

SENNYBRIDGE ARMY TRAINING AREA:

Mycological Survey of Epynt Ranges Grassland, 2002

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1 INTRODUCTION

Traditionally-farmed pastureland and meadows have long been valued by conservationists because of the high diversity of plants and animals they harbour. They also support their own unique fungi and the number of fungal species in a given area is often greater than the number of vascular plant species. However, such unimproved, semi-natural habitats have suffered serious decline throughout northern Europe. In Britain 95 per cent of all hay meadows have been lost since 1950. The 'ancient' grassland habitat has been decimated as the result of agricultural intensification, herbicide and fertilizer treatment, ploughing and reseedling, building development and land drainage of wetter sites. Thus this important ecosystem for many groups of wildlife has become a rarity.

A suite of fungal species, covering a number of groups, is confined to nutrient-poor grasslands, and these disappear immediately if fertilizer is applied – to be succeeded by more common nitrophiles. The species in this suite belong to the genera *Hygrocybe*, *Camarophyllopsis*, *Entoloma*, *Dermoloma* and *Porpoloma* and to the orders Clavariaceae (Fairy Clubs) and Geoglossaceae (Earth Tongues). Because of their sensitivity to higher levels of dissolved nitrate and phosphate, it has been suggested that these groups can be used as indicators of habitat quality. Habitats rich in these species have been described as "*Hygrocybe* grasslands" (Feehan & McHugh, 1992) or Waxcap grasslands (Rotheroe *et al.*, 1996) and a number of authors have proposed formulae which enable the numbers of fungal indicator species recorded from a site to be used to judge its conservation value (eg Rald 1985).

With these conservation concerns in mind, members of the British Mycological Society began a survey throughout the British Isles in 1996 in order to identify and evaluate the fungus flora (mycota) of unimproved grasslands (Rotheroe *et al.*, 1996). It is an ongoing project. Intensive surveys have subsequently been carried out in parts of Wales (Rotheroe, 1999), in Ireland (McHugh *et al.*, 2001) and in Scotland (Newton *et al.*, 2003).

The Epynt Ranges at Sennybridge have long been regarded as having a rich potential as waxcap grasslands with a high conservation value (Ray Woods, personal communication). The 35 square mile army training area includes very extensive tracts of grassland which have remained relatively undisturbed by Ministry of Defence activity. They have been traditionally farmed by grazing by sheep, without the use of modern fertilizers or herbicides. However, no detailed mycological survey work to investigate the mycota has been undertaken.

1.2 The Present Survey

It was originally intended that five areas of the ranges should be the object of an intensive mycological survey during September, October and the first half of November, 2002. However, unavoidable delays resulted in the number of target areas being reduced to two (**Site A** and **Site B**) and it was not possible to commence survey work until mid November. The sites were selected and boundaries delineated by Defence Estates staff (Nicola Hawkeswood, personal communication). See: Maps 1, 2 & 3. From these it will be seen that **Site A** sits astride four one kilometre squares, ie SN8837; SN8838; SN8937 and SN8938, being centred on the point SN8938. **Site B** includes parts of squares SN8834; SN8835; SN8934 and SN8935, centred on the point SN8935. Both sites are in Vice-county 42 (Brecon).

2 METHODOLOGY

A total of eight recording visits were made on the following days: November 17, 19, 20, 22, 23, 24, 26 and 28. Each visit lasted approximately four hours. Recording was carried out on random transects, but attempts were made to cover all types of grassland on the two selected sites ie including mires, rush-pasture and flushes, as well as the dominant calcifugous grassland. Grid references were noted for the occurrence of rare or uncommon species and for areas where abundance was high and species fruited in troops. Discrete areas where large numbers of different species were fruiting were designated "hotspots", and the grid references of these areas were noted. In an attempt to correlate the occurrence of waxcap species with higher plant associations, records were studied in relation to appropriate NVC codes assigned during a detailed Phase I habitat survey of the ranges undertaken in 1999 (Anon). These data and maps were provided by Nicola Hawkeswood (personal communication).

Commoner species were identified in the field but in other cases collections were retained and identifications made on subsequent occasions in the laboratory, using microscopic methods. All species in the indicator groups referred to above were recorded, together with a

number of species outside the indicator groups, which are regarded as “fellow travellers”, often accompanying taxa in the waxcap-grassland suite, eg *Cordiceps militaris*, *Cystoderma amianthinum* and *Mycena flavo-alba*. Fungi encountered were identified to species or variety level, except in the case of the sub-genus *Nolanea* of *Entoloma*. Many representatives of this sub-genus are very difficult to identify to species level unless all stages of fruit body production are present, while the sub-genus is a poor indicator of quality grassland. Therefore, about half the *Nolanea* collections were simply recorded as *Nolanea* sp. This follows the procedure adopted by McHugh *et al.*, 2001 for Northern Ireland. However, following the suggestion of Rotheroe *et al.*, 1996, the number of *Nolanea* species was noted and this was added to the Entolomataceae totals.

2.2 Assessing Conservation Value and Mycological Importance

A number of different methodologies are available to evaluate the conservation value of waxcap grasslands and these are summarized and discussed in some detail in Appendix I. (Briefly, these techniques involve judging the importance of a site by the number of waxcaps recorded on a single visit and in total. Next, the mycological profile (“CHEG profile”) of the site is produced by listing the numbers of indicator in the various groups represented, ie C = Fairy Clubs; H = Waxcaps; E = Pink-gills; G = Earth Tongues. Finally, those species listed by Rotheroe, 1999, as being indicators of higher conservation value are tabulated to produce a prediction of the qualitative ranking.) Thus the profiles of waxcap indicator species could be compiled for the two target sites, permitting quantitative assessments of mycological importance to be set out and comparisons to be made between the Epynt sites and sites elsewhere in Britain.

The conservation status of species recorded in the survey was also considered in relation to their appearance on one of the two published lists of rare or endangered species.

The first of these, the British Red Data List of Ing, 1992 (BRDL) proposed three categories of threat: E = Endangered; V = Vulnerable; and R = Rare.

The second (Ing, 1993) consists of a list of macrofungi regarded as being under threat in a European context (ERDL), with threat categories as follows: A = Widespread losses, rapidly declining populations, many national extinctions, high-level concern; B = Widespread losses, evidence of steady decline, some national extinctions, medium-level concern; C = Widespread, but scattered populations, fewer extinctions, low-level concern; and D = Local losses, some extinctions but mainly at edge of geographical range.

A third criterion of conservation value was judged to be the appearance of any species that occurs in the Biodiversity Action Plan list (Anon, 1995).

2.2.1 Important Fungus Areas

Consideration was given to the question of whether either or both of the two target sites could be designated as Important Plant Areas, as defined in a publication with that title published by Plantlife, the Association of British Fungus Groups and the British Mycological Society (Evans *et al.*, 2002). The criteria for selecting Important Fungus Areas in the UK are:

Criterion A: The site holds significant populations of rare fungal species which are of European or UK conservation concern.

A site should be considered in this category if it includes at least five species from:

- * The British Red Data List (Ing, 1992)
- * UK Biodiversity Action Plan and/or Schedule I
- * European Red Data List (Groups A & B) and/or species of European concern (based on Bern Convention proposals)

Criterion B: The site has an exceptionally rich and well-recorded mycota in a UK context.

A site should be considered if it includes at least 500 recorded species.

Criterion C: A site which is an outstanding example of habitat type of known mycological importance.

Criterion D: A nominated site which is considered to be important but for which further information is needed.

2.3 Comparison of Epynt Sites with Other Welsh Locations

In the autumn of 1998 the author carried out a survey of selected semi-natural grasslands in the neighbouring county of Carmarthenshire under contract to the Countryside Council for Wales (Rotheroe, 1999). This survey involved ten different sites selected by CCW officers, but in addition, data on waxcap-grassland fungus records from another seven Welsh sites were collated. Some of the results from this survey were used in the present survey to enable comparisons to be made between Epynt ranges sites and other important Welsh sites. The sites used for these comparisons with Epynt were as follows: "Talley" Site of Special Scientific Interest (SSSI) GR: SN6--3--; Pwll Edrychiad SSSI GR: SN584162; Waun-las, Middleton GR: SN528178; Llanerchaeron Estate, National Trust (Cards.) GR: SN:480600; Hafod Estate (Cards.) GR: SN756731; Garn Ddyrys, Tumble GR: SO258117; Carreg Cennin SSSI GR: SN670191; St David's College lawns, Lampeter (Cards) GR: 579482 and Maestir Churchyard, Lampeter (Cards.) GR: SN553494. Further data for comparative purposes were obtained from Gilfach Farm, Rhayader, Radnorshire (Ray Woods, personal communication).

2.4 Nomenclature

In general the classification of the *Dictionary of the Fungi* (Hawksworth, *et al.*, 1995) has been used in this study. However, there is some disagreement currently over aspects of nomenclature for certain groups. For the Entolomataceae (Pink-gill species), this study uses the nomenclature of Noordeloos (1992), which reduces some genera to sub-generic level, notably *Leptonia* and *Nolanea*, rather than the classification of the Dictionary of the Fungi, which retains these at generic level. For *Hygrocybe*, the nomenclature follows Boertmann (1995), with a number of small modifications proposed by Henrici (1996).

3 RESULTS

3.1 General

In Wales the peak time for fungal fruiting on grasslands is usually from mid to late October (personal observation). In an average November frosts mark the end of the fruiting season. The year 2002 was unusual firstly in that September and October were remarkably dry months and very few fungi had sufficient moisture to promote fruiting. The season was therefore delayed considerably, resulting in a fruiting peak which, fortuitously, coincided with the period covered by this survey's recording visits. Secondly, November 2002 was unusual for the absence of frosts. None occurred on Epynt until after the survey period (MOD security staff, personal communication).

On the other hand, species which usually fruit earlier in the autumn season were unfortunately absent by November. Thus species in the *Entoloma* sub-genus *Leptonia*, which reach a fruiting peak in August and early September (usually following wet and warm Julys), were entirely absent at the time this survey was carried out. Other early-fruiting species in all genera were also missing.

3.2 Community Associations

Although, as described in Methodology at 2 above, all types of grassland habitat were covered during the recording visits, all the records obtained were made in just one NVC type, ie U4a Calcifugous Grassland (*Festuca ovina*-*Agrostis capillaris*-*Galium saxatile* grassland: Typical sub-community). This is perhaps not surprising since the U4a community was the dominant NVC grassland type in the two Epynt sites investigated. Mires, rush pasture and flushes yielded no waxcap-grassland indicator species – almost certainly because they were so wet that the soils became anaerobic and would not support mycelial development to the formation of fruit bodies. (Rotheroe, 1999, showed that wetter grassland types were very unproductive mycologically.) Only fungi on dung were found in these areas.

3.3 Analysis of Data Obtained

A cumulative list of all species recorded from **Sites A and B** in the eight recording visits is given in Table 1.

From these data and with reference to Appendix I, it can be seen that the CHEG profile for **Site A** is as follows: **C 4, H 20, E 7, G 2**.

The quality value of this site, using the Rotheroe "Top Twenty-four" weighting detailed in Appendix I, produces a profile of **A2 B4**. Species which produce this weighting are A: *Hygrocybe punicea* & *H. splendidissima* and B: *H. calyptriformis*, *H. flavipes*, *H. fornicata* & *Geoglossum glutinosum*.

The CHEG profile for **Site B** is **C 2, H 24, E 6, G 1** while the "Top Twenty-four" value is **A2 B3**. Species producing this latter rating are A: *Hygrocybe punicea* & *H. splendidissima* and B: *H. calyptriformis*, *H. fornicata* & *Trichoglossum hirsutum*.

The highest number of *Hygrocybe* species recorded on any one visit was as follows:

Site A *Hygrocybe* total = 14 (19 November, 2002).

Site B *Hygrocybe* total = 19 (17 November, 2002).

From these data, and using the Rald formula set out in Appendix I, it will be seen that **Site A** can be interpreted as being of National Importance. This is by virtue of its having 20 species of *Hygrocybe* in total recorded there (14 recorded during a single visit).

The Rald formula shows **Site B** to be of International Importance, with a total of 24 *Hygrocybe* species recorded (and 19 on a single visit).

In addition both may be regarded as high quality sites from interpretation using the Rotheroe "Top Twenty-four" formula also referred to in Appendix I.

Table 1 also indicates those species which are regarded as having special conservation status. These data may be summarised as follows:

Site A Waxcap-grassland mycota includes one species on the British Red Data List (Ing, 1992), listed as Vulnerable, with six species on the European Red Data List (Ing, 1993), one listed in Category B and five in Category C. One species at this site is on the Biodiversity Action Plan list.

Site B has two species on the BRDL (V); five on the ERDL (C) and one BAP species.

The number of species recorded which occur on either the BRDL, the ERDL or the BAP list is further evidence of the high conservation value of both sites.

Neither of the two sites satisfies criterion A or B as defined by Evans *et al.* 2002 in their Important Fungus Areas document. However, from the evidence above, both of the Epynt sites should qualify for this status using Criterion C and Criterion D.

TABLE 1: List of Species Recorded During Survey, showing Sites and Conservation Status
(Y = Present N = Absent)

<u>Fungus</u>	<u>No*</u>	<u>Site A</u>	<u>Site B</u>	<u>Status</u>
Clavulinopsis corniculata	1	Y	Y	
Clavulinopsis fusiformis	1	Y	N	
Clavulinopsis helvola	1	Y	N	
Clavulinopsis umbrinella	1	N	Y	BRDL (V)
Ramariopsis kunzei	1	Y	N	
Dermoloma cuneifolium	2	N	Y	
Hygrocybe calyptriformis	2	Y	Y	BRDL (V); BAP
Hygrocybe cantharellus	2	N	Y	ERDL (C)
Hygrocybe ceracea	2	Y	Y	
Hygrocybe chlorophana	2	Y	Y	
Hygrocybe coccinea	2	Y	Y	
Hygrocybe conica v chloroides	2	N	Y	
Hygrocybe flavipes	2	Y	N	
Hygrocybe fornicata	2	Y	Y	ERDL (C)
Hygrocybe glutinipes	2	Y	Y	
Hygrocybe insipida	2	N	Y	ERDL (C)
Hygrocybe laeta	2	Y	Y	
Hygrocybe mucronella	2	Y	Y	
Hygrocybe perplexa	2	Y	N	ERDL (B)
Hygrocybe pratensis	2	Y	Y	
Hygrocybe pratensis v. pallida	2	Y	Y	
Hygrocybe psittacina	2	Y	Y	
Hygrocybe punicea	2	Y	Y	ERDL (C)
Hygrocybe reidii	2	Y	Y	
Hygrocybe russocoriacea	2	Y	Y	
Hygrocybe splendidissima	2	Y	Y	
Hygrocybe cf. subpapillata	2	N	Y	
Hygrocybe virginea	2	Y	Y	
Hygrocybe virginea v fuscescens	2	N	Y	
Hygrocybe virginea v ochraceopallida	2	Y	Y	
Hygrocybe vitellina	2	Y	Y	
Entoloma ameides	3	Y	N	
Entoloma conferendum	3	N	Y	
Entoloma papillatum	3	N	Y	
Entoloma porphyrophaeum	3	Y	Y	
Geoglossum fallax	4	Y	N	ERDL (C)
Geoglossum glutinosum	4	Y	N	ERDL (C)
Trichoglossum hirsutum	4	N	Y	ERDL (C)
Cordyceps militaris	5	Y	Y	
Cystoderma amianthinum	5	Y	Y	
Mycena flavo-alba	5	N	Y	
Mycena pura	5	N	Y	

* Note: These numbers are assigned for sorting purposes only. 1 = Clavarioid fungi;
2 = Tribus Hygrocybeae; 3 = Entolomataceae; 4 = Geoglossaceae; 5 = Others ("Fellow travellers")

Table 2 lists the species recorded in the survey, together with some grid references indicating positions on the two sites where principal collections were made. These grid references may be regarded as “hotspots”. This is because within 10 metres of the grid reference quoted, several different species were recorded, often fruiting in troops.

These hotspots are as follows: (All SN): 884382, 886383, 887383, 887384, 888383, 890354, 891383, 893343, 893350, 893351, 896381.

TABLE 2: Grid References of locations where records of Waxcap-grassland Species were made

<u>Fungus</u>	<u>Distribution</u>
<i>Clavulinopsis corniculata</i>	SN893351, 890354
<i>Clavulinopsis fusiformis</i>	SN884382
<i>Clavulinopsis helvola</i>	SN893351
<i>Clavulinopsis umbrinella</i>	SN893350
<i>Ramariopsis kunzei</i>	SN893351
<i>Dermoloma cuneifolium</i>	SN893350
<i>Hygrocybe calyptriformis</i>	SN886383, 893350, 887384, 891383, 888383, 887383
<i>Hygrocybe cantharellus</i>	SN893350
<i>Hygrocybe ceracea</i>	SN884382, 886383, 893350
<i>Hygrocybe chlorophana</i>	SN890354, 893350, 893343
<i>Hygrocybe coccinea</i>	SN886383, 893350, 893343
<i>Hygrocybe conica</i> v <i>chloroides</i>	SN893350
<i>Hygrocybe flavipes</i>	SN884382
<i>Hygrocybe fornicata</i>	SN886383, 890354, 893350, 893343, 888383
<i>Hygrocybe glutinipes</i>	SN884382, 893350, 893343
<i>Hygrocybe insipida</i>	SN893350
<i>Hygrocybe laeta</i>	SN893351, 884382, 890354, 893350
<i>Hygrocybe mucronella</i>	SN893351, 893350
<i>Hygrocybe perplexa</i>	SN886383
<i>Hygrocybe pratensis</i>	SN893351, 896381, 884382, 886383, 893350, 887383
<i>Hygrocybe pratensis</i> v <i>pallida</i>	SN893350
<i>Hygrocybe psittacina</i>	SN893351, 884382, 886383, 893350
<i>Hygrocybe punicea</i>	SN896381, 886383, 890354, 893350, 887383
<i>Hygrocybe reidii</i>	SN896381, 896381, 893350
<i>Hygrocybe russocoriacea</i>	SN893351, 896381, 886383, 890354, 893350, 893343
<i>Hygrocybe splendidissima</i>	SN884382, 890354, 893350, 893343, 887383
<i>Hygrocybe</i> cf. <i>subpapillata</i>	SN893350
<i>Hygrocybe virginea</i>	SN896381, 893350
<i>Hygrocybe virginea</i> v <i>fuscescens</i>	SN893350
<i>Hygrocybe virginea</i> v <i>ochraceopallida</i>	SN893350, 893350
<i>Hygrocybe vitellina</i>	SN884382, 893350
<i>Entoloma ameides</i>	SN893350
<i>Entoloma conferendum</i>	SN893350
<i>Entoloma papillatum</i>	SN893350
<i>Entoloma porphyrophaeum</i>	SN890354, 893350
<i>Geoglossum fallax</i>	SN884382
<i>Geoglossum glutinosum</i>	SN884382
<i>Trichoglossum hirsutum</i>	SN893350

Cordyceps militaris	SN893351, 896381, 884382, 893350
Cystoderma amianthinum	SN884382, 890354, 893350
Mycena flavo-alba	SN893350
Mycena pura	SN884382

3.4 Comparison with other Welsh Sites

Table 3 below shows the position of the two Epynt sites in a "league table" of locations which have been investigated for their Waxcap-grassland mycota (after Rotheroe, 2002).

Table 3: Cumulative list of indicator species recorded at important Welsh sites

(Conservation values assigned according to Rald [1985] as adapted by Vesterholt *et al* [1999])

<u>Location</u>	<u>C</u>	<u>H</u>	<u>E</u>	<u>G</u>	<u>Conservation Value</u>
Hafod Estate	5	30	7	1	(International Importance)
Garn Ddyrys, Tumble	3	28	0	5	(International Importance)
<u>Epynt Site B</u>	2	24	6	1	(International Importance)
Llanerchaeron (NT)	6	23	7	2	(International Importance)
Gilfach Farm, Rhayader	3	23	0	0	(International Importance)
Waun-las Farm, Middleton	4	22	7	0	(International Importance)
<u>Epynt Site A</u>	4	20	7	2	(National 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)

From this table it will be seen that both the two Epynt sites surveyed are of major importance in a Welsh context. (It is important to note also that many or most of the other Welsh sites had been surveyed during several months of the year and often for several years, whereas the Epynt data refer only to records from one month in one year, ie November, 2002.)

Table 4 shows a list of highest scoring Welsh grasslands according to the "Top Twenty-four" formula proposed by Rotheroe (1999). 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. The Epynt sites are among nine locations in South Wales which may be judged to have shown their high conservation value (extremely high in a UK context).

Table 4: Comparative Conservation Values for Important Welsh Waxcap-grassland Sites, using “Top Twenty-four” scores (See Appendix I)

<u>Location</u>	<u>Conservation Value</u>
Llanerchaeron Estate (NT)	A7 B4
Hafod Estate	A4 B9
Gilfach Farm, Rhayader	A4 B4
Garn Ddyrys, Tumble	A3 B10
Waun-las Farm, Middleton	A3 B5
Maestir Churchyard, Lampeter	A3 B2
Epynt Site A	A2 B4
Epynt Site B	A2 B3
‘Talley’ SSSI	A1 B5

This table reveals that the two Epynt sites have a very respectable quality rating and feature in the top ten of the 20 sites in South Wales for which records are available.

3.5 Unusual Records

One of the most striking features of the survey was the very large numbers of fruit bodies of some species which were recorded – especially given the lateness in the season of the recording visits. The common meadow waxcap, *Hygrocybe pratensis*, was particularly prolific in its fruiting patterns, occurring in troops and being widespread in its distribution at both target sites. On one occasion (17 November, 2002) it was estimated that some 400 to 500 fruit bodies were encountered. The BAP species *Hygrocybe caliptriformis* was also recorded in considerable numbers (circa 50-plus fruit bodies at any one time), as was *H. punicea* (20 to 30 fruit bodies in some colonies). Also notable were the troops of *Hygrocybe russocoriacea* fruiting in particular in closely cropped turf along the roadside verges.

The “fellow traveller” caterpillar fungus, *Cordyceps militaris*, which grows on buried larvae of insects, was recorded in greater numbers than had previously been experienced during grassland survey work by the author.

In contrast, one of the commonest waxcaps, *H. conica* was recorded only once (one fruit body of the variety *chloroides*). Another extremely common species, *H. chlorophana*, which usually dominates foray lists, was found at only three locations in total, in groups of only two or three. *H. flavipes* was found only once at one location on **Site A**. The complete absence of pink-spored species in the sub-genus *Leptonia* has already been noted above. But also unexpectedly absent were such relatively widespread waxcaps as *H. citrinovirens*, *H. intermedia* and *H. quieta*.

Of particular note was a collection from **Site B** which agreed with descriptions of *Hygrocybe subpapillata*. However, since this taxon has not previously been reported as British, dried material from the collection will be sent to Danish expert David Boertmann to seek a definitive determination.

4 DISCUSSION

The results outlined above are remarkable particularly in view of the fact that the survey was confined to such a narrow time slot, very late in the fungus season. Both sites have been shown to rate very highly in terms of conservation value by the series of different criteria and analysis methods in terms of

- a) the number of endangered species recorded;
- b) the rating of International Importance for **Site B** and National Importance for **Site A** using the Rald formula;
- c) the quality value of the two sites using the Rotheroe "Top Twenty-four" rating;
- d) the qualification of both sites as Important Fungus Areas
- and e) their status as being among the top ten waxcap-grassland sites in South Wales.

5 CONCLUSIONS

The two target sites surveyed may be regarded as important semi-natural resources of high nature conservation value. From the survey it may be inferred that the other three sites originally targeted would also produce similar results and, indeed it seems most likely that many other areas of the Epynt ranges would also prove to be extremely rich and diverse in mycological terms. The ranges as a whole might therefore be regarded as of one of the largest areas of major conservation importance in the whole of Wales.

5.1 Management

It should be emphasized that any change in existing management regimes would quickly and dramatically damage what is a very fragile habitat type. Once lost, most of the more important indicator species would be unlikely to return for many years, or even decades. It is advised, therefore, that the best management to retain this quality resource is to maintain the status quo ie sheep grazing at a relatively high intensity and with no addition of fertilizers or other "improvement" regimes such as ploughing and reseedling.

5.2 Future Work

The above results must be regarded as "the tip of the iceberg", having been compiled from a relatively small area of the ranges and carried out during a very brief period late in the season. Undoubtedly survey work over a longer timescale and embracing other areas of the ranges grassland would prove extremely rewarding.

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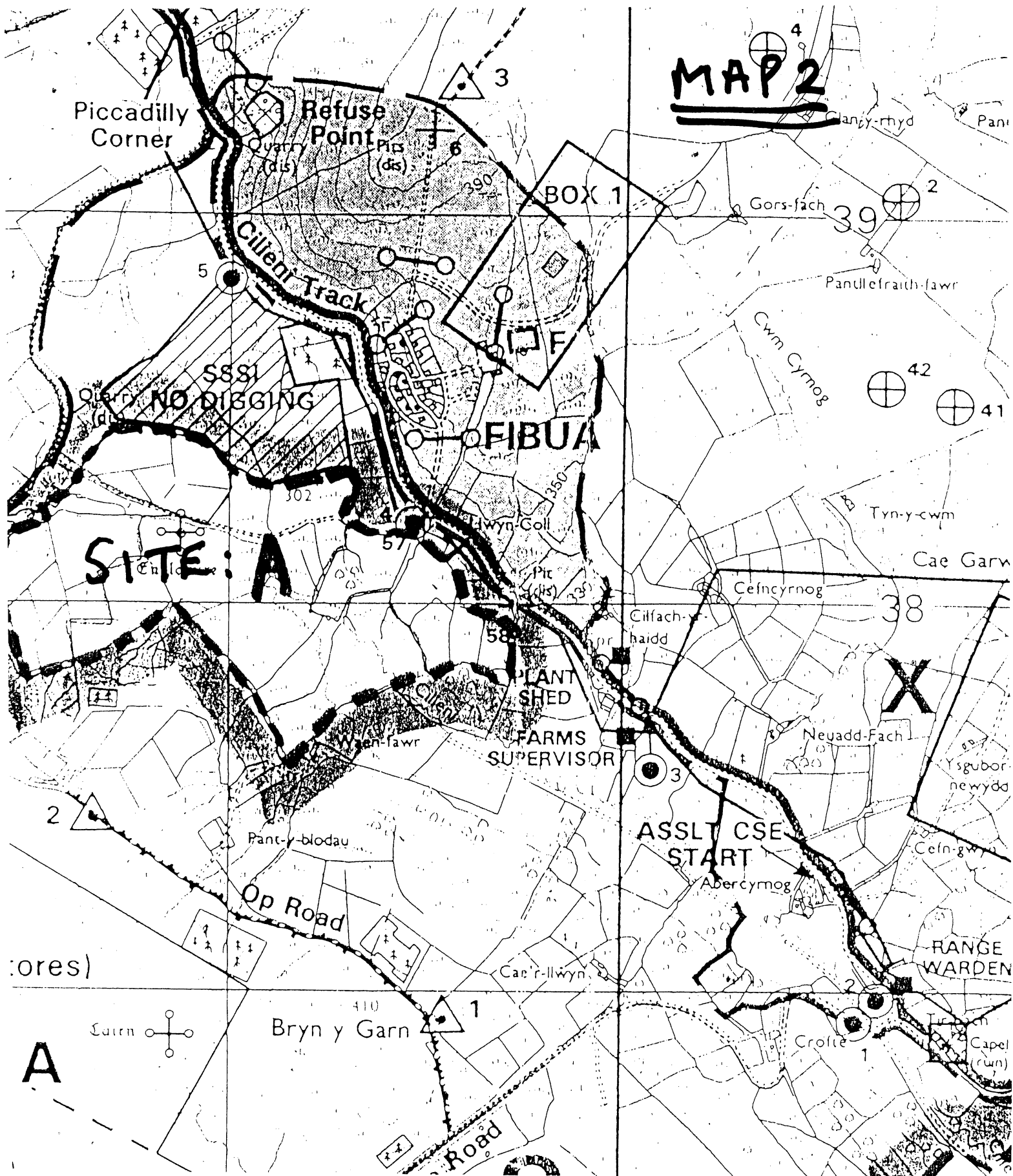
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SITE A

SITE D

MAP 2



~~MAP~~

Gun Park Road

二、

Black

Or-fan

Brain-du

7

March

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 during 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 weighting 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)
Hygrocybe unguinosa (Slippery-eel Waxcap, European Red Data List species)
 Any other species in the Geoglossaceae (than *Microglossum olivaceum* or *Trichoglossum walteri*)

The species are listed in order of their value as indicators of the highest conservation value. (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.)