

National Vegetation Classification (NVC) Phase II Survey of Grassland within the Malvern Hills Site of Special Scientific Interest.

Client: Malvern Hills Conservators and English Nature.
Site: The Malvern Hills within the boundary of the SSSI.
OSGR: SO 767473 (north) – SO 758349 (south).
Date: May 2003.
Appendices: Appendix 1. Vegetation maps
Appendix 2. MATCH analysis
Appendix 3. Maps showing the location of scarce and rare species
Appendix 4. Condition assessment forms
Attached reports: Community and quadrat cards

1.0 Introduction

This specialist ecological survey was jointly commissioned by The Malvern Hills Conservators and English Nature to identify the location, extent and quality of grass and heath vegetation communities within the Malvern Hills SSSI, using the National Vegetation Classification Phase II Survey methodology as described in the Handbook for Using the NVC (Rodwell 1996).

The production of this information was intended to provide a basis for the setting of land management priorities and facilitate grant aid bids.

2.0 Commissioning brief

Countryside Consultants were instructed by The Malvern Hills Conservators on 12 April 2002 to carry out a Phase II National Vegetation Classification survey of grass and heath communities within the Malvern Hills SSSI, under the jurisdiction of the Malvern Hills Conservators, the National Trust, English Nature and The Eastnor Estate.

The brief instructed:

- to carry out a field survey of the grassland and heath within the Malvern Hills SSSI using the NVC Phase II Survey techniques;
- to describe the survey process stating the criteria used and sources of information;
- to show the extent of the NVC boundaries on MapInfo compatible Geographical Information Systems;

- Justification for each NVC community/sub-community identified and any anomalies with recognized community descriptions.
- Maps, brief descriptions of and species lists for areas of particular importance for high quality short acid grassland with annual species.
- A considered appraisal of the survey, including a list of the extent, location and distribution of the communities/sub-communities present, including the area covered by each sub-community and highlighting areas or problems where NVC is not fully effective at defining communities.
- Condition assessments for the areas of acid grassland and heath communities within each of the 15 monitoring units of the SSSI and a review and analysis of these assessments,

3.0 Survey & Analysis Methodology

3.1 Survey personnel

The work was carried out by Katey Stephen BSc (Hons), the principal partner responsible for the implementation of the contract.

3.2 Survey period

Field surveying took place over a period during March and April 2003. This period followed and coincided with a prolonged dry and exceptionally mild period of weather which brought forward the flowering season and emergence of many Spring-flowering annuals making it an ideal time for survey

3.3 Survey Methodology

Phase II surveying of grassland communities on the site was carried out using the National Vegetation Classification techniques (Rodwell et al 1991).

3.3.1 Delimiting the survey area

The area of survey was firstly defined by the extent of the Malvern Hills Site of Special Scientific Interest using maps supplied by The Malvern Hills Conservators.

The extent of grassland and transitional communities for survey were identified by excluding all areas of woodland and scrub as identified in “A Study of the Woodland Boundaries within the Malvern Hills SSSI” (Countryside Consultants 2002).

3.3.2 Survey of grassland and heath

For each homogenous stand of vegetation a minimum of five randomly selected 2m² quadrats were sampled. A quantitative measure of the abundance was recorded using the DOMIN scale, cover being assessed by eye as a vertical projection on the ground of all the live, above ground parts of the plant in the quadrat.

A full species list was drawn up for each homogenous stand and the abundance of individual species indicated by using the DAFOR scale.

Both quadrat and community cards were numbered and their location noted using a site name and a full grid reference using a hand held GPS which is accurate to between 8 and 20 metres. Altitude and aspect were taken from GPS and slope estimated by eye.

Any additional information on the community structure and management was included in note form on individual cards.

Each homogenous stand was mapped as an individual unit and allocated an identification number from 1-113, to enable cross reference with survey cards.

3.3.3 Survey of bracken and scrub

The extent, location and distribution of scrub, bracken, tall herb communities and other herbaceous based communities/sub-communities were mapped. Quadrats were used for initial characterisation of communities, but thereafter mapping was carried out on a visual basis, with quadrats taken only where required to characterise stands which were difficult to characterize by eye. A community card was completed as for grassland and heath communities as described above.

It must be noted that there was some overlap of scrub communities that were identified as light scrub in the woodland survey (Countryside Consultants 2002) and scrub communities mapped in this survey.

Each homogenous stand was mapped as an individual unit and allocated an identification number to enable cross reference with survey cards.

Any notable management and threats such as potential scrub invasion were also noted as part of this recording process.

3.4 Analytical Technique

Survey data was input and analyzed using MATCH so that stands could be assigned to appropriate communities by comparing the constancy of the constituent species of each stand with the characteristic profiles of the NVC diagnostic communities of the software.

Any major discrepancies from the diagnostic data were noted which were then useful for assessing the quality of the grassland stand.

Full community descriptions are given in “British Plant Communities” for each different vegetation type and as such they are not included in this report.

4.0 RESULTS

4.1 National Vegetation Classification communities identified within the Malvern Hills SSSI.

Phase II survey of the Malvern Hills SSSI recorded fourteen sub-communities excluding woodland. A summary of these is given in Table 1. This also gives a rough indication of their location on the site.

Table 1

NVC	End Hill-Wyche Cutting	Wyche Cutting-Black Hill	British camp-Swinyard Hill	Mid-summer Hill	Ragged Stone Hill	Chase End	Total
U1a			2.63	0.27	1.05	2.62	6.57
U1b	2.88	0.26	6.28	2.24	0.31	0.63	12.6
U1d				0.44		0.36	0.8
U1e	2.69	5.84	5.31		2.74		16.58
U2a	19.87	4.3	10				34.17
U4a	5.71	0.56	7.28	1.56			15.11
U4b		0.5		0.28			0.78
U20a		1.45	3.76				5.21
U20b	31.45		4.71				36.16
H8e	1.8		0.15				1.95
MG1	1.16	0.22					1.38
W23a	20.73	6.67	0.12		0.32		27.84
W25a						15.64	15.64
W25b	46.66	40.96	54.89	7.34	11.61		161.46

For each sub-community, the quadrat information was analysed through MATCH with the results given in Appendix 2.

4.2 Maps, species lists and brief descriptions of each community

This detailed, Phase II survey of the Malvern Hills SSSI generated a large amount of raw data in terms of community and quadrat cards. These give valuable and provide detailed information about each community. These are provided in a separate report in their raw state.

Each community was assigned a number, working broadly from End Hill to Chase End Hill. This number can be cross referenced with the maps in Appendix 1 to give the exact location of the community. In addition to this the quadrat data for each community is also provided. The location of each quadrat can be found using the 10 figure grid reference.

Maps are provided as a hard copy in Appendix 1. These are also provided in an electronic format.

4.3 Areas of particular importance for high quality short acid grassland

The following section is a summary of communities considered from the survey to be of high quality in terms of its acid grassland or heath. This also includes areas that exhibit a potential to support such communities through the presence of species usually associated with high quality grassland or heath.

In addition to the specific communities mentioned below, the following community types should all be considered of high importance:

- *Festuca-Agrostis-Rumex* (U1) grassland, a habitat targeted by Worcestershire, Herefordshire and Gloucestershire BAP as under threat. It is within these communities that most of the national and regional rarities were found.
- *Festuca-Agrostis-Galium* (U4) grassland, a habitat targeted by Worcestershire, Herefordshire and Gloucestershire BAP as under threat. It is this community that was thought to cover much of the Malvern Hills SSSI before the cessation of grazing (Davies 1994).
- *Deschampsia* (U2) grassland and *Pteridium-Galium* (U20) are included with the Worcestershire, Herefordshire and Gloucestershire BAP as target habitats, but are generally rank with little species variety. The location of specific, species rich examples of this community are highlighted below, but are only included in this section where it is felt that they contain species valuable to the site.

- *Calluna-Ulex* (H8) heath, a Worcestershire, Herefordshire and Gloucestershire BAP habitat under threat and of considerable regional conservation importance.

For ease of reference these communities are described working from End Hill to Chase End Hill.

4.3.1 End Hill – Wyche Cutting

- U1b grassland is fragmented with small, isolated communities on the ridges and summits, often associated with the Shire Ditch. This includes communities 6, 15, 21, 26, 30, 37, 38 and 114. *Cerastium semidecandron* is present in the majority of these locations.
- U1e grassland is also highly fragmented, occurring in positions slightly below the ridge and on rock outcrops on the eastern flanks of North Hill. This includes communities 13, 18, 20, 28, 31 and 39.
- The majority of U4a grassland is associated with paths in this area and is particularly species poor. This includes communities 5, 7, 8 and 14. The small isolated fragments where this community was recorded away from the paths, communities 3 and 19 provide slightly more species variety, although both are surrounded by bracken communities.
- Units of H8e heath, community 23, within *Deschampsia* grassland are highly fragmented and very small with most areas only 0.04ha in size. This community was only recorded in two locations within the SSSI.
- Communities 11, 22 and 27 support U2a grassland and communities 12 and 24 support U20b with a high frequency of *Vaccinium myrtillus* within the stand. Community 33 is dominated by *V. myrtillus*, but the high frequency of bracken classifies this as a U20b community. Such heath elements should be considered of importance due to the national and regional importance of lowland heath and the lack of such heath elements in the Malvern Hills SSSI as a whole.

4.3.2 Wyche Cutting to Black Hill

- U1b grassland is restricted to the ridge in communities 43, 44, 47, 48, 57 and 58, but forms a continuous corridor throughout this section of the hill which is only interrupted by heavy erosion on the steeper sections. Communities 54 and 59 are the most extensive areas of U1b grassland recorded within the SSSI, with community 54 exhibiting one of the greatest species variety found during the survey, particularly in mosses and lichens. *C. semidecandron* was recorded in several of these communities. This is the location of an intense fire in 1995.
- Community 53 is the largest area of U1e grassland recorded in the survey and coupled with adjacent U1b it forms the largest areas of species rich acid grassland recorded. This was also included in the area burnt in 1995. Communities 42 and 44 are small isolated areas of U1e along the ridge.
- U20a grassland in community 55 supports a rich and varied ground flora similar to that found in U1 grassland to the west. This may have previously been U1

grassland due to re-colonisation of bracken after the fire the community is now U20a.

- Community 56 supports the only area of U4a grassland which is heavily invaded by bracken and only maintained as grassland through path cutting.
- This section of the hills is heavily scrubbed with scrub extending to the ridge along much of its course, as such all areas of U2 grassland should be considered of importance as open grassland habitat even though these hold little species variety. This includes communities 44, 49 and 63.

4.3.3 British Camp-Swinyard Hill

- The ramparts of British Camp and Millennium Hill support a complex mosaic of U1a, U1b, U1e and U4a, high quality, acid grassland, interspersed with ranker U2 grassland where the ground is flatter. Communities referred to here are 70, 71, 72, 73, 74 and 76. This forms one of the larger areas of open grassland within the SSSI. *Moenchia erecta* was recorded in U1b grassland in this area.
- Community 75 supports U2a grassland with frequent *C. vulgaris*. Such heath elements should be considered of importance due to the national and regional importance of lowland heath and the lack of such heath elements in the Malvern Hills SSSI as a whole.
- Community 76 supports U20b with a particularly species rich ground flora supporting a number of species associated with U1 grassland. *C. vulgaris* is also frequent within this community.
- U1b grassland in communities 79, 85, 86, 90, 91 and 96 support a high quality grassland by nature of the U1b classification although in reality these are not particularly species rich, occurring in a narrow band along the ridge and in isolated locations where rocks outcrop.
- Community 81 supports H8e heath dominated by *C. vulgaris*. This community was only recorded in two locations within the SSSI. It is here that the rare club moss *Diphasiastrum x issleri* was recorded.
- All acidic grassland around the Clutters Cave, Broad Down and Hangman's Hill should be considered of importance because of their muted calcareous characteristics of U1 and U4 where *Helianthemum nummularium* and *Thymus serpyllum* are present within the stand. This is due to the presence of the Warren House volcanic series which is higher in calcareous minerals and is more susceptible to weathering to release the minerals than the other rocks. The resultant downwash of material influences the calcicole floristics. This includes communities 82, 83, 87, 88, 89, 90, 91, 92 and 93. Community 89 supports one of the richest floras in the survey with the highest number of species in a quadrat for acid grassland on the site. *Potentilla neummanniana* was recorded in community 89 and on a rock outcrop in 92 and *Moenchia erecta* was recorded in 87 and 89.
- Broad Down and Hangman's Hill support the largest area of U4a grassland recorded within the SSSI. This includes communities 82, 83, 88 and 92.
- U1b and U1e grassland along the summit of Swinyard Hill remains in a narrow band associated with the summit. Scrub extends to the summit here and only gives way to acid grassland where the soils are thin on the summit.

- Community 98 and localised parts of community 97 support a very rich grassland community beneath dense bracken. Survey was undertaken at an unfavorable time of year for this type of community, but the sward is more mesotrophic at this altitude, with frequent springs suggesting that the grassland could conform to MG10 grassland if the bracken was removed. Castlemorton Common is renowned for its rich flora and past surveys may confirm that this area within the SSSI potentially supports a species rich community. The area is known to support a high incidence of Common spotted orchid with sedges, great horsetails and mire species including *Sphagnum sp.*, but these were not visible at the time of survey.

4.4.4 Midsummer Hill

- Acid grassland is limited to two narrow bands of U1a, U1b and U4a grassland within the ramparts of the iron age fort incorporating communities 102, 103, 104, 105 and 106. Scrub encroachment on all sides suggests that these may be under threat.
- A small area of U1d (100) and U4b (99) was recorded near the car park on the southern side of the hill. Both of these communities were only recorded in one other place within the SSSI.

4.4.5 Ragged Stone Hill

- This supports the second largest area of U1e grassland recorded within the SSSI. Community 108 covers a large area of the summit.
- U1a and U1b grassland are also present on the summit with abundant lichens.
- Community 107 has a large population of *Hyacinthoides non-scripta*.

4.4.6 Chase End Hill

- The summit supports a large area of U1 grassland. Community 112 is one of the largest areas of U1a grassland recorded, whilst community 111 supports U1b grassland.
- W25a scrub was only recorded in community 114 with a rich assemblage of spring flowering plants including *Hyacinthoides non-scripta* and *Anemone nemorosa*. The eastern side of the hill may not be as rich in ground flora and may be detrimental to acid grassland to the west.
- Community 113 is one of only two locations that U4b grassland was recorded on the Malverns.

4.4 Rare and scarce plant species

The locations of three nationally and locally restricted plants known to exist on the site are recorded in map format in Appendix 3. These include *Moenchia erecta*, *Potentilla neumanniana* and *Cerastium semidecandron*. *Trifolium ornithopodioides* was not recorded during survey.

Appendix 3 also includes the location maps for *Calluna vulgaris* and *Vaccinium myrtillus*.

4.5 Distribution, extent and location of NVC grassland communities/sub-communities on the Malvern Hills SSSI

4.5.1 U1 *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland

Festuca-Agrostis-Rumex (U1) grassland is characteristic of oligotrophic and parched soils with grazing and disturbance very important to maintaining the vegetation. A decline in grazing of these communities on a national level has resulted in a loss of many stands and its extent on the Malvern Hills SSSI is, on the whole, limited to pathways, the ridge and rock outcrops, although it is often badly eroded to the extent that there are significant areas of bare ground.

This vegetation type is more extensive on the hills above Holy Well and on the three southern hills, Midsummer Hill, Ragged Stone Hill and Chase End Hill.

- U1a is confined to the southern hills from British Camp to the south particularly on Ragged Stone Hill and Chase End Hill
- U1b occurs in fragments along much of the ridge and again in isolated stands on rocky outcrops on lower slopes.
- U1b gives to U1e where *Festuca-Agrostis-Rumex* grassland has survived the lack of grazing on the less parched soils to either side of the ridge. A larger expanse of U1e occurs above Holy Well, this is discussed later.
- U1d only occurs at two locations on Midsummer Hill and Chase End Hill at low altitude where soil conditions are moister.

4.5.2 U2a *Deschampsia flexuosa* grassland: *Festuca ovina-Agrostis capillaris* sub community

Deschampsia flexuosa grassland (U2) grassland is most often found with sub-shrub vegetation, woodland, scrub and bracken in mosaics reflecting complex management histories. In the lowlands it is frequently associated with small remnants of semi natural vegetation where neglect is the major controlling factor of its distribution.

This sub community forms a transitional position between scrub and ephemeral rich grassland. Grazing is important in maintaining the community and neglected stands become invaded by scrub and Bracken limiting *D. flexuosa* to well worn paths or remnants of more open ground where woody plants have not yet established.

It remains the most extensive area of acid grassland community present within the SSSI. It is most extensive on North Hill where *Vaccinium myrtillus* is frequent and the community has a heath appearance and to the south on Worcestershire Beacon and British Camp where the community is much ranker. These areas represent the largest areas of open grassland within the SSSI. It was not found at any location south of British Camp where *Festuca-Agrostis Rumex* (U1) grassland is bounded by bracken, scrub and woodland communities.

4.5.3 U4a *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland

Festuca-Agrostis-Galium grassland: typical sub community (U4a) probably covered the majority of the slopes before grazing was stopped, (Davies 1994), but is now limited to paths on the northern hills and small isolated communities on British Camp, Hangman's Hill and Midsummer Hill. It appears to be present along path edges at lower altitudes, where bracken is regularly cut although the frequency of the cut bracken stalks in the stand tends to match this to U20a.

The community is typically found on hill slopes on 10-25° giving way to U1 grassland on locally parched soils and over fractured hill tops. Since the cessation of grazing, such areas within the SSSI are now covered in bracken, gorse, bramble, scrub and woodland and the remaining area of U4a covers just 15ha over the entire site.

The grassland is associated with wetter conditions provided by run-off from the slopes and was recorded on paths in the End and North Hill area and on small fragmented areas elsewhere, with the largest recorded area around British Camp and Broad Down.

U4b was only recorded in two locations at lower altitudes where the soils were moister.

4.5.4 U4b *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland: *Holcus lanatus-Trifolium repens* sub community

U4b was only recorded in two locations, adjacent to the car parks on Midsummer Hill and Black Hill totaling 0.78ha. Both locations were at low altitude compared to all other upland grassland communities recorded within the SSSI.

4.5.5 H8e *Calluna-Ulex gallii* heath

Calluna-Ulex (H8) heath is a community of free draining, acidic soils where edaphic conditions influence floristic variation and grazing/burning affect its physiognomy and composition and help maintain the community against succession to woodland. It is fragmented and only covers a total of just under 2ha of the site. A small remnant was located adjacent to the British Camp Reservoir

and isolated patches, none of which are larger than 0.04ha on Worcestershire Beacon.

4.5.6 U20 *Pteridium aquilinum-Galium saxatile* community

The *Pteridium-Galium* community is widespread throughout Britain on quite moist, base poor soils on upland fringes. U20a grassland was only found where there were large open areas including North Hill, Worcestershire Beacon and British Camp generally in close proximity to *Deschampsia* grassland. U20b was only recorded on British Camp.

4.5.7 W23 *Ulex europaeus-Rubus fruticosus* scrub

This community is characteristic of free draining, moderately acid soils and its establishment and spread are much encouraged by agricultural neglect. This is found in mosaic with the bracken and *Deschampsia* communities particularly on the hills between End Hill and Black Hill.

4.5.8 W25a *Pteridium aquilinum- Rubus fruticosus*

The *Pteridium-Rubus* underscrub is characteristic of deeper, free draining and moderately acid soils, and is usually found in close association with woodlands. The community occurs on grassland where the abandonment of traditional treatments like grazing and bracken cutting has allowed this vegetation to spread over large areas.

The W25a *Pteridium aquilinum- Rubus fruticosus: Hyacinthoides non-scripta* sub-community was only recorded on Chase End Hill. The W25b *Pteridium aquilinum- Rubus fruticosus: Teucrium scorodonia* sub-community was the most extensive community within the SSSI after woodland.

4.6 Lowland grassland condition assessments

The condition assessments are provided in Appendix 4. These are provided for Units 1, 2, 23, 3, 19, 17, 24, 20, 4, 21, 22, 7, 8 and 9. All other units did not contain any grassland habitat, but were established woodland.

5.0 DISCUSSION

5.1 Floristic composition trends for each NVC community

5.1.1 U1 *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland

In the U1a *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland: *Cornicularia aculeata* – *Cladonia arbuscula* sub community all three constants are present at their expected constancies and covers. 11 of the 16 preferential species were recorded in the stand and 2 of the 3 differential species were recorded, *Galium saxatile* at a higher constancy than would be expected. 9 of the 11 associate species were recorded.

In the U1b *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland: Typical sub community all three constants were present at their expected constancies and covers. All three preferentials were missing from the stand, but these species are all either rare or are of local distribution in Britain which explains their absence from the community. 20 of the 36 differentials were recorded with *Galium saxatile* and *Polytrichum piliferum* occurring at a much higher constancy than would be expected. 19 of the 42 differentials were present with *Hypnum cupresseforme* occurring at a much higher constancy than would be expected.

Only two small areas of U1d *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland: *Anthoxanthum odoratum-Lotus corniculatus* sub community were recorded during the survey, limiting the samples which may account for the low coefficient similarity. All 3 constants were recorded at their expected constancies and covers. 7 of the 18 preferentials were recorded with *Aphanes arvensis* and *Myosotis ramosissima* at much higher constancies than expected. 8 of the associate species recorded were at significantly higher constancies than would be expected and 14 species of constancy two or greater in the NVC unit were missing from the test data.

These results suggest that the match is not conclusive, but the variation between test data and NVC unit constancies may be attributed to the low number of samples entered and in fact, the matching of individual samples made a good fit.

Within the U1e *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland: *Galium saxatile-Potentilla erecta* sub community all the constant species were present in the stand at the expected constancy. 3 of the 5 preferential species were missing from the test data, but one of these is *Potentilla erecta* which may not have been visible at the time of survey.

In general, *Festuca-Agrostis-Rumex* grassland survives on inhospitable ground where invaders cannot flourish, particularly in the absence of active management through grazing or burning. As a result this community is restricted to the ridges

and rocky outcrops where soils are thin. Periodic disturbance does allow the resurgence of this community an example of which can be seen in the burnt area above Holy Well.

Gap creation is vital for the continued survival of annuals, bryophytes and lichens. This is maintained to some extent by visitor pressure, particularly along the ridge, although this is obviously a fine balance as excessive pressure has led to large extents of bare ground.

Visitor pressure is far lighter on the southern hills and rabbit grazing plays a major factor in keeping the sward open. U1b grassland is found along much of the ridge where, in addition to visitor pressure, the drought conditions act as a natural barrier to invasive and competitive species, and parching produces micro sites for germination of new individuals.

U1e grassland occurs particularly on the deeper soils off the ridge and is susceptible to a progressive increase in *D. flexuosa* resulting in tussock expansion that shades out certain species and prevents the survival and colonization of light demanding species.

U1a and U1e are also particularly prone to bracken and gorse invasion.

It should be noted that survey was undertaken in March and April at which time some of the later flowering summer annuals may not have been visible, notably *Potentilla erecta*, *Ornithopus perpusillus*, *Erodium cicutarium* and *Erophila verna*. These are all either preferential, differential or associates of U1 grassland.

5.1.2 U2a *Deschampsia flexuosa* grassland: *Festuca ovina*-*Agrostis capillaris* sub community

Both constants were present, but *Calluna vulgaris* was present at a much lower constancy than would be expected and was only actually recorded in the area around British Camp to Hangman's Hill.

The lack of this species elsewhere may have been as a result of historic overgrazing with its re-colonisation hindered by dense, rank swards. Elsewhere *D. flexuosa* dominated, its marked increase in cover could be attributed to the lack of grazing with the plants spreading vegetatively to form larger plants and producing a closer sward. Humus produced by *D. flexuosa* contributes to the inhibitory effect and to the survival or colonization of other plant species. The overall effect of this increase in *D. flexuosa* is to reduce the amount of bare soil and to shade out low growing, light demanding species.

As a result of long term cessation of grazing the majority of U2a grassland recorded was low in species diversity with the exception of areas from British Camp to Hangman's Hill. 18 of the 21 preferential species were recorded with

Galium saxatile, *Festuca ovina*, *Agrostis capillaris* and *Dicranum scoparium* all at much higher constancies than would be expected for the community. *Potentilla erecta* was absent from the test data, but this may be due to the time of survey.

Arrhenatherum elatius was recorded in the test data at a constancy of II when it is absent in the diagnostic data for this community. This possibly reflects the succession of the community to ranker, bracken or scrub habitat as these tended to be recorded as adjoining habitats during survey. The coefficient of similarity is low and the community fits into U20b with more ease which again suggests that it may be in transition.

5.1.3 U4a *Festuca-Agrostis-Galium* grassland: typical sub community

Four of the five constants were recorded with *Anthoxanthum odoratum* at a lower constancy than would be expected. *Potentilla erecta* is a constant for this community, but was not recorded although this may be due to the timing of the survey in March/April.

Cladonia portentosa, *Rumex acetosella*, *Ceratodon purpureus* and *Polytrichum piliferum* are species that are not present in the NVC diagnostic table for this community although they were recorded at constancies of II or above in the sample data. This may have been due to localised rock outcrops within the U4a community where the vegetation tended towards a U1 grassland community. These areas were generally associated with paths and constant trampling restricted the growth and expansion of sub-shrubs such as *Calluna vulgaris*.

Grazing is a major factor in preventing the reversion of *Festuca-Agrostis-Galium* grassland from reverting to woodland communities. The cessation of grazing on the hills has been attributed to the loss of U4a grassland that was thought to have covered much of the hills (Davies 1994) and the increase in ranker, *Deschampsia* grassland although there is no survey data on which this can be based. The high constancy of *D. flexuosa* in the *Festuca-Agrostis-Galium* sward suggests that there may be a tendency for this succession on the Malvern Hills.

5.1.4 U4b *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland: *Holcus lanatus-Trifolium repens* sub community

Only two areas of U4b grassland were recorded in the survey totaling 0.78ha giving this little scope for a large sample base. Only 3 of the 5 constants were recorded with *Potentilla erecta* absent from the sample data and *Galium saxatile* at a lower constancy than would be expected. 11 of the 14 preferentials was recorded. *Arrhenatherum elatius* and *Hyacinthoides nonscripta* were recorded in the sample data and do not appear in the diagnostic data. Their presence is most probably due to the proximity of ranker grassland/scrub vegetation in both cases.

5.1.5 H8e *Calluna-Ulex gallii* heath: *Vaccinium myrtillus* sub community

This community was only recorded on Worcestershire Beacon and on a small headland adjacent to British Camp Reservoir. In each location they have very different compositions with two of the constants absent in each location. On Worcestershire Beacon the vegetation is dominated by *Vaccinium myrtillus* with the constants *Calluna vulgaris* and *Erica cinerea* absent. There is a close association with this heath community and *Deschampsia grassland* that surrounds it. *V. myrtillus* is frequent within the grassland in this area, but does not achieve the dominance that it does in the areas mapped as heath.

On British Camp this community is dominated by *Calluna vulgaris* with the constants *Erica cinerea* and *Vaccinium myrtillus* absent. Both communities key out to H8e and have been entered into MATCH together which may explain some of the anomalies with the constants. *Pteridium aquilinum* occurs at a higher quantitative value than would be expected, but both samples appear to be under threat from encroaching bracken communities.

5.1.6 Scrub and Bracken communities

Bracken and scrub habitats account for the remainder of the NVC communities recorded during survey and together with woodland cover the remainder of the ground surveyed.

Quadrats were used for initial characterization of these communities, but thereafter mapping proceeded on a visual basis and quadrats were only used to characterize difficult stands as requested in the project objectives. This method of survey did not generate enough quadrat data to analyse using MATCH, but observations on the community floristics were made on a visual level based on the community cards produced.

A common feature throughout all these communities is the mosaic that they form with *Deschampsia flexuosa* grassland where it is limited to the path edges and areas where woody species and bracken have not yet got hold in the rank sward. Throughout all the bracken and scrub communities there is a strong floristic continuity among the various vegetation types with *D. flexuosa* running on under the more open canopies of bracken, sub shrubs and trees together with herbs such as *G. saxatile*. Such comparisons between these communities suggest that bracken and scrub communities are in the process of encroaching on the grassland sward.

5.1.7 U20a *Pteridium aquilinum-Galium saxatile: Anthoxanthum odoratum* sub-community

It is probable that the bracken community is encroaching into these areas of *Deschampsia* grassland although there is no previous survey data to base this on.

Elsewhere the bracken community appeared more established with extensive bramble, rosebay willow herb and shrubs.

3 of the 4 constants were recorded in this community with *Potentilla erecta* absent, but as with earlier communities this was attributed to the early survey dates. The Bracken stand contained a species assemblage characteristic of U2 grassland and occasionally formed a mosaic with areas of this grassland on its uphill boundaries. Zonations with grassland communities are gradual where the surrounding grassland has not yet been invaded. It is also found in close association with W25 scrub and the boundaries were frequently indefinable.

5.1.8 U20b *Pteridium aquilinum-Galium saxatile: Vaccinium myrtillus-Dicranum scorium* sub-community

This was only recorded in one location on British Camp where 3 of the 4 constants were recorded as discussed in U20a. The presence of *Calluna vulgaris* provided a heath appearance and numerous bryophytes and lichens typify this community.

5.1.9 W23 *Ulex europaeus-Rubus fruticosus* scrub

This is found in mosaic with the bracken and *Deschampsia* communities particularly on the hills between End Hill and Black Hill with associated species from both these communities frequent in the ground flora, particularly *Deschampsia flexuosa*.

3 of the 4 constants are present in this community with *Ulex europaeus* replacing *U. gallii* as the dominant gorse.

5.1.10 W25a *Pteridium aquilinum- Rubus fruticosus*

Rodwell suggests that the invasion of woody species is limited in this vegetation because of the dense canopy of the Bracken and so its progression to woodland is slow, but the abundance of saplings and young trees in the community suggests that this may not be the case on the Malvern Hills SSSI.

There is no reference in Rodwell to this community being a natural succession from the *Pteridium-Galium* community, but the results of previous Phase I surveys suggest that this may be occurring on the Malvern Hills.

5.1.11 W25a *Pteridium aquilinum- Rubus fruticosus: Hyacinthoides non-scripta* sub-community

This only occurs on Chase End Hill where the constants are present at the expected constancy and 8 of the 21 preferential species were recorded with particular note to the abundance of *Hyacinthoides non-scripta* throughout the

community and localised *Anemone nemorosa*. Such communities are generally associated with areas where woodland clearance has taken place.

5.1.12 W25b *Pteridium aquilinum*- *Rubus fruticosus*: *Teucrium scorodonia* sub-community

This covers large expanses throughout the survey area and is closely associated with woodland to the downhill side and *Pteridium-Galium* and *Ulex* communities to the sides and uphill, forming unclear boundaries. Where this extends to the ridge there is a definite cut off point to acidic grassland associated with the thin soils and pathways.

Both constants are present throughout with no marked vernal aspect to the vegetation although *H. non scripta* and *Digitalis purpurea* are locally frequent. *Chamerion angustifolium* is locally dominant though rarely to the exclusion of the bracken. *Quercus sp.*, *Betula pendula*, *Acer pseudoplatanus* and *Sorbus aucuparia* saplings and shrubs are locally frequent.

5.2 Comparisons with previous Phase I surveys

Four major habitat types dominate the site, woodland, bracken, grassland and scrub. A Phase I of the woodland and scrub carried out by Countryside Consultants, (A Study of the Woodland Boundaries within the Malvern Hills Site of Special Scientific Interest- April 2002) indicated that 356ha of the site was covered in woodland and scrub. This project surveyed acid grassland, bracken, light scrub, heath and mesotrophic grassland communities and the areas that they cover within the site boundary are given in Table 2

Table 2

Habitat	Area (ha)
Acid grassland	86
Heath	2
Mesotrophic grassland	1
Bracken dominated communities	218
Woodland and scrub	383

The table shows that woodland, scrub and bracken communities cover the a large area within the SSSI accounting for 87% of the site with grassland communities, including a small area of heath, covering only 13% of the total site area.

Woodland and scrub habitats are on the whole found at lower altitudes on the periphery of the SSSI although they extend to higher altitudes within the valleys,

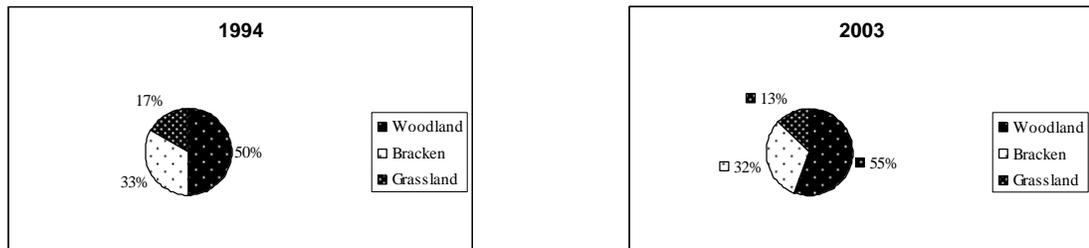
particularly on the eastern side and reach the ridge in several places between the Wyche cutting and Black Hill, south of Broad Down and on Midsummer and Ragged Stone Hills.

Species rich acidic grassland communities tend to be restricted to a narrow band along the ridge and paths. There are exceptions to this where larger expanses of acid grassland occur on the hills above Holy Well, British Camp and on the three southern hills, Midsummer Hill, Ragged Stone Hill and Chase End Hill. Ranker, acid grassland communities cover a more extensive area than species rich acid grassland, but only occur on the hills between End Hill and British Camp, on the slopes between the ridge and the Bracken and communities below.

Bracken communities cover an extensive area and are located between the woodland on the lower slopes and the acid grassland along the ridges.

Table 3 shows the difference in Phase I habitats between 1994 and 2003 comparing results from this survey with those of a Phase I survey undertaken by Davies (1994).

Table 3



There is an increase of 5% in the area of the SSSI covered in woodland and scrub between 1994 and 2003. Bracken cover remains the same and there is a fall in 4% of the amount of grassland remaining.

A comparison of Phase I habitat areas present on the Malvern Hill SSSI between 1994 and 2003 shows very little difference in the area covered in Bracken communities, but a small increase in woodland. This may be as a result of bracken communities becoming scrubby and falling into the woodland/scrub category and the geographical location of the bracken may have changed to the detriment of the acid grassland community which has decreased in area, although it is difficult to confirm this theory from the earlier survey.

It should be noted that 8ha of acidic grassland that accounts for 9% of the total area of acid grassland within the SSSI surveyed in 2003 located on the hills above Holy Well was bracken and scrub in 1994 before a fire in the following year.

There is a relatively small increase in the amount of bracken, scrub and woodland cover between the Phase I survey in 1994 and this definitive Phase II survey. In the absence of surveys before this date, the inference of grassland decrease on the Malvern Hills SSSI can be drawn from reference to photographs and paintings of the Malvern Hills before 1900 where there is visibly little tree cover on the hills and vast areas of what appears to be grassland.

Other indications of the increase of bracken and scrub at the expense of grassland communities can be seen from the species composition of the bracken and scrub communities which contain high quantities of species associated with adjacent grassland communities.

This suggests that the overall area of acid grassland elsewhere on the hills has reduced since 1994 although the similarity between the two sets of figures also suggests that much of the “scrubbing up” of the site had occurred by 1994.

5.3 Lowland grassland condition assessments

The condition assessments were carried out for the units as a whole with sampling taken over the entire area although in many cases this was mostly scrub. All units were found to be unfavourable and failed to pass the assessment as lowland grassland.

The classification for each unit was as follows:

- **Unfavourable improving** – Units 3, 17, 19 and 24. These units are all in the British Camp/Broad Down area. Scrub clearance and the recent introduction of grazing in this area should benefit the grassland communities. Unit 24 was the only unit to pass the assessment as lowland grassland on extent, but failed on species composition.
- **Unfavourable, no change** – Unit 1, End Hill to The Wyche Cutting. Some scrub clearance had taken place
- **Unfavourable declining** - Units 2, 4, 7, 8, 9, 20, 21, 22 and 23. This accounts for the majority of the Malvern Hills SSSI. There was no active management in these areas to limit the loss of grassland.
- **Partially destroyed** – Unit 20. There was a negligible amount of grassland here where it could potentially cover the majority of the unit.

If the survey had been carried out only on the grassland communities within the unit the results would show that they were in a favorable condition on all

mandatory attributes, but may have failed on none mandatory attributes particularly due to disturbance levels.

5.4 The areas susceptible to damage

The continued constriction of grassland areas throughout the SSSI has severe consequences for flora and invertebrate composition, but in addition there are more specific areas of potential damage to valuable acid grassland noted during survey work.

- Along the majority of the ridge from End Hill to Black Hill the high quality acid grassland is heavily eroded to bare soil and rock.
- U1a grassland on Chase End Hill has undergone some damage from horse riding and from what appears to be vehicle access on Ragged Stone Hill. Large amounts of moss and lichen have been disturbed on both sites.
- U1e grassland to from End Hill to the Wyche cutting contains large amounts of *Deschampsia flexuosa* and has a ranker appearance than where it is found further south on the hills.
- The presence of *Arrhenatherum elatius* within acid grassland swards particularly on Broad Down (community 83) and on the eastern flanks of Worcestershire Beacon (community 32) suggest that the cessation of grazing may be detrimental to the sward, although grazing has been re-introduced to the Broad Down area.
- Bracken and saplings growing within areas of *V. myrtillus* and *C. vulgaris* threaten these communities.
- The presence of bracken within the stands of communities 53, 54 and 55 threaten the extensive U1 grassland at this location.
- Rabbit warrens are damaging valuable U1 grassland on the ramparts of British Camp.
- H8e heath in community 81 is threatened by its isolation and is surrounded by trees with abundant bracken.
- Community 98 and localised parts of community 97 support a very rich grassland community beneath dense bracken. The long term presence of bracken over this are may be detrimental to the ground flora.

6.0 SUMMARY

Results from the survey indicate that the extent of acid grassland within the Malvern Hills SSSI is severely restricted to isolated fragments associated with thin soils, particularly along the ridges. Such small areas tend to produce swards with a limited species variety and a high number of non diagnostic species as the influences of adjacent habitats has an impact on them.

Long, thin areas of grassland along the ridges are also susceptible to erosion from heavy visitor usage, particularly when surrounding habitat are thick scrub resulting in large amounts of bare ground that further fragment the communities.

The largest expanses of species rich U1 grassland are associated with the southern hills, British Camp/Broad Down and the area above Holy Well where there is less trampling by visitors and an apparent increase in rabbit grazing. The area above Holy Well that was severely burnt in 1995 supports the largest area of species rich U1 grassland on the northern section of the hills.

U4 grassland is poorly represented on the site where it would possibly occupy a niche on the lower slopes that are heavily covered in bracken, scrub and rank *Deschampsia* grassland.

Bracken, Gorse, scrub and woodland account for 77% of the habitat cover on the site and its invasion is possibly the greatest threat to grassland within the SSSI.