
166	Boletus trisporus	1105	2001
167	Calciporus (Boletus) piperatus	1105	2000
168	Paxillus involutus	1102, 1120, 1121	1999, 2000
169	Pulveroboletus lignicola	1105	1999
170	Suillus luteus	1102, 1103, 1117, 1119, 1120, 1121	1999
171	Suillus grevillei	1102, 1118, 1120, 1121	1999
172	Xerocomus (Boletus) chrysenteron	1105	2000, 2001
173	Xerocomus (Boletus) spadiceus	1104, 1105	2000, 2001
174	Xerocomus (boletus) subtomentosus	1105	2001
175	<u>Cantharellales (Chanterelles)</u>		
176	Cantharellus amethysteus	1105	2000, 2001
177	Cantharellus cibarius	1103, 1105	2000, 2001
178	<u>Heterobasidiomycetes (Jelly Fungi, etc)</u>		
179	Auricularia auricula-judae	1105	2000
180	Auricularia mesenterica	1104	2000
181	Calocera cornea	1105, 1116	2000
182	Calocera viscosa	1105, 1116, 1118, 1119, 1121	1999, 2000, 2001
183	Calocera pallidospathulata	1116	2000

APPENDIX III:

Cumulative List of Species Recorded at Hafod Estate, December, 2001

	A	B	C
184	Dacrymycetes stillatus	1116	2000
185	Exidia thuretiana	1115	1999, 2000
186	Pseudohydnum gelatinosum	1105	1999, 2000
187	Tremella mesenterica	1116	2000
188	<u>Gasteromycetes (Puffballs, Earthballs, Stinkhorns, etc)</u>		
189	Bovista nigrescens	1104, 1105	1999, 2000
190	Geastrum triplex	1103	1999, 2000
191	Lycoperdon foetidum	1105	1999, 2000
192	Lycoperdon pyriforme	1105, 1118, 1119, 1121	1999, 2000
193	Mutinus caninus	1116	2000
194	Phallus impudicus	1105, 1118, 1119, 1121	2000, 2001
195	Scleroderma citrinum	1105	1999, 2000, 2001
196	<u>Russulales (Milkcaps & Brittle-gills/Russulas)</u>		
197	Lactarius blennius	1115	1999
198	Lactarius glyciosmus	1102, 1105	1999
199	Lactarius plumbeus	1115	1999
200	Lactarius pubescens	1103, 1105	1999
201	Lactarius quietus	1114, 1105	1999, 2001
202	Lactarius rufus	1102, 1103, 1105	1999
203	Lactarius tabidus	1115	1999, 2001
204	Lactarius vietus	1116	1999
205	Russula atropurpurea	1105, 1119, 1120	2000
206	Russula betularum	1105, 1118, 1121	1999
207	Russula cyanoxantha	1104, 1116	1999, 2001
208	Russula fellea	1115, 1116	1999, 2000, 2001
209	Russula foetens	1116	1999
210	Russula fragilis	1105, 1118, 1119, 1120	1999, 2001
211	Russula ionochlora	1115	1999, 2001
212	Russula mairei	1115	1999
213	Russula nigricans	1105, 1120	1999, 2001
214	Russula ochroleuca	All compartments	1999, 2000, 2001
215	Russula vesca	1105	1999, 2000
216	<u>Uredinales & Ustilaginales (Rusts & Smuts)</u>		
217	Puccinia buxi	1104	2000, 2001
218	Ustilago violacea	1104, 1105, 1117	1999, 2000

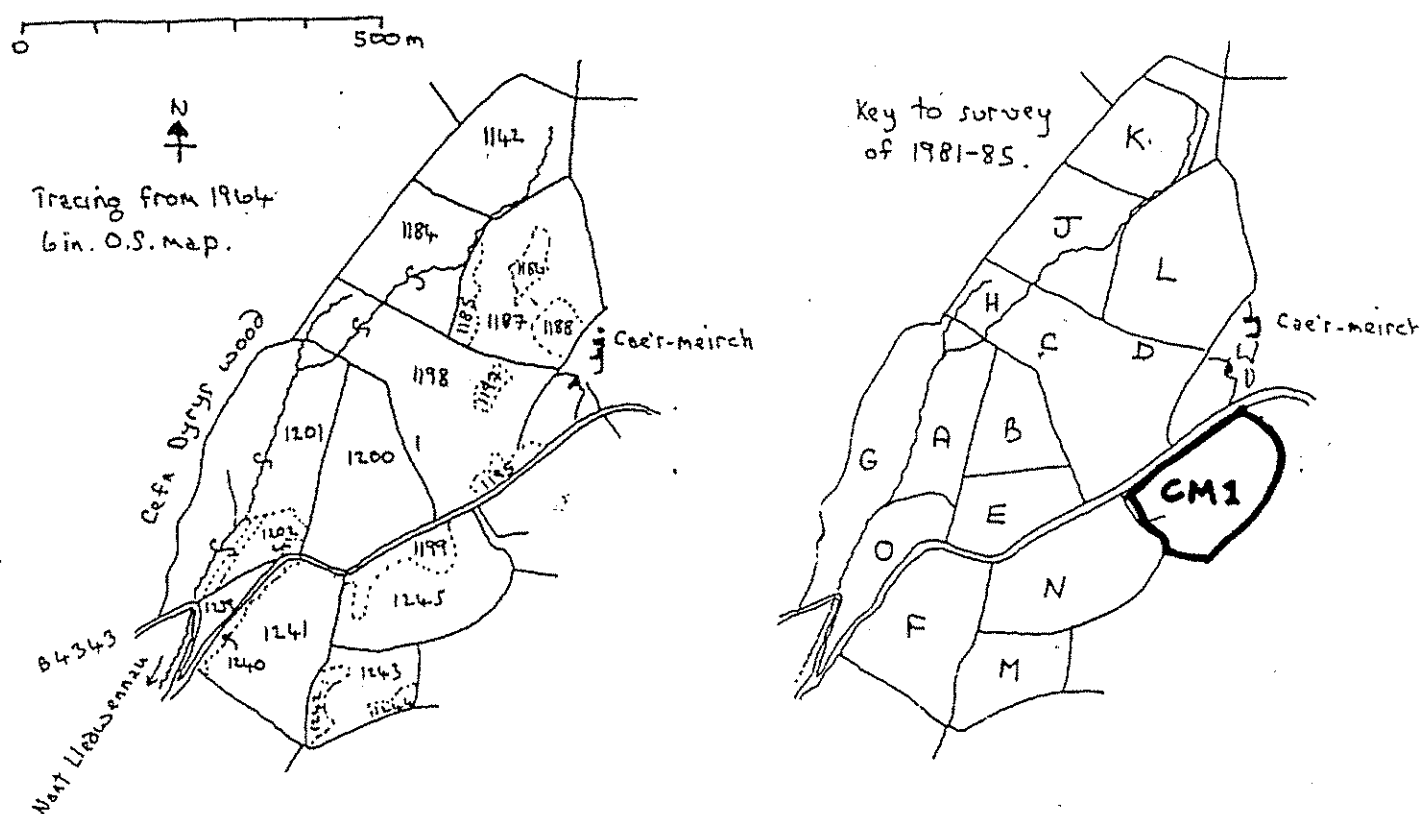
APPENDIX III:

Cumulative List of Species Recorded at Hafod Estate, December, 2001

	A	B	C
219	<u>Ascomyetes (Cup fungi, Flask fungi, etc)</u>		
220	Aleuria aurantia	1105	1999, 2000
221	Chlorosplenium aeruginascens	1116	2000
222	Coprobria granulata	1104	2000
223	Cordyceps militaris	1104	1999
224	Daldinia concentrica	1105	2000
225	Disciotis venosa	1115	2000
226	Elaphomyces granulatus	1105	2000
227	Geoglossum fallax	1104	2000
228	Humaria hemisphaerica	1115	2000
229	Hypoxylon fragiforme	1115, 1116	1999, 2000
230	Hypoxylon nummularium	1115	2000
231	Nectria cinnabarina	All compartments	1999, 2000, 2001
232	Peziza vesiculosa	1116	2000
233	Sarcoscypha austriaca	1105	2000
234	Scutellinia scutellata	1105	2000
235	Xylaria carpophila	1116	2000
236	Xylaria hypoxylon	1102, 1104, 1115, 1116	2000
237	Xylaria multifforme	1115, 1116	2001
238	Xylaria polymorpha	1115, 1116, 1117	1999, 2000

APPENDIX IV

LIST OF FUNGI RECORDED AT CAE'R Y-MEIRCH, 2001



KEY to OS numbered areas and coded areas at Cae'r y-Meirch. (After Arthur Chater, 2001 *pers. comm.*) Note that CM1 was not included in Mr Chater's survey and was given this code by the present author.

APPENDIX IV:
List of Fungal Species Recorded at Cae'r y-Meirch, 2001

Species Recorded	Associated Organism	Area	Year
AGARICALES			
(MUSHROOMS & TOADSTOOLS)			
Agaricus campestris	Poaceae	N	2001
Amanita muscaria	Betula	B	2001
Amanitopsis fulva	Betula	C	2001
Armillaria mellea s. stricto	Quercus	C	2001
Armillaria lutea	Coniferae	C	2001
Armillaria ostoyae	Carpinus	CM1	2001
Arrhenia retiruga	Bryophyta	C	2001
Coprinus comatus	?	A	2001
Hypholoma fasciculare	Coniferae	C	2001
Inocybe rimosa	?	B	2001
Laccaria laccata	Betula	N	2001
Lepista nuda	Poaceae	C	2001
Micromphale perforans	Abies procera	C	2001
Mycena galopus	?	C	2001
Mycena inclinata	Coniferae	C	2001
Mycena polygramma	Quercus	C	2001
Oudemansiella mucida	Fagus	C	2001
Pluteus cervinus	Betula	A	2001
APHYLLOPHORALES			
(BRACKETS, FAIRY CLUBS)			
Daedalea quercina	Quercus	C	2001
Fuscoporia (Phellinus) ferrea	Quercus	N	2001
Inonotus radiatus	Larix	C	2001
Meripilus giganteus	Fagus	C	2001
Phaeolus schweinizii	Picea abies	G	2001
Piptoporus betulinus	Betula	C	2001
Piptoporus betulinus	Betula	N	2001
Stereum hirsutum	Quercus	N	2001
Sterum gausipatum	Quercus	O	2001

APPENDIX IV:
List of Fungal Species Recorded at Cae'r y-Meirch, 2001

Species Recorded	Associated Organism	Area	Year
BOLETALES			
(BOLETES, etc)			
Boletus badius	Pinus	C	2001
Boletus edulis	Quercus	C	2001
Pulveroboletus lignicola	Picea abies	G	2001
Xerocomus chrysenteron	Abies sp	C	2001
Xerocomus subtomentosus	Abies procera	B	2001
CANTHARELLALES			
(CHANTERELLES)			
Cantharellus cibarius	Fagus	C	2001
RUSSULALES			
(MILKCAPS & BRITTLE-GILLS)			
Lactarius tabidus	Betula	C	2001
Russula ochroleuca	Coniferae	B	2001
Russula ochroleuca	Coniferae	C	2001
GASTEROMYCETES			
(PUFFBALLS, EARTHBALLS, STINKHORNS, ETC)			
Scleroderma citrinum	Quercus	C	2001
Scleroderma citrinum	Betula	N	2001
HETEROMYCETES			
(JELLY FUNGI ETC)			
Calocera viscosa	?	B	2001
Pseudohydnum gelatinosum	Coniferae	C	2001

APPENDIX IV:
List of Fungal Species Recorded at Cae'r y-Meirch, 2001

Species Recorded	Associated Organism	Area	Year
ASCOMYCETES			
(CUP FUNGI, FLASK FUNGI, ETC			
Claviceps purpurea	Dactylis glomerata	N	2001
Claviceps purpurea	Dactylis	CM1	2001
Claviceps purpurea	Molinia	CM1	2001
Claviceps purpurea	Lolium	CM1	2001
Claviceps purpurea	Anthoxanthum	CM1	2001
Taphrina betulina	Betula	N	2001
Taphrina carpina	Carpinus	N	2001
Taphrina tormentillae	Potentilla erecta	CM1	2001
Xylaria hypoxylon	Coniferae	C	2001

APPENDIX V:

List of Fungal Species recorded on the Pwllpeiran Trail

Species	D	M	Yr	Place	Association
AGARICALES					
(MUSHROOMS & TOADSTOOLS)					
Agaricus arvensis	13	10	2001	Bwlch yr Oerfa, Pwllpeiran, Hafod	
Amanita muscaria f aureola	13	10	2001	Bwlch yr Oerfa, Pwllpeiran, Hafod	Picea sitchensis
Amanita muscaria	13	10	2001	Bwlch yr Oerfa, Pwllpeiran, Hafod	Picea sitchensis
Amanita muscaria	13	10	2001	Arch	Abies procera
Coprinus cinereus	13	10	2001	Arch	
Coprinus niveus	13	10	2001	Parc Vicarage Wetland, Pwllpeiran	
Cystoderma amianthinum	13	10	2001	Parc Vicarage Wetland, Pwllpeiran	Poaceae
Entoloma (Nolanea) sp	13	10	2001	Parc Vicarage Wetland, Pwllpeiran	Poaceae
Entoloma conferendum	13	10	2001	Parc Vicarage Wetland, Pwllpeiran	Poaceae
Galerina hypnorum	13	10	2001	Parc Vicarage Wetland, Pwllpeiran	Poaceae
Hygrocybe calyptriformis	13	10	2001	Parc Vicarage Wetland, Pwllpeiran	Poaceae
Hygrocybe chlorophana	13	10	2001	Parc Vicarage Wetland, Pwllpeiran	Poaceae
Hygrocybe coccinea	13	10	2001	Arch	Poaceae
Hygrocybe coccinia	13	10	2001	Bwlch yr Oerfa, Pwllpeiran, Hafod	Poaceae
Hygrocybe conica	13	10	2001	Parc Vicarage Wetland, Pwllpeiran	Poaceae
Hygrocybe conica var chloroides	13	10	2001	Parc Vicarage Wetland, Pwllpeiran	Poaceae
Hygrocybe glutinipes	13	10	2001	Parc Vicarage Wetland, Pwllpeiran	Poaceae
Hygrocybe pratensis	13	10	2001	Parc Vicarage Wetland, Pwllpeiran	Poaceae
Hygrocybe pratensis	13	10	2001	Arch	Poaceae
Hygrocybe psittacina	13	10	2001	Parc Vicarage Wetland, Pwllpeiran	Poaceae
Hygrocybe real (mucronella)	13	10	2001	Parc Vicarage Wetland, Pwllpeiran	Poaceae
Hygrocybe reidii	13	10	2001	Bwlch yr Oerfa, Pwllpeiran, Hafod	Poaceae
Hygrocybe reidii	13	10	2001	Arch	Poaceae
Hygrocybe splendissimus	13	10	2001	Parc Vicarage Wetland, Pwllpeiran	Poaceae
Hygrocybe unguinosa	13	10	2001	Arch	Poaceae
Laccaria bicolor	13	10	2001	Bwlch yr Oerfa, Pwllpeiran, Hafod	Picea sitchensis
Mycena galericulata	13	10	2001	Parc Vicarage Wetland, Pwllpeiran	
Mycena inclinata	13	10	2001	Parc Vicarage Wetland, Pwllpeiran	
Psilocybe semilanceata	13	10	2001	Parc Vicarage Wetland, Pwllpeiran	
Rickenella fibula	13	10	2001	Parc Vicarage Wetland, Pwllpeiran	

APPENDIX V:

List of Fungal Species recorded on the Pwllpeiran Trail

Species	D	M	Yr	Place	Association
APHYLLOPHORALES					
(BRACKETS, FAIRY CLUBS)					
Clavulinopsis corniculata	13	10	2001	Arch	Poaceae
Clavulinopsis corniculata	13	10	2001	Bwlch yr Oerfa, Pwllpeiran, Hafod	Poaceae
Clavulinopsis fusiformis	13	10	2001	Bwlch yr Oerfa, Pwllpeiran, Hafod	Poaceae
Clavulinopsis helvola	13	10	2001	Arch	Poaceae
Clavulinopsis helvola	13	10	2001	Bwlch yr Oerfa, Pwllpeiran, Hafod	Poaceae
Dedaelea quercinum	13	10	2001	Parc Vicarage Wetland, Pwllpeiran	
BOLETALES					
(BOLETES, etc)					
Boletus badius	13	10	2001	Arch	Pinus
RUSSULALES					
(MILKCAPS & BRITTLE-GILLS)					
Lactarius vellereus	13	10	2001	Parc Vicarage Wetland, Pwllpeiran	
Russula cyanoxantha	13	10	2001	Parc Vicarage Wetland, Pwllpeiran	
Russula ochroleuca	13	10	2001	Parc Vicarage Wetland, Pwllpeiran	
Russula ochroleuca	13	10	2001	Bwlch yr Oerfa, Pwllpeiran, Hafod	
Russula ochroleuca	13	10	2001	Arch	
ASCOMYCETES					
(CUP FUNGI, FLASK FUNGI, ETC)					
Cordyceps militaris	13	10	2001	Arch	?
Scutellinia pseudotrechispora	13	10	2001	Parc Vicarage Wetland, Pwllpeiran	

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Michael Norman
Hafod Trust
Coed Glantawe,
Esgairdawe
Llan deilo
Ceredigion SA19 7RXT

13th July, 2002

Dear Michael

Macrofungi of the Hafod Estate and its Environs

Here, finally, is the full report on the above (two copies). I am so sorry about its delay, but you know of some of my problems and they have exacerbated in recent months.

Please dispense with the version of the main report which I supplied to you earlier this year because I have done several updates and corrections to it. Please discard that and regard this as the final revised report on the above survey in 2001 and the cumulative data for the three years.

Thank you very much for your forbearance.

In view of the importance mycologically of the Pwllpeiran Trail, will you be sending a copy of this report to ADAS, or should I do that? I think they should see it.

Yours sincerely

Maurice