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FINAL REPORT

This final report has been prepared by Carter Ecological Limited, with all reasonable skill, care and diligence within the terms of the Contract with the client.

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This report is confidential to the client and we accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report at their own risk.



1 INTRODUCTION

1.1 Purpose of the Report

This report provides information supporting vegetation mapping of grasslands in the Malvern Hills carried out to the standard of the National Vegetation Classification in summer 2006.

1.2 Project Brief

The aims of this project are set out in the project brief provided by the Malvern Hills Conservators in the document: Study of National Vegetation Classification Communities within Worcestershire Beacon Common (CL16), Central Hills Common (CL14), Malvern Common (CL17 and CL18), British Camp and Swinyard Common (CL12), Ragged Stone Common (CL11), Chase End Hill Common CL10 and Various in Bye Pasture.

The principle objective is to map the extent, location and distribution of grassland, scrub, bracken and other herbaceous-based communities and sub-communities using National Vegetation Classification (Phase 2) techniques, including collection of relevant quadrat data. Quadrat sampling is to be used for initial characterisation of communities, but thereafter mapping is to proceed on a visual basis. Woodland is excluded from detailed survey, except for scrub and woodland edge communities.

Survey work should be carried out between mid April and mid July 2006, in order to take account of spring ephemeral species in the early part of the survey. This is to be the second of a three-yearly survey (first completed in 2003) to inform monitoring of the management on the Malvern Hills and its five-yearly management plan.

1.3 Ecological Background

1.3.1 General

The 12 km ridge of the Malvern Hills is a prominent granite outcrop rising to over 400 m above sea level in an otherwise flat landscape near the border of Herefordshire and Worcestershire (from National Grid Reference SO 766472 in the north down to SO 758330 in the south). The hills and surrounding commons represent one of the largest areas of semi-natural habitat in the district, incorporating a mosaic of grassland, tall herb and woodland vegetation.



1.3.2

Designations

The hills are the focal point of the Malvern Hills Area of Outstanding Natural Beauty (AONB) and are themselves designated as a Site of Special Scientific Interest (SSSI). Amongst the numerous important habitats and species of the hills are three grassland types identified as Priority Habitats under the UK Biodiversity Action Plan and various Local Biodiversity Action Plan species and habitats.

The Malvern Hills SSSI is principally designated for its grassland and woodland habitats. Grassland on the hills is heavily influenced by the underlying, base-poor geology and a long history of traditional grazing. Much of the woodland on the site is semi-natural and of a type that is restricted to base-poor, dry soils.

1.3.3

Vegetation Types

The predominant vegetation types of the ridge are calcifugous (acidic) grasslands occurring on nutrient-poor, summer parched soils. They generally have a close-grazed sward dominated by the grasses *Agrostis capillaris* (Common Bent) and *Festuca ovina* (Sheep's-fescue), with smaller amounts of *Deschampsia flexuosa* (Wavy Hair-grass). They are typically open and support a range of diminutive annual species, many of which flower, set seed and die back before late spring or early summer. Amongst this group are several species of nationally restricted distribution, such as *Moenchia erecta* (Upright Chickweed). The ridge-top grasslands also support a range of lichen species, which form a prominent part of the sward in some of the less-trampled areas.

Elsewhere on the hills, deeper, more humus-rich soils support characteristic lowland calcifugous grasslands dominated by *Agrostis capillaris* (Common Bent), *Deschampsia flexuosa* (Wavy Hair-grass) and *Festuca ovina* (Sheep's-fescue). These grassland types are rare in a lowland setting, and may be relatively herb-rich. Small areas of slightly more base-rich soils occur through some parts of the middle hills. The grassland here supports a range of attractive herbs such as *Galium verum* (Lady's Bedstraw), *Thymus polytrichus* (Wild Thyme) and *Potentilla neumanniana* (Spring Cinquefoil), a species of nationally restricted distribution.

From the distant past, the grasslands of the Malvern Hills were maintained by low-input, high intensity sheep grazing overseen by those holding commoner's rights over the land. This kind of grazing has been in decline nationally and - until recently - on the Malvern Hills, threatening the rare habitats and species that they support.

Common land below the hills supports a mosaic of grassland, tall herb vegetation and scrub. Of particular note are the traditionally managed hay meadows, a UK Priority Habitat. They are dominated by a range of grass species including *Agrostis capillaris* (Common Bent) and *Cynosurus cristatus* (Crested Dog's-tail), but there is usually an almost equal cover of broad-leaved herbs. These include a large number of common



species and some species generally restricted to nutrient-poor, herb-rich mesotrophic grasslands such as *Silaum silaus* (Pepper-saxifrage).

The wide variety and large extent of semi-natural vegetation found on the Malvern Hills provides a home for many uncommon and protected species of wildlife. The hills have viable populations of uncommon butterfly species such as the nationally rare High Brown Fritillary (*Argynnis adippe*) and the regionally uncommon Grayling (*Hipparchia semele*). Woodland on the hills supports a range of breeding birds and numerous invertebrate species. In addition they are home to scarce mammal species such as the Dormouse (*Muscardinus avellanarius*) and Polecat (*Mustela putorius*).

The geology of the hills is scientifically important, as an excellent example of Precambrian basement, and a site for important petrological and geochemical studies. The geology of the hills has been a subject of academic study throughout the twentieth century, and in addition to important exposures of igneous geology there are good examples of sedimentary deposits yielding important stratigraphic fossil records.

1.3.4

Previous Studies

Floras

The flora of the Malvern Hills was first studied in detail by Edwin Lees. His *Botany of the Malvern Hills*, which ran to three editions (Lees 1843, 1852, 1868), is widely considered to be the classic example of a 19th Century Florula, and the Malvern Hills are also specifically discussed in his later county Flora *The Botany of Worcesterstershire* (Lees 1867). Other 19th or early 20th Century county floras for Herefordshire and Worcesterstershire cover the Malvern Hills (Amphlett & Rea 1909, Purchase & Ley 1889), but in the 20th Century these counties have been poorly served for up-to-date floras. Several recent checklists cover them (Whitehead 1976, Day 2001, Herefordshire Botanical Society 2001), but they do not contain special discussion of individual districts such as the Malvern Hills. An updatable compendium of notable plants on land owned by the Malvern Hills Conservators has been prepared by Barnett & Garner (2005).

Vegetation Surveys

So far as we are aware the first NVC survey of the Malvern Hills was conducted as part of a Masters degree thesis dealing primarily with management (Davies 1994). This excellent study was conducted at a time when the grassland section of the NVC had only recently been published (Rodwell 1992), and the ecological community at large had acquired only a few years of experience in applying the NVC.

A more detailed NVC study of the Malvern Hills was carried out over the period 2001 to 2002. This was supported by voluminous quadrat sampling and analysis, which is covered by summary in the report (Countryside Consultants 2003), but otherwise



available only as raw data held by the Malvern Hills Conservators. However - as in the present study - the main output of this survey was not the report, but rather a GIS map-and-database product in MapInfo.

Most NVC studies prior to about 2000 adopted a pigeon-holing approach. All vegetation samples were figuratively put into a box corresponding to an NVC type, and none were treated as transitional between NVC types; anomalous stands went into the box they fitted best, even if they did not fit well. To do this, heavy reliance was placed on computer programs such as MATCH (Malloch 1999). Possible criticisms of this approach notwithstanding, it has merits for the purpose of communicating the vegetation profile of a site, and producing inventories of vegetation types for use in nature conservation management plans. Increasingly, however, NVC studies are using a reference-point approach. Vegetation samples are placed in notional continua relative to NVC types as reference points, and though most samples are still pigeon-holed into NVC types, some are if necessary treated as transitional between NVC types, while anomalous stands are treated as non-NVC vegetation. This approach has been adopted in this study, whereas the pigeon-holing approach was strictly adhered to by Davies (1994) and Countryside Consultants (2003). As a result we have inevitably commented on differences between the previous studies and this study, usually in cases where the reference-point approach results in an improvement in understanding. We therefore stress at the outset that this should not be interpreted as individual criticism of the previous studies, both of which were competent and useful studies that conformed in their time to what was generally accepted as best-practice in a rapidly developing field of study.

1.4 ***Structure of the Report***

1.4.1 ***Terminology***

In this report, the ‘survey area’ means the whole of the area actually surveyed, while the ‘Malvern Hills district’ means the landscape holding the survey area (without regard to local government boundaries). The ‘Malvern Hills’ refers here to the hills themselves (excluding common lands and estates at their foot). The ‘ridge’ is almost the same, referring here to the orographic feature as a whole, while its sharp top is referred to here as the ‘crest’. The ‘Commons’ is used collectively to refer to the commons east of the ridge, and other areas are referred to individually by name. The following acronyms are used widely in this report, without further explanation.

- *NVC - National Vegetation Classification.* A phytosociological classification system that divides all mainland UK vegetation-types into a series of named and well-described ‘communities’ (roughly equivalent to the plant ‘associations’ of Continental phytosociology), so that - for example - the whole range of variation



in UK grasslands is covered by 48 communities, each with on average about three sub-communities, giving around 150 classificatory units.

- *GPS - Global Positioning System.* Hand-held electronic equipment that uses satellites to obtain a navigational fix on its current location, either in the form of grid co-ordinates or in the form of latitude and longitude.
- *GIS - Geographical Information System.* A computer program that links spatially-referenced data to a map-base on the one hand and a data-base on the other, and allows complex manipulations of the data for mapping and analytical purposes.

1.4.2 *Plant Nomenclature*

Scientific and English names of vascular plants follow Sell & Murrell (1996, 2006) for the Liliopsida and certain families in the Magnoliopsida (Campanulaceae, Rubiaceae, Caprifoliaceae, Adoxaceae and Asteraceae); and they follow Stace (1997) for all other families of vascular plants. The names of mosses follow Smith (2004) and the names of liverworts follow Paton (1999). The names of lichens follow Purvis *et al.* (1992). The names of NVC communities and sub-communities follow Rodwell (1991a, 1991b, 1992, 2000), and the names of syntaxa in the Continental system of phytosociology (classes, alliances, associations *etc.*) follow the NVC phytosociological conspectus in Rodwell *et al.* (2000).

1.4.3 *Layout*

This report is organized as follows.

- *Section 1* provides introductory material including an account of previous vegetation surveys and a summary of terminology used in this report.
- *Section 2* sets out the field methods used in surveys for spring ephemerals and NVC mapping, the analytical methods used in the diagnosis of NVC types, and the GIS methods used in handling the NVC mapping data.
- *Section 3* presents the results of the spring-ephemeral survey.
- *Section 4* describes and discusses the NVC types that were encountered, recognized and ultimately mapped.
- *Section 5* discusses aspects of management in relation to observations made during the course of the spring-ephemeral and NVC surveys.
- *Section 6* describes the results of the condition assessments.



- *Section 7* contains the references.
- *Section 8* is *Annex 1*, which contains the NVC tables.
- *Section 9* is *Annex 2*, which contains target notes from the spring ephemeral survey.
- *Section 10* is *Annex 3*, which gives the areas of vegetation types.
- *Section 11* is *Annex 4*, which gives the English Nature GIS standards for Phase 2 Habitat Survey.



2

METHODS

2.1

General

The methodology of the National Vegetation Classification (NVC) was used to describe the vegetation types present (Rodwell 1991a, 1991b, 1992, 2000; Rodwell *et al.* 2000). NVC types were largely identified on the basis of observation and experience. Quadrat sampling was not generally carried out where vegetation could trivially be assigned to appropriate NVC types by inspection alone. However, quadrat data were collected in some locations for the following reasons:

- to provide data supporting the interpretation of the main NVC types in the survey area; and
- to assist in identification of the more unusual or debatable NVC types.

2.2

Field Survey

2.2.1

Spring Ephemerals

Open calcifugous grasslands on thin, summer-parched soils typically support a spring-ephemeral assemblage that contributes significantly to floristic diversity, and often characterizes the NVC types. Grasslands of this general kind occupy the crest of the Malvern Hills, and spring ephemerals have long been recognized as an important element of the flora (Lees 1867, 1868). On the basis that they might flower and disappear from the scene before the main period of NVC survey, a study of spring ephemerals was undertaken in April and early May 2006. There were two main aims.

- To assess the spatial distribution and relative abundance of the common spring ephemerals in those parts of the survey area where they are an important feature of the vegetation, principally the Malvern Hills themselves (excluding the Commons and other outlying land parcels). This did not extend to searching out rarities.
- To assess the contribution of spring ephemerals to the principal NVC types of the Malvern Hills, lest this should prove difficult during the main period of NVC survey, with potential to cause poor understanding and mapping of those NVC types for which spring ephemerals are a diagnostic feature.

There was no intention to devote large resources to this (*Section 1.2*), but it was necessary to cover most of the survey area. The main approach was therefore to make target notes where spring ephemerals were encountered in a walkover survey of the hills. Quadrat data were obtained for the typical assemblages, and for some distinctive assemblages. The following kinds of data were therefore collected.



- Target notes describing as necessary:
 - the physical characteristics of places supporting spring ephemerals;
 - the physiognomy and dominant-species composition of vegetation containing spring ephemerals; and
 - characteristics of the spring-ephemeral assemblages themselves, often based on species-lists with subjective estimates of relative abundance.

- Quadrat data for places containing high concentrations of spring ephemerals. Dominant-scale estimates of cover were recorded for all species present in two-metre square quadrats pegged out with rope (or quadrats of other size and shape where vegetation stands were of irregular shape). Because spring ephemerals on the Malvern Hills tend to occur in small patches, it was not generally possible to collect a series of quadrats from homogeneous vegetation, and the spring-ephemeral quadrats were mostly single quadrats. Sets of five quadrats were, however, collected where spring ephemerals were more widespread. Spring ephemeral quadrat data is provided in an Excel spreadsheet in a separate Annex.

Target note locations were mapped, and in most cases also fixed by a reading from a hand-held GPS device - a Garmin Etrex - giving a ten-figure Nation Grid Reference, notionally fixing the target-note location to within one-metre, but in practice only claiming accuracy in most conditions to within 6 m (*Section 2.2.3*). These are shown in *Figure 1* in *Annex 5*.

Over 140 target locations were recorded in a more or less even scatter across the hills, and though they focus on places where spring ephemerals were present, they still provide a basis for dot-mapping the occurrence of spring-ephemeral species. The target notes are given in *Annex 2*, and full species lists for each target note are provided as an Excel spreadsheet in a separate Annex.

2.2.2

Field Sampling of NVC Types

During routine mapping, NVC types were identified visually. However, at the outset the grassland vegetation types were sampled to confirm that the surveyors were assigning them to NVC types correctly, and also to investigate difficult transitions between NVC types and unusual grassland stands.

Quadrat data were collected from two-metre square quadrats pegged out with rope. The location of these quadrats is shown in *Figure 3* in *Annex 5*. Five quadrats were recorded for each grassland type under investigation. Following recommendations in Rodwell (2006), the five quadrats in each set were so far as possible placed in homogeneous stands of grassland. In practice, there are gradients of variation between the grassland types of the Malvern Hills, and to sample homogeneous vegetation it was first necessary to form an opinion as to what constituted a vegetation type. This is



normal in NVC sampling, which is subjective. In other words, the sampling was carried out to confirm the NVC diagnosis of those grassland types that were perceived to be present. It was outside the remit of the study to probe gradients by random sampling and multivariate analysis.

Within each quadrat, the cover of the species present was estimated by eye and recorded using the Domin Scale (10 - over 90% cover, 9 - 76-90%, 8 - 51-75%, 7 - 34-50%, 6 - 26-33%, 5 - 11-25%, 4 - 5-10%, 3 - less than 5% abundant, 2 - less than 5% occasional, 1 - less than 5% rare).

2.2.3

Field-mapping

In open country such as the Malvern Hills, air photography provides a far more detailed and reliable mapping base than any conventional form of mapping. Colour photocopies of 1:1000 air photographs were therefore used as the map-base upon which to sketch vegetation boundaries during fieldwork. This approach was adopted after testing and rejecting alternatives, *e.g.* sketch mapping vegetation boundaries in compartments defined by the path network, which works well in small compartments where all of the vegetation can be taken in at a single view, but breaks down in larger compartments where the vegetation has to be viewed from several places, and perspective leads to conflicts in sketch-mapping produced from different viewpoints.

As a map-base, 1:1000 air photographs allow ample space for legible sketching and annotation under difficult field conditions. They also have the advantage that 1 cm represents 10 m, so that patches of vegetation can be paced out and mapped more accurately than would otherwise be possible. On the other hand, at this scale the map-base has to be printed on many sheets of paper, so that a large proportion of the field-mapping is confused by the necessity to work from one sheet to another.

To a large extent, vegetation boundaries can actually be seen on air photographs. This obviously makes the sketch-mapping of vegetation easier, but introduces the risk of over-reliance on the air photography. The air photographs available for this study were variously taken in 1990, 1995 and 1999, and therefore ranged from 7 to 16 years old. Reliance on the air photography for recognition of vegetation types and boundaries would therefore have been ill-founded. Vegetation looking like one thing, *e.g.* bracken, on the air photography might easily have changed into something else, *e.g.* willowherb, and the position of vegetation boundaries might easily have moved, even where patches of vegetation are unchanged in character. On the other hand, many features on the air photographs could - assuming reasonable circumspection - be relied on for sketch-mapping, especially the following:

- rock outcrops (though these were surprisingly hard to see on some air photographs) and quarries;
- roads, car parks and most paths (except for desire-lines on open hillsides);
- most buildings;



- most fences, power lines and pylons, and countryside furniture, *e.g.* park benches (just discernable on the images); and
- the larger extant trees, (because if trees were there in the field in 2006 then they must be on the air photography, though the converse is obviously not true).

These features are mostly abundant in the Malvern Hills, and most vegetation boundaries could therefore be sketch-mapped in the field with confidence. It was generally possible to see whether old vegetation patterns appearing in the air photography were still there in 2006 or not by reference to several more-or-less immutable features. Usually it seemed safe to assume that such patterns had changed little (boundaries moved by less than 6 m), and the fact that changes were detected in some places bolstered confidence that changes were not being missed elsewhere.

However, many vegetation boundaries could not be related to immutable features on the air photography. These boundaries were sketched onto the air-photographic map-base to the best ability of the surveyor, but this alone would have left uncertainties about whether they were correctly placed. So far as time and feasibility of access allowed, uncertainties were therefore removed by the use of GPS. Reference points on vegetation boundaries were recorded as GPS way-points, using a hand-held Garmin Etrex GPS device giving as its reading a ten-figure Nation Grid Reference, notionally fixing the way-point to within one-metre, though hand-held GPS devices are not really this accurate. However, GPS devices also indicate the accuracy of their readings according to the number of satellites in use. In most conditions, the device indicated accuracy to within 6 m, which is as accurate as a hand-held device can ever be, and in this study there was no occasion to make GPS readings when GPS accuracy was lower, *e.g.* in woods where the canopy obstructs clear views of the sky.

Time did not, however, allow for large numbers of GPS way-points to be recorded along the whole length of uncertain vegetation boundaries. Small numbers of way-points were instead recorded as a check on the sketch-mapping. For maximum effect these were generally recorded in the following kinds of places:

- points where vegetation boundaries crossed paths or other linear features;
- inflection points on the curves formed by vegetation boundaries; and
- occasional reference points on long straight boundaries devoid of landmarks.

There are many constraints on the effectiveness of sketch-mapping and on the recording of GPS way-points in the Malvern Hills. Mostly they relate to the steepness of the western and eastern slopes of the ridge, and to the prevalence of tall-herb vegetation (bracken and willowherb) interspersed with bramble. They may be summarized as follows.

- Some slopes are simply too steep to work on (unless there are paths), especially at the lower levels on the western side of the hills. Many more are covered in bracken, willowherb and bramble, making progress across them almost



impossible, or at least too time-consuming for survey purposes. A few areas such as some of the quarries cannot be accessed for safety reasons.

- It is hard to judge the distance to a vegetation boundary viewed from above or below on a steep slope, and this introduces error into sketch-mapping. For grassland boundaries the sketch-mapping of such boundaries was so far as possible supported by GPS data (including boundaries between grassland on the one hand and tall-herb, fern or scrub vegetation types on the other). But for boundaries between tall-herb, fern and scrub vegetation types, this was beyond the remit of the survey, and potential for inaccuracy should be taken into account in interpreting the mapping of such vegetation types and boundaries.
- Where small patches of grassland survive among bracken or other tall-herb vegetation, it is near-impossible to see them from above or below on steep slopes. Occasionally a slight hole can be discerned in the vegetation canopy, but it is impossible to see whether it contains vegetation that is unimportant in a grassland survey, *e.g.* slightly shorter bracken or bramble, or whether it contains grassland. More commonly the hole in the bracken canopy cannot be seen at all. Small patches of grassland up to about 15 m across could easily have been missed in this way. Where their existence was suspected from air photography, they were investigated if it was practicable to do so, *e.g.* on moderate slopes in bramble-free bracken on Broad Down, but in many cases it was not possible to make progress through difficult vegetation on steep slopes, or to do so would have involved disproportionate loss of time to investigate a merely suspected lacuna. Only up-to-date air photography could possibly overcome this problem.

Other mapping difficulties relate mainly to the identification of NVC types, which is discussed in *Section 2.3*.

2.3 *Diagnosis of NVC Types*

2.3.1 *Computer Analysis*

NVC types were identified by means of the NVC accounts (Rodwell 1991a, 1991b, 1992, 2000, Rodwell *et al.* 2000) and by means of computer-matching using the program MATCH (Malloch 1999).

The program MATCH computes coefficients of similarity¹ between quadrat data and standard tables of species-abundance data that define the NVC communities in Rodwell (1991a, 1991b, 1992, 1995, 2000). These ‘matching coefficients’ indicate possible NVC diagnoses (*i.e.* assignments to NVC communities) for the quadrat data,

¹ Czekanowski’s coefficient.



but they do not provide a firm or ‘correct’ identification. MATCH provides the 10 best matches, which then need to be carefully considered in relation to the NVC accounts in Rodwell (1991a, 1991b, 1992, 2000) to arrive at the best diagnosis; the highest coefficients produced by MATCH by no means always correspond to this.

Differences between the grassland NVC types **U1 *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland** and **U4 *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland** are relatively subtle. They largely share the same dominant species, and though some sub-communities have highly distinctive ‘character-species’, e.g. the Breckland sub-communities of U1, the typical sub-communities largely lack such species. In the Malvern Hills, the difficulty of deciding among the less distinctive sub-communities of U1 and U4 is exacerbated by the fact that most swards are more than usually species-poor (except for those with calcicolous tendencies or a high incidence of spring-ephemerals and lichens). When quadrat-data from these swards are entered into MATCH it often happens that the matching coefficients are low, usually in the range 35 to 45 indicating weak though usually interpretable matching with the NVC tables in Rodwell (1992). Often there are several NVC sub-communities with similar matching coefficients – more than five within 2% of one another is not unusual - so the case for accepting the NVC type with the highest matching coefficient as the correct NVC diagnosis is even weaker than it usually is. Even consideration of over- and under-represented species may only serve to give undue weight to marginal and confusing floristic differences. Thus, it is more than ever important to interpret MATCH output in relation to the NVC community and sub-community descriptions in Rodwell (1992).

In tables in *Annex 1*, acceptable NVC diagnoses are indicated by matching coefficients in bold text; unacceptable but informative diagnoses are indicated by matching coefficients in italics; and unacceptable diagnoses are in plain text.

2.3.2

Treatment of Transitions

In this study, we have assigned grassland stands to transitions between NVC types as well as to the types themselves. While this approach enhances the veracity of an NVC study, it has to be recognized that it may detract somewhat from its utility for the following reasons.

- The standard NVC types described in *British Plant Communities* are the currency of communication between ecologists, and references to transitions between NVC types convey information less readily than references to the types themselves.
- Simple statistics, e.g. total areas of vegetation types, are more difficult to extract and interpret if they are complicated by transitions between vegetation types.



We have therefore preferred to report discrete NVC types rather than transitions wherever possible; transitions have not been invoked gratuitously. Nevertheless, in our view large areas of vegetation in the Malvern Hills are best treated as transitions. Fortunately, they are mostly transitions towards NVC types that are either not represented at all, or to types that are only represented in small quantity as the end-point of a vegetation gradient, so that they cannot be separately mapped. In that case, the utility of an NVC output is little affected whether stands are assigned to a doubtfully present NVC type, *e.g.* U1a (which we have not mapped), or whether they are assigned to a transition, *e.g.* U1b to U1a (which we have mapped): it is one vegetation type regardless.

2.4 *GIS methods*

The GIS product uses the standard English Nature data model as published in their GIS standards for Phase II Habitat Surveys (*Annex 4*). This applies to the NVC vegetation data, the supporting quadrat data, and the spring ephemeral data including target notes.

The NVC compartments were digitised within MapInfo. The Mapinfo ‘check regions’ option was used to identify any errors in digitizing, *e.g.* gaps, self insertions and overlaps. This made sure that the data was ‘clean’ and met the requirements of the English Nature GIS standards for Phase II Habitat Surveys, and more generally for the provision of a searchable GIS database.

Many vegetation types were recorded in the NVC survey including transitions and mosaics. It was not possible to represent all of these by means of colour coding in hard-copy maps. For the purposes of hard-copy mapping, closely related vegetation types were therefore grouped together into 18 categories to which simple colour codes could be assigned in *Figure 4* in *Annex 5*. The groupings are indicated in *Table 2.1*. Transitions and mosaics were mapped as the first NVC code appearing in the GIS database, so U1b-U2a is mapped as U1b, and U4b (50%) + OV27b (50%) is mapped as U4b. In *Figure 4* some colour-blocks have compartment boundaries within them, and this always implies that similar but different vegetation types have been grouped together. The full and detailed information is of course searchable in the GIS product.

GPS readings were taken for quadrat locations in the field. These were entered into the GIS database, and point objects were created for each GPS point. Hard-copy mapping of quadrat locations was produced at 1:10000 scale (*Figure 3* in *Annex 5*).

GPS readings were taken for the locations of spring-ephemeral target notes. These were entered into the GIS database, and point objects were created for each GPS point. The target locations were mapped at 1:10000 scale (*Figure 1* in *Annex 5*). Six spring-



ephemeral species were queried out in the GIS, and dot-maps were produced for them on the basis of target-note locations where they were present.

Table 2.1. Grouping of vegetation types for hard-copy mapping in Figure 4.

Legend Code	Encompassed Types
CG10a	CG10a,
U1b	U1b, U1u, Cleared Type 2, U1b open var.
U1b lichen variant	U1b lichen variant
U2	U2a, U2b, Cleared Type 3
U4a	U4a
U4b	U4b, U4u, Cleared Type 1,
MG1	MG1a, MG1a <i>Chamerion</i> var., MG1b
MG5	MG5u, MG5a, MG5b
MG6	MG6u, MG6a, MG6b
MG10	MG10a, MG10b
U20	U20a, U20b, U20c
W25	W25u, W25a, W25b
W23	W23u, W23a, W23b, W23c
Vaccinium	Pure stands of <i>Vaccinium myrtillus</i> (Bilberry)
Wood	All woodland not assigned to an NVC type
W16, W21, W24	Woodland and scrub assigned to an NVC type
OV21, OV23, MG7	Eutrophic and amenity grassland types
OV24, OV25, OV26, OV27 and S12a	Tall herb vegetation
Not Assessed	Prohibited access areas, hardstanding, roads, footpaths and buildings, open water and quarries

2.5

Condition Assessment

Condition assessments were made of 12 units within the Malvern Hills Site of Special Scientific Interest (SSSI) identified as lowland acid grassland. They were conducted in accordance with guidance in English Nature (2000), and centre on pre-selected attributes such as species-composition and physical characteristics of grassland in the unit. Attributes are aspects of the habitat that provide ‘an indication of the condition of the interest feature to which it applies’ (English Nature 2000). A target is set for each attribute in the assessment, and the unit is assessed in relation to that target.

A unit is considered to be in ‘favourable’ condition if all mandatory attributes are within the range of acceptable values, and ‘unfavourable’ condition if it fails to meet one or more of the mandatory attributes. The dynamic sub-divisions of ‘recovering’ and ‘declining’ are estimated by comparison with previous surveys, aerial photography and observer experience of the site. Where an attribute has been lost so that it cannot be re-instated (*e.g.* through construction of a road over grassland) it is recorded as ‘partially destroyed’ or ‘totally destroyed’.

As far as possible, the assessment was made so as to be comparable with the 2003 condition assessment. This meant that the same recording protocols were used in 2006 as in 2003. In the 2003 assessment, all units were assessed under the category of



Lowland Acid Grassland; NVC types U1e, U3, U4a, U4c, U4/U20-related (species-rich bracken). These specific communities are lacking or are of limited extent in many of the units under assessment. Assessment of the units under Species-rich Parched Grassland; NVC types CG7a, CG7b, CG7c, CG7d, CG7e, U1b, U1c, U1d and U1f might have been more appropriate, but the original strategy was maintained to allow comparison of attributes between the surveys.

The units assessed were Units 1, 2, 4, 7, 8, 9, 17, 19, 20, 21, 22 and 23. This excludes the following two that were assessed in the 2003 survey:

- Unit 3 was assessed as Lowland Acid Grassland in 2003, and is more than 70% woodland cover, and so was not assessed.
- Unit 24 is not on the location maps provided, and so was not assessed.

Change in the extent of grassland within the units was assessed by comparing historical aerial photography with the results of the 2006 NVC survey. Direct comparisons of 2006 acreages with those given in the 2003 survey was not possible owing to lack of information on procedures used in the 2003 survey.



3 **SPRING EPHEMERALS**

3.1 **General**

3.1.1 *Flowering Time*

Spring ephemerals on the Malvern Hills turned out to be later-flowering and less evanescent than the term 'spring-ephemeral' might suggest. Such continuously-flowering weeds of eutrophic soils as *Capsella bursa-pastoris* (Shepherd's-purse), *Lamium purpureum* (Red Dead-nettle) and *Stellaria media* (Common Chickweed) have an early-spring peak, but leaving these aside, truly early-flowering species on the hills are few. By far the earliest is *Stellaria pallida* (Lesser Chickweed), flowering in March even in cold years. It is already difficult to determine from key-characters in April, though it remains easy enough to recognize by 'jizz' the yellow-green patches of weak stems growing in summer-parched places, rather than the disturbed or eutrophic places favoured by *Stellaria media* (Common Chickweed). Almost as early is *Erophila verna* (Common Whitlowgrass), which grows on the most inhospitable, stony substrates, mainly on paths and heavily eroded areas on the crest of the hills.

By the time the spring-ephemeral walkover survey was begun in early April, only a few species additional to these two were actually in flower. Among species that are widespread on the hills, *Cerastium glomeratum* (Sticky Mouse-ear) was generally in flower, as was the less widespread *Cerastium semidecandrum* (Little Mouse-ear), and the very local *Cerastium diffusum* (Sea Mouse-ear). On paths *Montia fontana* ssp. *chondrosperma* (Blinks) was in flower, and in a few places the first-formed capsules of the year were just sufficiently mature to allow critical determination from seed-coat characters. Other species such as *Moenchia erecta* (Upright Chickweed) and *Myosotis discolor* (Changing Forget-me-not) were just breaking bud in some places. Several such species were insufficiently advanced in flowering to allow determination at species level; for example, it was impossible to say whether *Aira* plants were *Aira caryophyllea* (Silver Hair-grass) or *Aira praecox* (Early Hair-grass), or whether *Aphanes* plants were *Aphanes arvensis* (Parsley-piert) or *Aphanes australis* (Slender Parsley-piert). Other species were not in flower at all, though they were recognizable from their foliage, e.g. *Ornithopus perpusillus* (Bird's-foot). And others again were so little in evidence that their presence was not even suspected, e.g. the annual grass *Vulpia bromoides* (Squirreltail Fescue), which turned out to be widespread and abundant by the time NVC surveys were in full swing in late May.

The greater part of the spring-ephemeral survey was carried out in late April, by which time the problem of late-flowering was generally receding, but there were a few anomalies. Spring ephemerals in the most exposed places on the highest summits were almost a month behind those in sheltered places a little lower down. Thus, for example, *Moenchia erecta* (Upright Chickweed) was flowering abundantly along the



relatively sheltered crest of Swinyard Hill in mid-April, when it was hardly to be found on the upper slopes of Herefordshire Beacon nearby (presumably it was missed in the vegetative state). But by the time the NVC survey was carried out in mid-May it was flowering abundantly on these upper slopes as well.

With the single exception of *Stellaria pallida* (Lesser Chickweed), the spring ephemerals were still in evidence, albeit in some cases as fruiting material, when NVC surveys were drawing to a close in mid- to late-June. A very few species were by then difficult to determine. It was not, for example, easy to distinguish *Cerastium diffusum* (Sea Mouse-ear) from *Cerastium semidecandrum* (Little Mouse-ear) other than by 'jizz', though both could be distinguished from *Cerastium glomeratum* (Sticky Mouse-ear). Neither was it possible to distinguish *Myosotis discolor* (Changing Forget-me-not) from *Myosotis ramosissima* (Early Forget-me-not). That would have been a problem in the NVC surveys if the spring-ephemeral survey had not been carried out, because plants might have been wrongly assigned to *Myosotis ramosissima* (Early Forget-me-not) as in previous surveys. As it was, only *Myosotis discolor* (Changing Forget-me-not) had been found despite extensive searching. On balance, an experienced botanist would probably miss fewer spring ephemerals on the Malvern Hills in an early June survey, when almost all species are extant even if well past their best, than he or she would miss in an early April survey when several key species are not fully in evidence, e.g. *Moenchia erecta* (Upright Chickweed).

3.1.2 *Habitats and Assemblages of the Spring Ephemerals*

Spring ephemerals are usually understood to be annuals that take advantage of the spring rains to complete their life-cycle before the onset of drying-out on thin, summer-parched soils. It might therefore be expected that their principal locus in the Malvern Hills would be the open vegetation of rocky outcrops on the crest. In fact this turned out to be by no means the best place to look for them.

A limited range of spring ephemerals do however occur in the open vegetation of rocky outcrops and trampled places on the crest, where species-poor swards are generally referable to the NVC type **U1b *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland, typical sub-community**. In this situation the grass *Aira praecox* (Early Hair-grass) is by far the most abundant of the spring ephemerals (often the only one). The crucifer *Erophila verna* (Common Whitlowgrass) is sometimes abundant, while several of the commoner spring ephemerals of the Malvern Hills are scattered at low levels of abundance, especially *Cerastium glomeratum* (Sticky Mouse-ear), *Poa annua* (Annual Meadow-grass) and *Veronica arvensis* (Wall Speedwell). These five species largely constitute the assemblage occurring in this situation. However, a few species that are uncommon in the Malvern Hills were seen only in this situation. In trampled areas, they included *Scleranthus annuus* (Annual Knawel) on Black Hill, Pinnacle Hill and a few other places, and *Spergularia rubra* (Sand Spurrey) rather generally; while on rocky outcrops they included *Arenaria*



serpyllifolia ssp. *serpyllifolia* (Thyme-leaved Sandwort) on Worcestershire Beacon, and *Teesdalia nudicaulis* (Shepherd's Cress) on the crest below Summer Hill.

The best assemblages of spring ephemerals tend to occur in species-rich and somewhat open calcifugous grassland, rich in mosses and lichens, and loosely referable to the NVC type **U1b *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland, typical sub-community** though having affinities with **U1a *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland, *Cornicularia aculeata*-*Cladonia arbuscula* sub-community**. These swards are probably open in late summer, but in spring the vegetation cover exceeds 90%. For some reason that we cannot explain, they mostly occur high up on the eastern side of the hills (on the western side bracken comes very close to the crest almost everywhere). On the eastern side they occur extensively on Chase End, Midsummer Hill and parts of Black Hill, and in narrow but long strips just off the crest-path on Swinyard Hill and Hangman's Hill (often on the eastern face of the Shire Ditch). Not dissimilar swards occur on the southern slopes of Millennium Hill and more locally on either side of the path descending on the southern side of Herefordshire Beacon; elsewhere they are scattered in small patches. Spring ephemerals in this situation are often concentrated around rabbit scrapes, where it is not uncommon to find ten spring-ephemeral species in a metre-square patch, but they also occur throughout the very warp-and-weft of the turf as well.

To a botanist's eye, the most striking species in this situation is *Moenchia erecta* (Upright Chickweed), which is unusually abundant on the Malvern Hills. Other species very consistently occurring in this assemblage are *Aira praecox* (Early Hair-grass), *Aphanes australis* (Slender Parsley-piert), *Cerastium glomeratum* (Sticky Mouse-ear), *Myosotis discolor* (Changing Forget-me-not), *Poa annua* (Annual Meadow-grass) and *Veronica arvensis* (Wall Speedwell). Also common are *Montia fontana* ssp. *chondrosperma* (Blinks), *Stellaria pallida* (Lesser Chickweed) and *Vulpia bromoides* (Squirreltail Fescue) - though the last is not in evidence in early spring - while in rabbit scrapes it is common to find species characteristic of more eutrophic soils, especially *Senecio vulgaris* (Groundsel) and *Stellaria media* (Common Chickweed). Around Clutter's Cave, a similar assemblage in open swards on slightly base-rich rocks is somewhat anomalously distinguished by the calcifugous species *Filago minima* (Small Cudweed). In a few places *Cerastium semidecandrum* (Little Mouse-ear) occurs in this situation, though it mainly occurs in similar but less species-rich spring-ephemeral assemblages on Herefordshire Beacon. Again a similar assemblage occurs on ant-hills, though on any one ant-hill it is necessarily depleted owing to sheer lack of space. Also commoner on ant-hills than elsewhere are the crucifers *Arabidopsis thaliana* (Thale Cress) and *Cardamine hirsuta* (Hairy Bitter-cress) and the grass *Aira caryophyllea* (Silver Hair-grass).

Large assemblages of spring ephemerals also occur on grassy paths - not the highly eroded paths of the crest described above, but rather those on the flanks of the ridge, often on slopes completely dominated by bracken. Here spring ephemerals are a



feature of very short but usually more-or-less closed calcifugous turf referable to the NVC type **U1b *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland, typical sub-community** though often having affinities with **U1d *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland, *Anthoxanthum odoratum-Lotus corniculatus* sub-community**. Most species that occur in the moss- and lichen-rich swards described above also grow here, though there are usually fewer species in any one place. The annual grasses *Aira praecox* (Early Hair-grass), *Poa annua* (Annual Meadow-grass) and *Vulpia bromoides* (Squirreltail Fescue) are all common, while *Aphanes australis* (Slender Parsley-piert) is especially abundant and characteristic, even in the most heavily trampled turf. Also to be found in well-trampled turf are *Montia fontana* ssp. *chondrosperma* (Blinks) and *Moenchia erecta* (Upright Chickweed), while occasional species in less trampled but still very short swards are *Ornithopus perpusillus* (Bird's-foot) and *Trifolium micranthum* (Slender Trefoil); another *Trifolium* seen here only in a vegetative state may have been *Trifolium striatum* (Knotted Clover). At the sides of these paths *Cardamine hirsuta* (Hairy Bitter-cress), *Cerastium glomeratum* (Sticky Mouse-ear), *Geranium molle* (Dove's-foot Crane's-bill), *Myosotis discolor* (Changing Forget-me-not), *Senecio sylvaticus* (Heath Groundsel) and *Veronica arvensis* (Wall Speedwell) are all common.

Only towards car-parks on the lowest slopes do species typical of eutrophic soils, e.g. *Capsella bursa-pastoris* (Shepherd's-purse), *Stellaria media* (Common Chickweed), *Veronica hederifolia* (Ivy-leaved Speedwell), become common.

3.2 *Individual Species*

Information on individual spring-ephemeral species is given below. The distribution of some of the less common species is shown in *Figure 2* in *Annex 5*.

- *Aira caryophyllea* (Silver Hair-grass) is an occasional species on the Malvern Hills, though it occurs widely in a range of habitats. It is common nationally.
- *Aira praecox* (Early Hair-grass) is enormously abundant in the grasslands of the Malvern Hills, especially in the more open swards, though it is more abundant in **U1 *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland** swards than in **U2 *Deschampsia flexuosa* grassland** swards. It was present in 87 out of 118 locations where spring ephemerals were recorded (74%). It is common nationally.
- *Aphanes australis* (Slender Parsley-piert) is common throughout the hills in a range of habitats and vegetation types. It was present in 67 out of 118 locations where spring ephemerals were recorded (58%). It is common in calcifugous vegetation types nationally. Recent NVC surveys seem to have recorded it as the similar species *Aphanes arvensis* (Parsley-piert), which is less calcifugous. Many plants were therefore examined in an effort to find *A. arvensis*, but all were *A.*



australis. However, close inspection with a lens is required, and *A. arvensis* could have been overlooked in small quantity, though *A. australis* is much the more likely species in the calcifugous grasslands of the Malvern Hills.

- *Arabidopsis thaliana* (Thale Cress) is scattered in a range of habitats in the Malvern Hills. It is very common nationally.
- *Arenaria serpyllifolia* ssp. *serpyllifolia* (Thyme-leaved Sandwort) grows at the top of Worcestershire Beacon. It is common nationally, usually growing in summer-parched places on at least marginally calcicolous substrates, e.g. sand-dunes, Breckland sands, wall tops, and many post-industrial substrates; this probably accounts for its scarcity on the siliceous rocks of the Malvern Hills.
- *Capsella bursa-pastoris* (Shepherd's-purse) is common in eutrophic places on the lower slopes. It is very common nationally.
- *Cardamine hirsuta* (Hairy Bitter-cress) is scattered though not especially abundant on pathsides, extending to the lowest slopes and occurring commonly around car-parks. It is very common nationally.
- *Cerastium diffusum* (Sea Mouse-ear) is scattered on the northern ramparts of British Camp, and very scattered in short, open swards elsewhere in the Malvern Hills. It was present in 12 out of 118 locations where spring ephemerals were recorded (10%). It is common nationally, especially in coastal areas.
- *Cerastium glomeratum* (Sticky Mouse-ear) is common throughout the hills in a range of habitats and vegetation types. It was present in 52 out of 118 locations where spring ephemerals were recorded (45%). It is very common nationally.
- *Cerastium semidecandrum* (Little Mouse-ear) is locally common on Herefordshire Beacon and scattered in short, open swards elsewhere. It was present in 46 out of 118 locations where spring ephemerals were recorded (39%). It is common nationally.
- *Filago minima* (Small Cudweed) is scattered in open and usually markedly calcifugous swards, mainly in the southern hills. It is fairly common nationally.
- *Geranium molle* (Dove's-foot Crane's-bill) is scattered on path-sides and occasionally in the open spots in the more species-rich and calcicolous swards. It is very common nationally.
- *Moenchia erecta* (Upright Chickweed) is locally abundant in short swards from Summer Hill in the northern hills to Chase End in the south. It was present in 56



out of 118 locations where spring ephemerals were recorded (47%). In many places its mostly single-flowered stems around 3 to 5 cm tall are packed at densities of more than a thousand to the square metre, and in some it is common in patches extending across about 0.25 ha. It is uncommon and declining nationally, though it is insufficiently rare to have any nature conservation designation. It has long been noted as a speciality of the Malvern Hills (Lees 1867, 1868).

- *Montia fontana* (Blinks) is fairly common throughout the hills, mainly on paths and in lichen-rich calcifugous turf. It was present in 22 out of 118 locations where spring ephemerals were recorded (19%). The material we examined was *Montia fontana* ssp. *chondrosperma*, which appears from Barnett & Garner (2005) to be the commonest sub-species in the Malvern Hills. It is fairly common nationally. Barnett & Garner (2005) also give records of Ssp. *amporitana* and Ssp. *variabilis*, which were expertly determined by Dr S.M. Walters. We cannot claim to have examined sufficient material to say whether these sub-species are more common or less common than Ssp. *chondrosperma*.
- *Myosotis discolor* (Changing Forget-me-not) is common throughout the hills, except perhaps in the northernmost parts. It was present in 44 out of 118 locations where spring ephemerals were recorded (37%). It is widespread but not especially common nationally, being commoner in the west. It has long been noted as a common plant in the Malvern Hills (Lees 1867, 1868). Recent NVC surveys seem to have treated it as the similar *Myosotis ramosissima* (Early Forget-me-not), *i.e.* they record *M. ramosissima* as a common plant and make no mention of *M. discolor*. We therefore examined virtually all of the *Myosotis* plants we encountered in an effort to find *M. ramosissima* but they were all *M. discolor*. This was practicable because flower colour is diagnostic obviating the need for close inspection. We took account of the fact that *M. ramosissima* can sometimes be pale- or white-flowered (rather than its usual deep blue), but the yellowish flowers and ‘jizz’ of *M. discolor* at anthesis cannot easily be confused with such colour-forms of *M. ramosissima*. Barnett & Garner (2005) include *M. ramosissima* in a list of ‘other notable plants’ in the Malvern Hills. If this is based on reliable records (no authority is cited), then *M. ramosissima* must at least occur as a rarity, and we simply did not encounter it in this survey. But the common annual *Myosotis* in the Malvern Hills is definitely *M. discolor*.
- *Ornithopus perpusillus* (Bird’s-foot) is very scattered in short, close and usually markedly calcifugous swards throughout the hills. It is fairly common nationally.
- *Poa annua* (Annual Meadow-grass) is common on paths throughout the hills, especially in eutrophic places. It also occurs to a lesser extent in open swards, especially in rabbit scrapes. It is very common nationally.



- *Scleranthus annuus* (Annual Knawel) occurs on trampled and eroded paths on Black Hill, Pinnacle Hill, Swinyard Hill and a few other places. It is rather uncommon and declining nationally, though it is insufficiently rare to have any nature conservation designation.
- *Senecio sylvaticus* (Heath Groundsel) is widely scattered on the hills in a range of habitats and vegetation types including cleared scrub. It is common nationally.
- *Senecio vulgaris* (Groundsel) is common in eutrophic places on the lower slopes and in rabbit scrapes in the less calcifugous grassland. It is very common nationally.
- *Spergularia rubra* (Sand Spurrey) occurs on trampled and eroded paths throughout the hills. Often a biennial, and flowering in June to July, it is barely to be regarded as a spring ephemeral. It is fairly common nationally.
- *Stellaria media* (Common Chickweed) is common in eutrophic places on the lower slopes and in rabbit scrapes in the less calcifugous grassland. It is very common nationally.
- *Stellaria pallida* (Lesser Chickweed) occurs locally in species-rich, open swards rich in mosses and lichens, mainly in the southern hills. It sometimes prefers rabbit scrapes, where it can be confused with *Stellaria media* (Common Chickweed), but by April the dying shoots are obviously distinct from those of *Stellaria media* (Common Chickweed), which when in flower is easily distinguished by the presence of petals. It is not especially common nationally, though it is greatly under-recorded on account of its very early flowering.
- *Teesdalia nudicaulis* (Shepherd's Cress) was seen only in small quantity on the crest at Summer Hill. It is generally rather uncommon nationally, though very abundant in some places, *e.g.* the Brecklands.
- *Trifolium micranthum* (Slender Trefoil) is very scattered in close swards on paths, mainly in the southern hills. It is common nationally.
- *Veronica arvensis* (Wall Speedwell) is common throughout the hills in a range of habitats and vegetation types. It is very common nationally.
- *Veronica hederifolia* (Ivy-leaved Speedwell) is common in eutrophic and usually shady places on the lower slopes only. It is very common nationally.
- *Vulpia bromoides* (Squirreltail Fescue) is abundant in open grasslands throughout the hills. It is very common nationally.



Among spring-flowering grassland perennials, plants of *Taraxacum* Sect. *Erythrosperma* species were widely scattered in the southern hills, mostly in marginally calcicolous swards referable to the NVC types **CG10a *Festuca ovina-Agrostis capillaris-Thymus praecox* grassland, *Trifolium repens-Luzula campestris* sub-community** or transitions from CG10a to **U1 *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland**. It is very scattered elsewhere. The Nationally Scarce species *Potentilla neumanniana* (Spring Cinquefoil) seems to be confined to the area around Clutters Cave where it occurs on rocks south of the cave, and in turf below the path to the north-west where it occurs in relictual grassland among invading bushes.



4

NVC TYPES

4.1

Comparison with Previous Studies

The grasslands of the Malvern Hills belong predominantly to the calcifugous grassland series of the National Vegetation Classification, *i.e.* vegetation types coded 'U' in Rodwell (1992), especially on the upper slopes of the ridge. Previous NVC accounts of the Malvern Hills grasslands (*e.g.* Davies 1994, Countryside Consultants 2003) have assigned them almost exclusively to the calcifugous grassland series, save for miniscule amounts of a single heath sub-community and small amounts of a few mesotrophic grassland sub-communities on the lower slopes. While the predominance of the calcifugous grasslands could hardly be in dispute, in this study we have been more ready to recognize grasslands in other series, especially towards the edges of the range of variation in the calcifugous grasslands.

Because the Malvern Hills stand on the edge of the Welsh Marches and rise to a height of around 1400 feet, it has often been supposed that their vegetation should have an upland-fringe character, and that their grasslands in particular should range from lowland NVC types to upland-fringe types. Previous NVC accounts of the grasslands (*e.g.* Davies 1994, Countryside Consultants 2003) have accordingly recognized a range of calcifugous grasslands belonging to the lowland type **U1 *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland** and to the upland-fringe type **U4 *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland**, including the sub-community **U4a *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland**, **typical sub-community**, which is the common type in the upland fringes throughout the British Isles. This view of the matter was therefore initially adopted in this study, though it was ultimately considered doubtful.

Successive NVC accounts of the Malvern Hills also quote an early statement to the effect that the NVC type **U4 *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland** was the main grassland type prior to the encroachment of bracken, scrub and woodland. There is no reason to dispute this, since **U4b *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland**, ***Holcus lanatus-Trifolium repens* sub-community** stands on the transition from calcifugous grasslands to mesotrophic grasslands belonging to the lowland NVC type **MG6 *Lolium perenne-Cynosurus cristatus* grassland**. Away from the thin soils of the crest, U4b remains a widespread type of calcifugous grassland on the hills, albeit mostly in small and fragmentary patches around paths, roadsides, car-parks and glades on the lower slopes.

Floristic accounts of the Malvern Hills - going back as far as those of Lees (1867, 1868) - fail to suggest the presence of any marked upland element among the vascular plants; and a recent study (Gilbert 2000) remarks on the strongly lowland character of



the lichen assemblage, which even includes typically coastal species such as *Cladonia foliacea*. The lowland character of the flora might cause some reasonable scepticism about the supposed presence of upland-fringe NVC communities, though it is insufficient on its own to preclude it.

Previous NVC accounts of the Malvern Hills assigned grassland stands exclusively to one NVC sub-community or another, and not to transitions between NVC types. It is therefore likely that some doubtfully-present NVC types were reported on the basis of stands that might have been better treated as transitions between NVC types (because the NVC types most closely matching the stands would have been selected as correct diagnoses even if they were poor matches). In this study, there was no need to invoke some previously reported NVC types, first because the core calcifugous grasslands were assigned not only to discrete NVC types but also to transitions between them, and second because more NVC types were recognized towards the edges of the range of variation in the calcifugous grasslands, allowing new possibilities for transitional stands. In addition, there are in our view some types of calcifugous grassland on the Malvern Hills that are similar to described NVC types but distinct in some way or other, perhaps warranting recognition as new sub-communities or local variants of existing sub-communities. In particular, we have treated the following previously reported sub-communities as variants of other NVC types or transitions between types, or else we have accepted them with serious reservations (*Section 4.4.11*):

- **U1a *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland, *Cornicularia aculeata-Cladonia arbuscula* sub-community;**
- **U1d *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland, *Anthoxanthum odoratum-Lotus corniculatus* sub-community;**
- **U1e *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland, *Galium saxatile-Potentilla erecta* sub-community;** and
- **U4a *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland, typical sub-community.**

That does not necessarily mean there is absolutely no vegetation belonging to these sub-communities. They may well be present as the end-points of vegetation gradients, but most grassland that might be referred to them is in our view transitional to other NVC types, and the end-points assignable to them cannot usefully be mapped.

Previous NVC accounts of the Malvern Hills noted calcicolous tendencies in calcifugous grassland over an area south of Clutters Cave including Hangman's Hill. Davies (1994) noted that Rodwell (1992) described close relationships between U4 grasslands and **CG10 *Festuca ovina-Agrostis capillaris-Thymus praecox* grassland** grasslands in the calcicolous series of grassland NVC types, but she considered that CG10 is lacking from Hangman's Hill (and the rest of the Malvern Hills). In this study, we have confirmed the very local occurrence of swards that are closer to CG10 than anything else, and this has allowed reinterpretation of the NVC status of some of the gradients in the calcifugous swards.



4.2

The Range of NVC Types Recorded

The core calcifugous grasslands of the Malvern Hills comprise a more-or-less linear gradient from swards with slight calcicolous tendencies on the southern hills to markedly calcifugous swards transitional to bilberry heath on the northern hills. Most swards lying outside the centre-line of this gradient can be seen as simple offshoots from it, so that a map of the vegetational variation among these swards might approximate to a herring-bone. The main stages in the centre-line of this gradation can be summarized as follows.

- Swards on the transition from calcicolous grassland types to calcifugous grassland types, and loosely referable to the NVC type **CG10a *Festuca ovina-Agrostis capillaris-Thymus praecox* grassland, *Trifolium repens-Luzula campestris* sub-community**.
- Relatively species-rich calcifugous swards of the lowland type, usually rich in spring ephemerals and lichens, referable to the NVC type **U1b *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland, typical sub-community**, though having affinities with **U1a *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland, *Cornicularia aculeata-Cladonia arbuscula* sub-community**.
- Species-poor calcifugous swards of the lowland type referable to the NVC type **U1b *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland, typical sub-community**.
- Species-poor swards similar to the U1b swards with *Deschampsia flexuosa* at sufficient levels of abundance to make them referable to the NVC type **U2a *Deschampsia flexuosa* grassland, *Festuca ovina-Agrostis capillaris* sub-community**.
- Species-poor swards strongly dominated by *Deschampsia flexuosa* (Wavy Hair-grass) referable to the NVC type **U2a *Deschampsia flexuosa* grassland, *Festuca ovina-Agrostis capillaris* sub-community**, though having affinities with **U2b *Deschampsia flexuosa* grassland, *Vaccinium myrtillus* sub-community**.

Two grasses, viz. *Agrostis capillaris* (Common Bent) and *Festuca ovina* (Sheep's-fescue) and one forb, viz. *Galium saxatile* (Heath Bedstraw), are prominent in all of these NVC types, and in all but the last they are the obvious dominants in swards that really have few other dominants. So these grasslands are actually very similar to one another and the change from one NVC type to another commonly hinges on small changes in species-richness, the relative proportions of the dominants, and the presence or absence of a very few character species.



4.3 *Synopsis of NVC Types Mapped*

4.3.1 *Calcicolous Grasslands*

Only one calcicolous grassland type was mapped:

- **CG10a *Festuca ovina-Agrostis capillaris-Thymus praecox* grassland, *Trifolium repens-Luzula campestris* sub-community.**

4.3.2 *Calcifugous Grasslands*

The following calcifugous grassland types were mapped:

- **U1 *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland, lichen variant**, a non-standard NVC type defined in *Section 4.4*;
- **U1b *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland, typical sub-community**;
- **U1b *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland, typical sub-community, open variant**, a non-standard NVC type defined in *Section 4.4*;
- **U1 *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland, undifferentiated**, a standard NVC type, but requiring definition in *Section 4.4*;
- **U2a *Deschampsia flexuosa* grassland, *Festuca ovina-Agrostis capillaris* sub-community**;
- **U2a *Deschampsia flexuosa* grassland, *Festuca ovina-Agrostis capillaris* sub-community, open variant**, a non-standard NVC type defined in *Section 4.4*;
- **U2b *Deschampsia flexuosa* grassland, *Vaccinium myrtillus* sub-community**;
- and
- **U4b *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland, *Holcus lanatus-Trifolium repens* sub-community.**

In addition, **U4a *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland, typical sub-community** was mapped in one location, though we have reservations about the NVC diagnosis (*Section 4.4*).

It was not necessary to map transitions among U1 types or among U2 types, but the following transitions are more-or-less common, and were widely mapped:

- U1b and U1-undifferentiated on the one hand to U2a on the other;
- U1-undifferentiated to U4-undifferentiated, requiring definition in *Section 4.4*;
- U1b, U1-undifferentiated and U2a on the one hand to mesotrophic grassland communities including Mg1a, MG1a *Epilobium angustifolium* variant and OV23a on the other;
- U1b, U1-undifferentiated and U2a on the one hand to tall-herb and fern communities including OV27b, U20a, U20c and W25b on the other; and
- U1b, U1-undifferentiated and U2a on the one hand to scrub communities including W23 undifferentiated on the other.



Under the calcifugous grassland heading we also include three early-successional sward types - non-NVC types - that occur in areas recently cleared of trees or gorse:

- ***Agrostis capillaris* swards in tree clearances;**
- **U1-type swards in gorse clearances;** and
- **U2-type swards in gorse clearances.**

All these require definition in *Section 4.4*.

4.3.3

Heaths

No heath NVC types *per se* were mapped. Some vegetation in areas previously mapped as heath was mapped as:

- **U20b *Pteridium aquilinum-Galium saxatile* community, *Vaccinium myrtillus-Dicranum scoparium* sub-community.**

In addition, pure stands of *Vaccinium myrtillus* (Bilberry) were simply mapped as ***Vaccinium myrtillus* stands**, *i.e.* as a non-NVC vegetation type.

4.3.4

Mesotrophic Grasslands

The following mesotrophic grassland types were mapped:

- **MG1a *Arrhenatherum elatius* grassland, *Festuca rubra* sub-community;**
- **MG1a *Arrhenatherum elatius* grassland, *Festuca rubra* sub-community, *Epilobium angustifolium* variant;**
- **MG1a *Arrhenatherum elatius* grassland, *Festuca rubra* sub-community, *Centranthus ruber* variant**, a non-standard NVC type defined in *Section 4.4*;
- **MG1b *Arrhenatherum elatius* grassland, *Urtica dioica* sub-community;**
- **MG6a *Lolium perenne-Cynosurus cristatus* grassland, typical sub-community;**
- **MG10a *Holcus lanatus-Juncus effusus* rush-pasture, typical sub-community**
and
- **OV23a *Lolium perenne-Dactylis glomerata* community, typical sub-community.**

It was not necessary to map transitions among these mesotrophic grassland types, and transitions from calcifugous types to mesotrophic types are covered above. Additional mesotrophic grassland types confined to the Commons, and to road verges between Great Malvern and Rhydd are described in *Section 4.5*

4.3.5

Tall-herb and Fern Communities

The following tall-herb and fern communities were mapped:

- **OV27b *Epilobium angustifolium* community, *Urtica dioica-Cirsium arvense* sub-community;**
- **U20a *Pteridium aquilinum-Galium saxatile* community, *Anthoxanthum odoratum* sub-community;**
- **U20c *Pteridium aquilinum-Galium saxatile* community, species-poor sub-community;**



- **W25a *Pteridium aquilinum*-*Rubus fruticosus* underscrub, *Hyacinthoides non-scripta* sub-community;** and
- **W25b *Pteridium aquilinum*-*Rubus fruticosus* underscrub, *Teucrium scorodonia* sub-community.**

All possible transitions between these four types are common, though they are more often mapped as mosaics than as transitions *per se*. To distinguish between W25a and W25b it is necessary to see herbaceous species in the field layer close up. Bramble scrub was not the main interest, so it was seldom possible to walk through it to do this, and W25 vegetation was therefore often mapped as W25 undifferentiated (W25u).

4.3.6 *Scrub and Woodland Types*

These are largely outside the remit of the study, and most scrub and woodland on the lower slopes is simply mapped as woodland. The following scrub types occur in juxtaposition with grassland communities, and are therefore separately mapped:

- **W23 *Ulex europaeus*-*Rubus fruticosus* scrub, undifferentiated,** defined in Section 4.4; and
- **W24 *Rubus fruticosus*-*Holcus lanatus* underscrub, undifferentiated.**

In addition, stands of invasive *Betula pendula* (Silver Birch) are very loosely referable to the NVC type **W16a *Quercus* spp.-*Betula* spp.-*Deschampsia flexuosa* woodland, *Quercus robur* sub-community**, and they have been mapped separately from other woodland in places where they are invading grassland.

4.3.7 *Areas of Vegetation Types*

Areas of each vegetation type recorded (including transitions and mosaics) are given in Annex 3. Areas are also given for the vegetation groupings used in Figure 4 in Annex 5.

4.4 *Details of Individual NVC Types*

4.4.1 *CG10a *Festuca ovina*-*Agrostis capillaris*-*Thymus praecox* grassland, *Trifolium repens*-*Luzula campestris* sub-community*

On the lower slopes of some of the southern hills - including the slopes above the Midsummer Hill car park and glades in scrub below Clutter's Cave - there are species-rich swards dominated by *Agrostis capillaris* (Common Bent), *Festuca ovina* (Sheep's-fescue) and *Thymus polytrichus* (Wild Thyme) in association with a wide range of more-or-less mesic species including the graminoids *Carex caryophylla* (Spring-sedge) and *Luzula campestris* (Field Wood-rush) and the dicotyledonous herbs *Achillea millefolium* (Yarrow), *Campanula rotundifolia* (Harebell), *Cerastium fontanum* (Common Mouse-ear), *Galium verum* (Lady's Bedstraw), *Potentilla sterilis* (Barren Strawberry), *Rumex acetosa* (Common Sorrel), *Trifolium repens* (White Clover) and *Veronica officinalis* (Heath Speedwell). These species are mostly



common to several NVC types including **U4 *Festuca ovina*-*Agrostis capillaris*-*Galium saxatile* grassland** and **CG10 *Festuca ovina*-*Agrostis capillaris*-*Thymus praecox* grassland**. In addition, species typical of **U1 *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland** are abundant, especially the U1 constants *Aira praecox* (Early Hair-grass), *Pilosella officinarum* (Mouse-ear Hawkweed) and *Rumex acetosella* (Sheep's Sorrel); these are common to U1 and CG10 but not U4.

Previous studies (Davies 1994, Countryside Consultants 2003) assigned these swards to **U4a *Festuca ovina*-*Agrostis capillaris*-*Galium saxatile* grassland, typical sub-community**. Though the species composition is largely consistent with U4a, most of the species concerned are actually abundant both in U4a and **CG10a *Festuca ovina*-*Agrostis capillaris*-*Thymus praecox* grassland, *Trifolium repens*-*Luzula campestris* sub-community**. We have treated it as CG10a largely because the presence of the U1 associates (listed above) pushes the balance of a difficult diagnosis towards CG10a rather than U4a. Other considerations are the following:

- the very occasional presence of calcicolous species typical of CG10a, especially *Helianthemum nummularium* (Common Rock-rose);
- the presence of a few dicotyledonous herbs that occur in CG10a but not U4a, e.g. *Potentilla sterilis* (Barren Strawberry); and
- a high incidence of mosses, e.g. *Dicranum scoparium*, which is typical of CG10a.

It might well be objected that CG10a is typically an upland-fringe grassland type, but that applies to U4a as well. These swards do perhaps have very slight affinities with the lowland counterpart of CG10a, viz. **CG7 *Festuca ovina*-*Hieracium pilosella*-*Thymus praecox/pulegioides* grassland** but they lack many species characteristic of CG7, and could not possibly be placed there. These swards are best understood as CG10a lacking the more specifically upland-fringe elements. Quadrat data for this vegetation type are given in *Table 1* in *Annex 1*.

More distinctly calcicolous swards containing such species as *Leontodon hispidus* (Rough Hawkbit) and *Linum catharticum* (Fairy Flax) occur on spoil in some of the quarries. Since *Agrostis capillaris* (Common Bent), *Festuca ovina* (Sheep's-fescue) and *Thymus polytrichus* (Wild Thyme) are dominant, they remain loosely referable to CG10a, or at least they are too fragmentary to distinguish as anything else.

4.4.2

*Transitions from CG10a *Festuca ovina*-*Agrostis capillaris*-*Thymus praecox* grassland, *Trifolium repens*-*Luzula campestris* sub-community to U1b *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland, typical sub-community.*

On the eastern slopes of Hangman's Hill and around Clutter's Cave there are species-rich swards more-or-less similar to the CG10a swards described above, but with greater dominance of species characteristic of **U1 *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland**, especially *Agrostis capillaris* (Common Bent), *Festuca ovina* (Sheep's-fescue), *Pilosella officinarum* (Mouse-ear Hawkweed) and *Rumex acetosella* (Sheep's Sorrel). The presence of a very few calcicolous species including



Helianthemum nummularium (Common Rock-rose) and *Potentilla neumanniana* (Spring Cinquefoil) underlines the affinities with **CG10a *Festuca ovina*-*Agrostis capillaris*-*Thymus praecox* grassland, *Trifolium repens*-*Luzula campestris* sub-community** and the contrasts with **U4a *Festuca ovina*-*Agrostis capillaris*-*Galium saxatile* grassland, typical sub-community**. However, the dominance of the U1 constants suggests that these swards are best treated as transitional from CG10a to U1b. A peculiar feature is an abundance of the grass *Trisetum flavescens* (Yellow Oat-grass), which is not typical of any of the possible NVC communities. Quadrat data for this transition are given in *Tables 2, 3 and 4 in Annex 1*.

4.4.3

U1b Festuca ovina-*Agrostis capillaris*-*Rumex acetosella* grassland, typical sub-community, lichen-rich variant

Under this heading, we have included those relatively species-rich U1 swards that contain mosses and lichens at high levels of cover. They occur mainly on the southern hills, where there are large areas mostly on east-facing slopes on Chase End and Midsummer Hill, in a narrow strip just below the crest on Swinyard Hill, and – in the middle hills – in the same position south of Black Hill. They are local, fragmentary or transitional to other types on Ragged Stone, Hangman's Hill, Millennium Hill and elsewhere. Typically, overall vegetation cover exceeds 90%, but some bare ground is usually visible. They are dominated by the grasses *Agrostis capillaris* (Common Bent) and *Festuca ovina* (Sheep's-fescue) with collective cover of around 50%, while *Rumex acetosella* (Sheep's Sorrel) is often very abundant, and *Galium saxatile* (Heath Bedstraw) may be. Other perennial vascular associates are few; grasses such as *Anthoxanthum odoratum* (Sweet Vernal-grass) are usually lacking, though dicotyledonous herbs typical of more calcicolous swards, *e.g.* *Campanula rotundifolia* (Harebell), *Thymus polytrichus* (Wild Thyme) may be present in very small quantity. The distinguishing feature of these swards is high cover of fruticose, terricolous lichens, often approaching 50%. The principal species is *Cladonia rangiformis*, though *Cladonia cf. portentosa* may occur (not critically confirmed). Thallose species such as *Cladonia foliacea* are also abundant. Less abundant but characteristic is *Cornicularia aculeata*, and many additional species are scattered, *e.g.* *Cladonia chlorophaea*. Mosses are abundant, especially the acrocarps *Ceratodon purpureus*, *Dicranum scoparium*, *Polytrichum juniperinum* and *Polytrichum piliferum*, while among pleurocarps *Hypnum cf. lacunosum* and *Pseudoscleropodium purum* are common, but the more calcifugous *Pleurozium schreberi* is usually lacking. Less abundant but characteristic is the liverwort *Ptilidium ciliare*. These swards are usually rich in spring ephemerals among which *Stellaria pallida* (Lesser Chickweed) is characteristic, while *Aphanes australis* (Slender Parsley-piert), *Cerastium glomeratum* (Sticky Mouse-ear), *Montia fontana* (Blinks), *Myosotis discolor* (Changing Forget-me-not) and *Veronica arvensis* (Wall Speedwell) are every common, and *Cerastium semidecandrum* (Little Mouse-ear) is occasional.



Previous studies (Davies 1994, Countryside Consultants 2003) assigned these swards to **U1a *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland, *Cornicularia aculeata-Cladonia arbuscula* sub-community**. This species-poor sub-community of base-poor East Anglian sands is the most lichen-rich of the U1 sub-communities described by Rodwell (1992), and it is not surprising that computer matching suggests close affinities between these lichen-rich Malvern swards and U1a. Certainly, they agree with U1a in the wide range of mosses and lichens, and in the limited range of vascular plants among which *Festuca ovina* (Sheep's-fescue) tends to dominate. The bryophyte assemblage is particularly consonant with U1a, and the relatively uncommon *Ptilidium ciliare* is among species noted by Rodwell (1992). However, there are important differences between these lichen-rich Malvern Swards and U1a.

- According to Rodwell (1992), mosses and lichens commonly form the bulk of the cover in U1a, but this is not strictly true of these lichen-rich Malvern swards, where vascular plants are somewhat more significant both in cover and variety.
- Among the lichens, the community constant *Cladonia arbuscula* appears to be lacking (though lichens have not been critically examined), while *Cladonia rangiformis* is not recorded from U1a in Rodwell (1992).
- It is clear from the NVC table for U1 in Rodwell (1992) that spring ephemerals are entirely lacking from U1a – there is not a single one in the table - whereas these lichen-rich Malvern swards are especially rich in spring ephemerals.

There are accordingly distinctions between these lichen-rich Malvern swards and classic U1a. They might perhaps be regarded as transitional from **U1b *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland, typical sub-community** to U1a, but it is hard to imagine where classic U1a could occur in the district, and we have therefore treated these swards as a lichen-rich variant of U1b, which in the Malvern Hills seems in general to be sufficiently distinct for mapping. Quadrat data for this vegetation type are given in *Table 10* in *Annex 1*.

4.4.4

*U1b *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland, typical sub-community*

The short, calcifugous grassland of the crest is best assigned to the NVC type **U1b *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland, typical sub-community**. However, on the Malvern Hills the swards are distinctly species-poor examples of U1b judging from the description in Rodwell (1992). They are strongly dominated by the grasses *Agrostis capillaris* (Common Bent) and *Festuca rubra* (Red Fescue), and other perennial grasses commonly found in U1b are generally lacking, though *Anthoxanthum odoratum* (Sweet Vernal-grass) and *Holcus mollis* (Creeping Soft-grass) are occasionally present at very low levels of abundance. Among dicotyledonous herbs, the community constant *Rumex acetosella* (Sheep's Sorrel) is



invariably present and usually abundant, while *Galium saxatile* (Heath Bedstraw) is common, and *Pilosella officinarum* (Mouse-ear Hawkweed) is often present at low levels of abundance. Other perennial forbs typical of U1 are however generally lacking, e.g. *Lotus corniculatus* (Common Bird's-foot-trefoil), *Plantago lanceolata* (Ribwort Plantain), *Potentilla erecta* (Tormentil). Mosses and lichens are usually scattered throughout at moderate to low levels of abundance, seldom much exceeding 10% in cover. The mosses commonly include *Ceratodon purpureus*, *Dicranum scoparium*, *Hypnum cupressiforme*, *Hypnum* cf. *lacunosum*, *Pleurozium schreberi*, *Polytrichum juniperinum*, *Polytrichum piliferum*, *Pseudoscleropodium purum* and *Rhytidiadelphus squarrosus*, while the lichens commonly include *Cladonia* cf. *chlorophaea*, *Cladonia* cf. *floerkeana*, *Cladonia foliacea*, *Cladonia* cf. *furcata*, *Cladonia* cf. *portentosa*, *Cladonia rangiformis* and *Cornicularia aculeata*. Spring ephemerals are similarly scattered at moderate to low levels of abundance, especially the annual grasses *Aira praecox* (Early Hair-grass), *Poa annua* (Annual Meadow-grass) and *Vulpia bromoides* (Squirreltail Fescue), and also *Aphanes arvensis* (Parsley-piert), *Cerastium glomeratum* (Sticky Mouse-ear), *Myosotis discolor* (Changing Forget-me-not) and *Veronica arvensis* (Wall Speedwell). Quadrat data for this vegetation type are given in *Table 6* and *7* in *Annex 1*.

4.4.5 *U1b Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland, typical sub-community, open variant

Steep slopes where rabbit activity is high often have open U1 swards that are conspicuously species-poor, at least in respect of vascular plants including spring ephemerals. Here cover may be as low as 60%. The perennial grasses *Agrostis capillaris* (Common Bent) and *Festuca ovina* (Sheep's-fescue) are scattered at around 40% cover, and among dicotyledonous herbs *Rumex acetosella* (Sheep's Sorrel) is common, while the spring-ephemeral grass *Aira praecox* (Early Hair-grass) is often extremely abundant. But there are few other vascular plants. The moss *Polytrichum piliferum* often occurs at levels of cover approaching 30%, and the full range of mosses and lichens specified for U1b above are generally present in small quantity. These swards have affinities with the NVC type **U1a *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland, *Cornicularia aculeata-Cladonia arbuscula* sub-community**. They agree with U1a in the abundance of *Polytrichum piliferum* but differ in the abundance of *Aira praecox* (Early Hair-grass). But floristically they are nothing more than impoverished stands of the U1b swards described in *Section 4.4.4*; they contain exactly the same suite of species though fewer tend to occur in any one patch. They have accordingly been treated here as an open variant of U1b, which in the Malvern Hills seems in general to be sufficiently distinct for mapping. Quadrat data for this vegetation type are given in *Table 8* in *Annex 1*.



4.4.6 *U1 Festuca ovina-Agrostis capillaris-Rumex acetosella grassland, undifferentiated*

Under this heading, we have included closed U1 swards in which vascular plants make up most of the cover. Like other U1 swards in the Malvern Hills, they are usually dominated by *Agrostis capillaris* (Common Bent) and *Festuca ovina* (Sheep's-fescue) in association with *Rumex acetosella* (Sheep's Sorrel). However, other perennial grasses including *Anthoxanthum odoratum* (Sweet Vernal-grass), *Holcus lanatus* (Yorkshire-fog) and *Holcus mollis* (Creeping Soft-grass) may be scattered in small quantity, and in some places there is a small amount of *Deschampsia flexuosa* (Wavy Hair-grass) signalling the beginning of the transition towards **U2 *Deschampsia flexuosa* grassland**. Among dicotyledonous herbs *Galium saxatile* (Heath Bedstraw) is often abundant, and there may be small amounts of *Potentilla erecta* (Tormentil) though this is unusually scarce in the U1 grasslands of the Malvern Hills. There may be the odd individual of *Achillea millefolium* (Yarrow), *Campanula rotundifolia* (Harebell), *Lotus corniculatus* (Common Bird's-foot-trefoil), *Pilosella officinarum* (Mouse-ear Hawkweed) or *Thymus polytrichus* (Wild Thyme), but it is seldom that more than one of these occurs in any given patch. The pleurocarpous mosses *Hypnum* cf. *lacunosum*, *Pleurozium schreberi*, *Pseudoscleropodium purum* and *Rhytidiadelphus squarrosus* are common, and they may contribute significantly to cover, but acrocarpous mosses, lichens and spring ephemerals are scarce, though any of those specified for U1b above may occur. Quadrat data for this vegetation type are given in *Tables 12, 13 and 14 in Annex 1*.

Previous studies (Davies 1994, Countryside Consultants 2003) seem to have assigned these swards either to **U1e *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland, *Galium saxatile-Potentilla erecta* sub-community** or – if the more mesic grasses such as *Anthoxanthum odoratum* (Sweet Vernal-grass) are prominent - to **U4a *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland, typical sub-community**. For reasons discussed in *Section 4.1.1* we have not inclined towards U4a. And though some of swards included here may actually be U1e, most differ in lacking the sub-community constant *Potentilla erecta* (Tormentil), and in having at least some spring ephemerals, mosses and lichens, which are lacking from this sub-community according to Rodwell (1992). We have therefore treated them as U1-undifferentiated.

4.4.7 *Transitions from U1 Festuca ovina-Agrostis capillaris-Rumex acetosella grassland, undifferentiated to U4 Festuca ovina-Agrostis capillaris-Galium saxatile grassland, undifferentiated*

Where the more mesic grasses *Anthoxanthum odoratum* (Sweet Vernal-grass) and *Holcus mollis* (Creeping Soft-grass) are prominent in swards dominated by *Agrostis capillaris* (Common Bent) and *Festuca ovina* (Sheep's-fescue), and especially where mesic forbs such as *Cerastium fontanum* (Common Mouse-ear) are also prominent, some swards have been assigned to the transition from **U1 *Festuca ovina-Agrostis***



***capillaris-Rumex acetosella* grassland to U4 *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland.** These are essentially species-poor swards lacking any large complement of species characteristic of either community. Quadrat data for this vegetation type are given in *Table 16* in *Annex 1*.

4.4.8 *Transitions from U1b Festuca ovina-Agrostis capillaris-Rumex acetosella grassland, typical sub-community to U2a Deschampsia flexuosa grassland, Festuca ovina-Agrostis capillaris sub-community*

According to Rodwell (1992), it is towards the upland fringes that *Deschampsia flexuosa* (Wavy Hair-grass) becomes more frequent in U1 grasslands. It is not therefore surprising that *Deschampsia flexuosa* (Wavy Hair-grass) does feature in the U1 swards of the Malvern Hills, especially at the higher altitudes. In certain U1 sward-types - the U1b, U1b open variant, and U1 undifferentiated swards - the occurrence of *Deschampsia flexuosa* (Wavy Hair-grass) at low levels of abundance signals the beginning of the principal gradient in the calcifugous grasslands of the Malvern Hills - the transition towards **U2a *Deschampsia flexuosa* grassland, *Festuca ovina-Agrostis capillaris* sub-community**. As the U2 grasslands of the Malvern Hills are even less species-rich than the U1 grasslands, *Deschampsia flexuosa* (Wavy Hair-grass) is accompanied by few if any additional species as it increases in abundance along the U1 to U2a gradient, though in the southern hills a few transitional stands contain *Calluna vulgaris* (Heather). Some U1 associates drop out along the U1 to U2a gradient, especially *Pilosella officinarum* (Mouse-ear Hawkweed), but these are not present in all U1 stands anyway. So in many cases, the only indication of where a stand lies on the gradient is the abundance of *Deschampsia flexuosa* (Wavy Hair-grass). In general, we have assigned stands with *Deschampsia flexuosa* (Wavy Hair-grass) at cover of less than 10% to the U1 sub-communities; we have assigned stands with *Deschampsia flexuosa* (Wavy Hair-grass) at cover of 10% to 30% - and with the U1 constant *Rumex acetosella* (Sheep's Sorrel) clearly present - to the U1 to U2a transition; and we have assigned stands with *Deschampsia flexuosa* (Wavy Hair-grass) at cover in excess of 30% to U2a. Quadrat data for this vegetation type are given in *Tables 19, 20* and *21* in *Annex 1*.

4.4.9 *U2a Deschampsia flexuosa grassland, Festuca ovina-Agrostis capillaris sub-community*

Swards in which *Agrostis capillaris* (Common Bent) and *Festuca ovina* (Sheep's-fescue) occur with *Deschampsia flexuosa* (Wavy Hair-grass) at high levels of cover are referable to the NVC type **U2a *Deschampsia flexuosa* grassland, *Festuca ovina-Agrostis capillaris* sub-community**. In the Malvern Hills they occur widely on steep slopes on either side of the crest from Millenium Hill northwards. Most of the larger expanses of open grassland are U2a. Where *Agrostis capillaris* (Common Bent) and *Festuca ovina* (Sheep's-fescue) remain common the vascular-plant associates of the U1 swards on the crest are generally found in small quantity, especially *Rumex*



acetosella (Sheep's Sorrel). But here the sward is generally closed and spring ephemerals, acrocarpous mosses and lichens are scarce, while pleurocarpous mosses are relatively abundant, and the calcifugous *Pleurozium schreberi* sometimes achieves high cover. Towards the northern hills *Deschampsia flexuosa* (Wavy Hair-grass) often approaches 90% cover, and these swards are very species-poor. They probably occur on more humified soils, but this has not been checked. Quadrat data for this vegetation type are given in *Tables 22 and 23 in Annex 1*.

4.4.10 *U2b Deschampsia flexuosa* grassland, *Vaccinium myrtillus* sub-community

Species-poor swards strongly dominated by *Deschampsia flexuosa* (Wavy Hair-grass) with small amounts of *Vaccinium myrtillus* (Bilberry) occur very locally on the northern hills. They have been assigned to **U2b *Deschampsia flexuosa* grassland, *Vaccinium myrtillus* sub-community**, though the presence of *Vaccinium myrtillus* (Bilberry) is their only distinguishing feature on the Malvern Hills.

4.4.11 *U4a Festuca ovina-Agrostis capillaris-Galium saxatile* grassland, typical sub-community

On level ground on top of Hangman's Hill - and therefore presumably on deeper soils than those generally prevailing towards the crest on the Malvern Hills - there are relatively tall, closed, mesotrophic and species-rich swards in which the grasses *Anthoxanthum odoratum* (Sweet Vernal-grass) and *Holcus lanatus* (Yorkshire-fog) approach *Agrostis capillaris* (Common Bent) and *Festuca ovina* (Sheep's-fescue) in abundance, while pleurocarpous mosses have high cover, especially *Pleurozium schreberi*, *Pseudoscleropodium purum* and *Rhytidiadelphus squarrosus*. They also contain a wide range of forbs. The species composition is actually very similar to the **CG10a *Festuca ovina-Agrostis capillaris-Thymus praecox* grassland, *Trifolium repens-Luzula campestris* sub-community** swards and the CG10a to **U1b *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland, typical sub-community** transitions described in *Sections 4.4.1 and 4.4.2*, the principal difference being the greater cover of the broader-leaved grasses and the near absence of *Thymus polytrichus* (Wild Thyme). Quadrat data for this vegetation type are given in *Table 5 in Annex 1*.

Previous studies (Davies 1994, Countryside Consultants 2003) have assigned this grassland to **U4a *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland, typical sub-community**. As with other possible U4 swards in the Malvern Hills, the main objection is the presence of the U1 constants *Pilosella officinarum* (Mouse-ear Hawkweed) and *Rumex acetosella* (Sheep's Sorrel), but here on Hangman's Hill they are distinctly reduced in abundance. Moreover, spring ephemerals - another feature of U1 rather than U4 - are altogether lacking. The case for rejecting U4 is therefore weak, and we have mapped this stand as U4a. It should however be noted that the species that make it U4 are all shared with CG10a, and there is a case for regarding this grassland as the complex transition from the intermediate state between CG10a



and U1b on the one hand and **U4b *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland, *Holcus lanatus-Trifolium repens* sub-community** - the typical community of deeper soils on lower slopes in the Malvern Hills - on the other.

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

On deeper soils on the lower slopes - often in grassy areas around car-parks - swards dominated by *Agrostis capillaris* (Common Bent) with *Anthoxanthum odoratum* (Sweet Vernal-grass) and *Holcus lanatus* (Yorkshire-fog) and a wide range of grasses at lower levels of abundance are commonly referable to the NVC type **U4b *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland, *Holcus lanatus-Trifolium repens* sub-community**. They typically have a wide range of more-or-less mesic forbs including *Achillea millefolium* (Yarrow), *Cerastium fontanum* (Common Mouse-ear), *Conopodium majus* (Pignut), *Hypochaeris radicata* (Cat's-ear), *Lotus corniculatus* (Common Bird's-foot-trefoil), *Plantago lanceolata* (Ribwort Plantain), *Rumex acetosa* (Common Sorrel) *Stellaria graminea* (Lesser Stitchwort), *Trifolium repens* (White Clover) and *Veronica chamaedrys* (Germander Speedwell), but rather more calcifugous species such as *Galium saxatile* (Heath Bedstraw) and *Potentilla erecta* (Tormentil) are commonly present too. On trampled paths they may contain many species more typical of the U1 swards, especially spring ephemerals, and quadrat data given in *Table 19* are of this kind. In a very few places, relatively species-poor swards dominated by *Agrostis capillaris* (Common Bent) and *Holcus lanatus* (Yorkshire-fog) with *Hypochaeris radicata* (Cat's-ear) at high levels of abundance may perhaps be better referred to **U1f *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland, *Hypochaeris radicata* sub-community**, but the case for distinguishing this from the U4b swards is not strong. Quadrat data for this vegetation type are given in *Tables 24* and *25* in *Annex 1*.

4.4.13 *Grassy vegetation in clearances, type 1*

Where woodland or scrub has been recently cleared there are often near monocultures of either *Agrostis capillaris* (Common Bent) or *Rumex acetosella* (Sheep's Sorrel), or sometimes species-poor stands containing just these two species. The only frequent associate is *Digitalis purpurea* (Foxglove) - which can be locally abundant - while *Ceratocarpus claviculata* (Climbing Corydalis) can occasionally appear in this situation. In older clearances, invasive *Chamerion angustifolium* (Rosebay Willowherb) and *Rubus fruticosus* agg. (Bramble) may also be abundant. This vegetation cannot be assigned to any NVC type.

4.4.14 *Grassy vegetation in clearances, type 2*

Where gorse has been recently cleared in the middle hills there are often species-poor stands consisting of *Agrostis capillaris* (Common Bent), sometimes in association with any or all of the grasses *Anthoxanthum odoratum* (Sweet Vernal-grass), *Festuca*



ovina (Sheep's-fescue), *Festuca rubra* (Red Fescue), *Holcus lanatus* (Yorkshire-fog) or *Holcus mollis* (Creeping Soft-grass). Dicotyledonous herbs are generally few though *Ceratocarpus claviculata* (Climbing Corydalis), *Chamerion angustifolium* (Rosebay Willowherb), *Digitalis purpurea* (Foxglove), *Rumex acetosella* (Sheep's Sorrel) and *Teucrium scorodonia* (Wood Sage) may occur at low levels of abundance. Older clearances tend to have denser swards containing more of the grass species listed above, and may approach **U4b *Festuca ovina*-*Agrostis capillaris*-*Galium saxatile* grassland, *Holcus lanatus*-*Trifolium repens* sub-community** in character, but like many early-successional swards they are species-poor in the extreme and lack the structural complexity of genuine U4b. They have more in common with the derivative communities recognized by some Continental phytosociologists (Schaminée *et al.* 1995). This vegetation cannot be assigned to any NVC type.

4.4.15 *Grassy vegetation in clearances, type 3*

Where gorse has been recently cleared in the middle hills and northern hills there are often near monocultures of the grass *Deschampsia flexuosa* (Wavy Hair-grass), sometimes with a scatter of large dicotyledonous herbs including *Chamerion angustifolium* (Rosebay Willowherb), *Digitalis purpurea* (Foxglove) and *Teucrium scorodonia* (Wood Sage). Again there may be small amounts of re-sprouting *Ulex europaeus* (Gorse) and invasive *Rubus fruticosus* agg. (Bramble). This vegetation cannot be assigned to any NVC type.

4.4.16 *U20b *Pteridium aquilinum*-*Galium saxatile* community, *Vaccinium myrtillus*-*Dicranum scoparium* sub-community*

In a few places on the east-facing slopes below British Camp and above the reservoir there is grass-heath vegetation consisting of *Calluna vulgaris* (Heather) at a relatively low cover of up to about 30%, together with the grass *Deschampsia flexuosa* (Wavy Hair-grass) and an abundance of pleurocarpous mosses, especially *Pleurozium schreberi*. Previous studies (Davies 1994, Countryside Consultants 2003) assigned this vegetation to **H8e *Calluna vulgaris*-*Ulex gallii* heath, *Vaccinium myrtillus* sub-community**, but it is so species-poor that it could equally well be assigned to any of several communities in which the trio of dominants listed above are key species, including **U20b *Pteridium aquilinum*-*Galium saxatile* community, *Vaccinium myrtillus*-*Dicranum scoparium* sub-community** and **U2b *Deschampsia flexuosa* grassland, *Vaccinium myrtillus* sub-community**. In most cases a light to moderate cover of *Pteridium aquilinum* (Bracken) suggests that it is best assigned to **U20b *Pteridium aquilinum*-*Galium saxatile* community, *Vaccinium myrtillus*-*Dicranum scoparium* sub-community**. Only by sampling strictly in bracken-gaps could a case be made for interpreting it as a mosaic of H8e or U2b in a matrix of **U20c *Pteridium aquilinum*-*Galium saxatile* community, species-poor sub-community**. Quadrat data for this vegetation type are given in *Table 26 in Annex 1*.



4.4.17 *MG1a Arrhenatherum elatius grassland, Festuca rubra sub-community*

On road verges and around car-parks, dense and species-poor stands of mesotrophic grassland strongly dominated by *Arrhenatherum elatius* (False Oat-grass) are unambiguously referable to the NVC type **MG1a *Arrhenatherum elatius* grassland, *Festuca rubra* sub-community**. They commonly contain a scatter of the smaller grasses and forbs found in U4b.

4.4.18 *MG1a Arrhenatherum elatius grassland, Festuca rubra sub-community, Epilobium angustifolium variant*

On path sides in the middle hills especially, and to a lesser extent on the northern hills, there are very commonly species-poor strips of mesotrophic grassland strongly dominated by *Arrhenatherum elatius* (False Oat-grass) in association with *Chamerion angustifolium* (Rosebay Willowherb). They are unambiguously referable to the NVC type **MG1a *Arrhenatherum elatius* grassland, *Festuca rubra* sub-community, *Epilobium angustifolium* variant**. They commonly contain a scatter of the smaller grasses and forbs found in U2a. In some places this type of grassland occupies more extensive areas on west-facing slopes below the crest, perhaps where bracken or gorse clearance took place sufficiently long ago for the signs to be obscure. In this situation it tends, however, to form a confusing mosaic and transition with other tall-herb, bracken and scrub NVC types, especially **OV27b *Epilobium angustifolium* community, *Urtica dioica*-*Cirsium arvense* sub-community**.

4.4.19 *MG1a Arrhenatherum elatius grassland, Festuca rubra sub-community, Centranthus ruber variant*

In the several quarries, very sparse mesotrophic grassland - often with overall cover as low as 10% and seldom more than 30% - consists almost entirely of *Arrhenatherum elatius* (False Oat-grass) together with the naturalized species *Centranthus ruber* (Red Valerian). Though probably nothing more than **MG1a *Arrhenatherum elatius* grassland, *Festuca rubra* sub-community**, it is so obviously distinct in the context of a Malvern Hills grassland survey, that we have treated it as a variant. In Wych Hill cutting and in some of the quarries, much more species-rich assemblages centre on the same two species, but for safety reasons they have not been investigated.

4.4.20 *MG1b Arrhenatherum elatius grassland, Urtica dioica sub-community*

On roadsides and occasionally on path-sides (mostly in eutrophic places near to car-parks), mesotrophic swards dominated by *Arrhenatherum elatius* (False Oat-grass) and *Dactylis glomerata* (Cock's-foot) in association with tall semi-ruderal herbs such as *Rumex obtusifolius* (Broad-leaved Dock) and *Urtica dioica* (Common Nettle) are unambiguously referable to the NVC type **MG1b *Arrhenatherum elatius* grassland, *Urtica dioica* sub-community**, though transitions from MG1a to MG1b are common.



4.4.21 *MG6a Lolium perenne-Cynosurus cristatus grassland, typical sub-community*

In a very few places around car-parks and houses, less calcifugous swards dominated by *Agrostis capillaris* (Common Bent) and *Holcus lanatus* (Yorkshire-fog) with admixture of *Cynosurus cristatus* (Crested Dog's-tail) and *Lolium perenne* (Perennial Rye-grass) are referable to the NVC type **MG6a *Lolium perenne-Cynosurus cristatus grassland, typical sub-community***. In these swards the more calcifugous forbs of U4b are generally lacking, especially *Galium saxatile* (Heath Bedstraw) and *Potentilla erecta* (Tormentil). The MG6a stands almost always occur here in mosaic and transition with U4b and MG1a stands.

4.4.22 *MG10a Holcus lanatus-Juncus effusus rush-pasture, typical sub-community*

On the northern hills there are a few places where *Juncus effusus* (Soft-rush) occurs in association with increased amounts of *Holcus lanatus* (Yorkshire-fog) among the more typical swards of the hills. These swards are loosely referable to the NVC type **MG10a *Holcus lanatus-Juncus effusus rush-pasture, typical sub-community***.

4.4.23 *OV23a Lolium perenne-Dactylis glomerata community, typical sub-community*

In some places, *Lolium perenne* (Perennial Rye-grass) has been seeded onto paths to provide protection against erosion due to trampling. It tends to occur with trampling-resistant forbs such as *Plantago major* (Greater Plantain), *Taraxacum* sect. *Ruderalia* species (Dandelion) and *Trifolium repens* (White Clover), with *Poa annua* (Annual Meadow-grass) in bare spots. It is loosely referable to the NVC type **OV23a *Lolium perenne-Dactylis glomerata community, typical sub-community***, and grades into the more typical U1b swards. OV23a also occurs extensive on roadsides and around car-parks, often in narrow strips adjacent to the carriageway.

4.4.24 *OV27b Epilobium angustifolium community, Urtica dioica-Cirsium arvense sub-community*

Previous NVC surveys of the Malvern Hills (Davies 1994, Countryside Consultants 2003) note the presence of the tall, clonal herb *Chamerion angustifolium* (Rosebay Willowherb) in bracken and bramble vegetation - mostly **W25 *Pteridium aquilinum-Rubus fruticosus underscrub*** - but they suggest that it is seldom a major constituent. In this survey we found *Chamerion* to be commonly dominant with cover in excess of 90% over huge areas, mainly on the upper slopes where it often abuts calcifugous grassland on the crest. This divergence of opinion could indicate that *Chamerion* has spread since 2003, but this seems unlikely; more probably it is due to the fact that the 2003 survey was conducted in very early spring when dominant *Chamerion* is inconspicuous, and observers see instead the sparse under-storey of *Rubus fruticosus* agg. (Bramble) with emerging croziers of *Pteridium aquilinum* (Bracken), which appear well before the shoots of *Chamerion*.



Where *Chamerion angustifolium* (Rosebay Willowherb) grows in rough grassland dominated by *Arrhenatherum elatius* (False Oat-grass) we have referred it to the NVC type **MG1a *Arrhenatherum elatius* grassland, *Festuca rubra* sub-community, *Epilobium angustifolium* variant** as described above. This usually occurs in a strip one or two metres wide beside paths, and it commonly grades into far more extensive stands of tall-herb vegetation strongly dominated by *Chamerion*. Here the commonest associates of *Chamerion* are *Pteridium aquilinum* (Bracken) and *Rubus fruticosus* agg. (Bramble), but tall semi-ruderal herbs are commonly present in small quantity, especially *Cirsium arvense* (Creeping Thistle) and *Urtica dioica* (Common Nettle) and also *Heracleum sphondylium* (Hogweed). Together with small amounts of coarse grasses such as *Arrhenatherum elatius* (False Oat-grass) these fairly unequivocally place this vegetation in the NVC type **OV27b *Epilobium angustifolium* community, *Urtica dioica*-*Cirsium arvense* sub-community**, though the ruderal species are less prominent than they are in typical stands. This is the commonest OV27b sub-community on the Malvern Hills, and especially occupied large areas where trees have been thinned or cleared more than two years previously.

On the lower slopes *Chamerion angustifolium* (Rosebay Willowherb) sometimes occurs in mosaic and transition with bracken communities close to woodland edges, and here *Chamerion* stands with high incidence of the fern *Dryopteris dilatata* (Broad Buckler-fern) have affinities with **OV27c *Epilobium angustifolium* community, *Rubus fruticosus* agg.-*Dryopteris dilatata* sub-community**, but there are few if any good examples of this sub-community (the closest noted in this survey were on the northern slopes of Ragged Stone Hill). Similarly, where *Chamerion* occurs in areas from which *Ulex europaeus* (Gorse) has been partially cleared (especially on the Middle Hills) it often grows among species-poor stands of such grasses as *Agrostis capillaris* (Common Bent), *Deschampsia flexuosa* (Wavy Hair-grass), *Festuca ovina* (Sheep's-fescue), *Holcus lanatus* (Yorkshire-fog) and *Holcus mollis* (Creeping Soft-grass). This vegetation has unconvincing affinities with **OV27a *Epilobium angustifolium* community, *Holcus lanatus*-*Festuca ovina* sub-community**, but it is better regarded as a mere juxtaposition of early successional species (though well-structured OV27c might eventually develop).

As *Pteridium aquilinum* (Bracken) and *Rubus fruticosus* agg. (Bramble) increase in abundance relative to *Chamerion angustifolium* (Rosebay Willowherb), OV27b grades into various bracken and bramble communities described below. Typically it grades into **W25b *Pteridium aquilinum*-*Rubus fruticosus* underscrub, *Teucrium scorodonia* sub-community** down-slope, and **U20c *Pteridium aquilinum*-*Galium saxatile* community, species-poor sub-community** up-slope, but this is far from being a rule, and all these communities occur in mosaic and transition.



4.4.25 *W25a Pteridium aquilinum-Rubus fruticosus underscrub, Hyacinthoides non-scripta sub-community*

On the lower slopes close to woodland edges, vegetation in which *Pteridium aquilinum* (Bracken) and *Rubus fruticosus* agg. (Bramble) are co-dominant often has a vernal under-storey of *Hyacinthoides non-scripta* (Bluebell) and other woodland herbs, e.g. *Oxalis acetosella* (Wood-sorrel). This vegetation is referable to the NVC type **W25a *Pteridium aquilinum-Rubus fruticosus underscrub, Hyacinthoides non-scripta sub-community***.

4.4.26 *W25b Pteridium aquilinum-Rubus fruticosus underscrub, Teucrium scorodonia sub-community*

Where *Pteridium aquilinum* (Bracken) and *Rubus fruticosus* agg. (Bramble) are co-dominant away from wooded areas, *Hyacinthoides non-scripta* (Bluebell) is commonly lacking, and the vegetation is mostly referable to the NVC type **W25b *Pteridium aquilinum-Rubus fruticosus underscrub, Teucrium scorodonia sub-community***, especially where grasses such as *Agrostis capillaris* (Common Bent) and *Holcus lanatus* (Yorkshire-fog) and dicotyledonous herbs such as *Digitalis purpurea* (Foxglove) and *Teucrium scorodonia* (Wood Sage) are scattered as minor components of the vegetation.

4.4.27 *U20a Pteridium aquilinum-Galium saxatile community, Anthoxanthum odoratum sub-community*

Open stands of *Pteridium aquilinum* (Bracken) with a grass-dominated under-storey are locally referable to the NVC type **U20a *Pteridium aquilinum-Galium saxatile community, Anthoxanthum odoratum sub-community***. Here *Rubus fruticosus* agg. (Bramble) occurs as a constant, but only at low levels of cover. The grass dominants of calcifugous swards - *Agrostis capillaris* (Common Bent), *Deschampsia flexuosa* (Wavy Hair-grass) and *Festuca ovina* (Sheep's-fescue) are the main constituents of the field-layer, but they are often joined by other grasses such as *Anthoxanthum odoratum* (Sweet Vernal-grass), *Arrhenatherum elatius* (False Oat-grass) and *Holcus lanatus* (Yorkshire-fog) at low levels of abundance. Dicotyledonous herbs, especially *Digitalis purpurea* (Foxglove), *Galium saxatile* (Heath Bedstraw), *Hypochaeris radicata* (Cat's-ear) and *Potentilla erecta* (Tormentil) are somewhat more common than in the calcifugous grasslands. These stands mainly seem to occur where livestock have broken dense *Pteridium* canopies on the less steep slopes.

4.4.28 *U20c Pteridium aquilinum-Galium saxatile community, species-poor sub-community*

Stands strongly dominated by *Pteridium aquilinum* (Bracken) are common on the upper slopes, and they are referable to the NVC type **U20c *Pteridium aquilinum-Galium saxatile community, species-poor sub-community***. They commonly contain small amounts of *Rubus fruticosus* agg. (Bramble).



4.4.29 *W23 Ulex europaeus-Rubus fruticosus scrub and W24 Rubus fruticosus-Holcus lanatus underscrub*

Scrub dominated by either *Ulex europaeus* (Gorse) or *Rubus fruticosus* agg. (Bramble) tends to be species-poor and fragmentary. It has mostly been mapped as **W23 *Ulex europaeus-Rubus fruticosus scrub*** undifferentiated and **W24 *Rubus fruticosus-Holcus lanatus underscrub*** undifferentiated. W23 and W24 occur in mosaic and transition on the Malvern Hills.

4.5 ***Additional Grassland Types on The Commons***

4.5.1 *MG5a Cynosurus cristatus-Centaurea nigra grassland, Lathyrus pratensis sub-community*

At Rhydd Common species-rich mesotrophic grassland contains the grasses *Agrostis capillaris* (Common Bent), *Agrostis stolonifera* (Creeping Bent), *Alopecurus pratensis* (Meadow Foxtail), *Cynosurus cristatus* (Crested Dog's-tail), *Deschampsia cespitosa* (Tufted Hair-grass), *Dactylis glomerata* (Cock's-foot), *Festuca pratensis* (Meadow Fescue), *Holcus lanatus* (Yorkshire-fog) and *Hordeum secalinum* (Meadow Barley), together with a wide range of forbs including *Centaurea nigra* (Common Knapweed), *Genista tinctoria* ssp. *tinctoria* (Dyer's Greenweed), *Lotus corniculatus* (Common Bird's-foot-trefoil), *Potentilla reptans* (Creeping Cinquefoil), *Ranunculus acris* (Meadow Buttercup) and *Trifolium pratense* (Red Clover). In addition there are species typical of (though not confined to) wetter grasslands such as *Briza media* (Quaking-grass), *Silaum silaus* (Pepper-saxifrage) and *Vicia cracca* (Tufted Vetch). This grassland is clearly referable to the NVC type **MG5a *Cynosurus cristatus-Centaurea nigra grassland, Lathyrus pratensis sub-community***. Quadrat data from vegetation of this kind are given in *Table 28 in Annex 1*.

4.5.2 *MG5b Cynosurus cristatus-Centaurea nigra grassland, Galium verum sub-community*

In Compartment CL18 the road verges support mostly species-rich mesotrophic grassland dominated by a wide range of grasses including *Agrostis capillaris* (Common Bent), *Bromus hordeaceus* ssp. *hordeaceus* (Soft-brome), *Cynosurus cristatus* (Crested Dog's-tail), *Dactylis glomerata* (Cock's-foot), *Festuca rubra* (Red Fescue), *Holcus lanatus* (Yorkshire-fog) and *Lolium perenne* (Perennial Rye-grass), together with forbs, especially *Galium verum* (Lady's Bedstraw) and *Trifolium pratense* (Red Clover) and also *Centaurea nigra* (Common Knapweed), *Lotus corniculatus* (Common Bird's-foot-trefoil), *Plantago lanceolata* (Ribwort Plantain) and *Vicia sativa* ssp. *segetalis* (Common Vetch). The forbs account for more than 50% of the cover, and these swards are referable to the NVC type **MG5b *Cynosurus cristatus-Centaurea nigra grassland, Galium verum sub-community***. . Quadrat data from vegetation of this kind are given in *Table 29 in Annex 1*.



4.5.3

MG6a Lolium perenne-Cynosurus cristatus grassland, typical sub-community and MG6b Lolium perenne-Cynosurus cristatus grassland, Anthoxanthum odoratum sub-community

Swards similar to those described in *Section 4.5.3* with a reduced range and percentage cover of forbs are mostly referable to the NVC type **MG6b *Lolium perenne-Cynosurus cristatus* grassland, *Anthoxanthum odoratum* sub-community** which occurs in mosaic and transition with **MG5b *Cynosurus cristatus-Centaurea nigra* grassland, *Galium verum* sub-community**. Where the range of forbs is much reduced there are transitions from MG6b to **MG6a *Lolium perenne-Cynosurus cristatus* grassland, typical sub-community**. Quadrat data from vegetation of this kind are given in *Table 31* in *Annex 1*.



5 **MANAGEMENT**

5.1 **Preamble**

The effectiveness and suitability of current management prescriptions are assessed in this section, and recommendations for further management are made. Management recommendations in this section are based upon conclusions drawn from the following sources of information.

- Observations made whilst conducting NVC survey and mapping of the Malvern Hills, including signs of management and examples of unusual vegetation types.
- Information supplied by The Malvern Hills Conservators, including:
 - Aerial photography of The Malvern Hills taken in 1990, 1995 and 1999;
 - ‘NVC Phase 2 survey of grassland within the Malvern Hills SSSI’ (Countryside Consultants 2003); and
 - ‘The Malvern Hills SSSI: a feasibility study for the re-introduction of grazing’ (Davies 1994).
- Management plans and relevant historical documents including:
 - Management Plan for the land managed by The Malvern Hills Conservators 2000-2005 (Alma 1999);
 - SSSI citation and condition assessment for the Malvern Hills; and
 - Application to Defra for the use of temporary fencing on the Malvern Hills.

In this report, comment is only made on aspects of management arising from observations made as a result of the NVC survey of the hills. The NVC system is essentially a blunt tool for assessing the short-term impacts of grassland, scrub and woodland management. In particular, successful management to control or reduce the extent of scrub communities will often not lead to an immediate change in the NVC community of the treated area. Where such a change does occur, it is more likely that it will only be seen at the sub-community level.

The following sections go on to summarise the suitability and effectiveness of current management and to make recommendations for further management where this has the greatest chance of success. A particular focus is placed on management for the control of woodland and scrub invasion, but mention is also made of invasion by *Chamerion angustifolium* (Rosebay Willowherb) and degradation of some calcifugous grassland to more mesotrophic types.



5.2 **Bracken**

5.2.1 *General*

Dramatically little change was seen in the extent of bracken communities during the NVC survey when compared with aerial photographs and GPS waypoints. Most bracken fronts (the interface between dense bracken and adjacent grassland vegetation) have clearly remained unchanged over the last 7-16 years, *i.e.* the period when the aerial photographs were taken. This can clearly be seen by the presence of tiny details in the shape of the bracken fronts still present at the time of survey, and by the position of the fronts relative to GPS waypoints and landmarks such as footpaths. These ‘permanent’ bracken fronts are also readily identifiable on the ground, where a neat edge to the bracken comprises stout fronds arising from apparently mature rhizomes, with little or no transitional zone of shorter fronds grading into adjacent vegetation. This suggests that grazing is, in many places, effective at preventing the encroachment of *Pteridium aquilinum* (Bracken) into grassland swards.

Exceptions to this rule are sometimes evident on the ridge of the hills. Here, it may be seen that previously ‘stable’ bracken fronts have been consolidated in their detail and the cover of dense bracken has extended up the hill towards the ridge. This is often marked, as on the ridge at Swinyard Hill, by a wide transitional zone between dense bracken and open grassland referable to the NVC type **U20a *Pteridium aquilinum-Galium saxatile* community, *Anthoxanthum odoratum* sub-community**. The cover of *Pteridium aquilinum* (Bracken) in this zone may be as much as 90%, but it typically comprises small fronds indicating younger plants and hence more recent establishment.

5.2.2 *Effectiveness of Current Management*

The principal signs of successful *Pteridium aquilinum* (Bracken) management on the Malvern Hills are where grazing has led to the opening up of bracken communities, mainly on the middle hills. This can be seen over some large areas as, for example, below the main path that runs above British Camp Reservoir. Here, as in other places, management has not resulted in a change at the community level (*i.e.* **U20** or **W25**). It has been enough, however, to bring about a change from dense, species-poor scrub vegetation classified as **U20c *Pteridium aquilinum-Galium saxatile* community, species-poor sub-community**, to more open vegetation classified as **U20a *Pteridium aquilinum-Galium saxatile* community, *Anthoxanthum odoratum* sub-community**.

In such cases, the overall cover of *Pteridium aquilinum* (Bracken) may remain high, but there is a greater range of associated species such as *Agrostis capillaris* (Common Bent), *Deschampsia flexuosa* (Wavy Hair-grass) and *Festuca ovina* (Sheep’s-fescue) characteristic of typical Malvern Hills calcifugous grassland. These swards are, however, generally more rank and contain larger quantities of mesic species such as



Anthoxanthum odoratum (Sweet Vernal-grass) and *Holcus lanatus* (Yorkshire-fog) than in the true grassland swards. They tend to form a mosaic of open *Pteridium aquilinum* (Bracken) dominated vegetation with open grassland.

This effect is most positive on the middle hills, where soils are thin and breaking-up of *Pteridium aquilinum* (Bracken) cover leads to the development of mosaics with calcifugous grassland referable to the NVC communities **U1** and **U4**. On the northern hills, where the dominance of *Pteridium aquilinum* (Bracken) is reduced the results are less positive. Possibly due to the deeper, more humus-rich soils here, where leaf litter build-up has led to increased nutrient levels, the resulting gaps tend to be colonised by mesophytic grass species such as *Arrhenatherum elatius* (False Oat-grass) and *Holcus mollis* (Creeping Soft-grass). Only around rocky outcrops where there are parched soils suitable for the development of **U1 grassland** is opening-up of *Pteridium aquilinum* (Bracken) scrub successful in expanding the total area of calcifugous grassland on the northern hills.

It is evident that current management is not able to prevent the encroachment of *Pteridium aquilinum* (Bracken) up the slopes towards some of the exposed ridges. In this situation both grazing and amenity use may be the controlling factors. For example there are secondary paths and desire lines just below the ridge that appear to be less well-used than in the past, as they are increasingly obstructed by dense *Pteridium aquilinum* (Bracken). This in turn has the effect of concentrating use on the main paths on the ridges, leading to the degradation of open grassland there, and an increase in the area of bare soil and rock.

Observations during the NVC survey in 2006 suggest that initial clearance of *Pteridium aquilinum* (Bracken), either through mechanical means or by grazing, followed by a period of neglect (*i.e.* insufficient grazing), results in colonisation by undesirable species. In particular *Chamerion angustifolium* (Rosebay Willowherb) can attain dominance in these conditions, resulting in establishment of **OV27 *Epilobium angustifolium* community**. Invasion by *Rubus fruticosus* agg. (Bramble) into areas of cleared **W25b *Pteridium aquilinum*-*Rubus fruticosus* underscrub, *Teucrium scorodonia* sub-community** was also noted. It was also observed that *Arrhenatherum elatius* (False Oat-grass) was invading some areas of open *Pteridium aquilinum* (Bracken), and this is discussed separately.

Grazing appears to be a much more effective means of *Pteridium aquilinum* (Bracken) control on the Malvern Hills than rolling. Where rolling has been undertaken, there is no evidence of any change in NVC type either at the community or sub-community level. It is, however, difficult to assess the long-term effectiveness of rolling as a means of reducing *Pteridium aquilinum* (Bracken) cover, as example from the Malvern Hills appear to be less than one to two years old. Research suggests that rolling alone is not an effective long-term strategy, and that it is best combined with other techniques such as spraying with herbicide or grazing.



5.2.3

Future Management Priorities

In general terms the continued grazing of areas of open grassland is essential to prevent the encroachment of *Pteridium aquilinum* (Bracken) scrub. Sheep grazing is most appropriate for this task, as sheep are suitable for the maintenance of the open swards characteristic of the Malvern Hills. Encroachment of *Pteridium aquilinum* (Bracken) into grassland appears not to be a major problem where dense stands are adjacent to well-established **U2a grassland**, as on much of the north hills. This community is particularly resistant to invasion of *Pteridium aquilinum* (Bracken) fronds, as the dense cover of *Deschampsia flexuosa* (Wavy Hair-grass) inhibits frond growth.

The maintenance of open grassland on the ridge of the hills is a high priority for nature conservation. This zone typically has some of the most species-rich assemblages of plants, a character that is lost through *Pteridium aquilinum* (Bracken) encroachment. Where transitional zones have been identified in the NVC survey *i.e.* areas of **U20a *Pteridium aquilinum*-*Galium saxatile* community, *Anthoxanthum odoratum* sub-community** adjacent to open grassland communities on the ridge, these may be targeted for mowing followed up by increased grazing pressure.

The opening up or attempted clearance of dense, well-established *Pteridium aquilinum* (Bracken) scrub on the northern hills apparently yields limited positive results in terms of expanding the total area of calcifugous grassland. It is therefore a low priority task, and these efforts are better directed towards the middle hills, where they are more likely to yield positive results.

The grazing and opening up of *Pteridium aquilinum* (Bracken) scrub on the middle hills results in the development of patches of calcifugous grassland between bracken fronds, though only small-scale sampling would classify these as discrete areas of grassland as opposed to part of a larger-scale pattern in the vegetation. Areas identified as **U20a *Pteridium aquilinum*-*Galium saxatile* community, *Anthoxanthum odoratum* sub-community** or transitions to this sub-community should therefore be treated as a priority for continued grazing in order maintain and expand areas of scrub-grassland mosaics. This vegetation type is of benefit to a wide range of wildlife including nesting birds and butterflies that feed on plants that are found here such as *Viola riviniana* (Common Dog-violet).

In areas where clearance is attempted, it is important to follow up initial management with continued grazing or mechanical treatment. Cattle-grazing may be more appropriate than sheep-grazing in these circumstances, as they are more effective at trampling and reducing the vigour of *Pteridium aquilinum* (Bracken). If grazing is not possible then mowing will be sufficient to prevent invasion by bulkier species such as *Chamerion angustifolium* (Rosebay Willowherb) and *Rubus fruticosus* agg. (Bramble), but it will generally result in the establishment of rank swards dissimilar to



the desired calcifugous grassland. This is, however, preferable to the results of neglect. Where possible a combination of techniques including mechanical control and continued grazing will often be more effective than a single-tier approach. Aside from preventing further encroachment, priority should be given to maintaining extant areas of open *Pteridium aquilinum* (Bracken) and mosaics with grassland vegetation.

5.3 *Gorse*

5.3.1 *General*

Several examples of successful management of *Ulex europaeus* (Gorse) were noted during the 2006 NVC survey. Large areas of gorse have been cleared mechanically and subjected to subsequent grazing. Evidence for this included the remains of *Ulex europaeus* (Gorse) bushes in open grassland, and comparison with aerial photographs, which showed previous areas of dense *Ulex europaeus* (Gorse) that were no longer present.

As with *Pteridium aquilinum* (Bracken) scrub, it appeared that encroachment of *Ulex europaeus* (Gorse) has, in general, not been substantial during the period since the aerial photographs were taken. Using GPS waypoints and hand-mapping, individual bushes and outlines of dense stands could be identified as occupying the same shape and space as on aerial photographs. It is, however, more difficult to accurately estimate spread in this case, as **W23 *Ulex europaeus*-*Rubus fruticosus* scrub** frequently forms complex mosaics with calcifugous grassland types, and expansion of *Ulex europaeus* (Gorse) within these mosaics is particularly difficult to estimate.

5.3.2 *Effectiveness of Current Management*

The results of clearance and subsequent grazing of *Ulex europaeus* (Gorse) have been sufficient in some cases to bring about a change in the NVC type at the community level. Examples were noted of changes towards desirable grassland types at one extreme, to a substitution of one scrub type for another, and the success apparently depended on both environmental factors and subsequent management. The biggest threat to the success of clearance is the re-invasion of *Ulex europaeus* (Gorse) from stumps and seedlings.

Examples of successful management are found on the northern hills, particularly at Table Hill. On these relatively gentle slopes where the soils are deep, clearance has resulted in creation of species-poor grassland referable to **U2a *Deschampsia flexuosa* grassland, *Festuca ovina*-*Agrostis capillaris* sub-community** similar to that of the surrounding hills. Significant differences remain between the floristics of these areas and typical **U2 grassland**. In particular there is often a persistence of herbs associated with **W23 scrub** such as *Digitalis purpurea* (Foxglove) and *Teucrium scorodonia*



(Wood Sage) and a high proportion of coarse and mesic grass species including *Dactylis glomerata* (Cock's-foot) and *Holcus lanatus* (Yorkshire-fog).

A significant concern in these areas is the re-growth of *Ulex europaeus* (Gorse) from stumps and seedlings, which remain abundant in the sward. This problem occurs in most areas where *Ulex europaeus* (Gorse) has been cleared and grazing does not appear to be effective at eradicating them in the short-term, though continued grazing may prove successful. In some cases the cover of *Ulex europaeus* (Gorse) seedlings in the sward is sufficient to classify the vegetation as transitional between **W23 scrub** and calcifugous grassland.

Differences were observed between this and the results of *Ulex europaeus* (Gorse) scrub on steeper slopes with thinner, less organic soils on the middle hills. An example on earthworks of the western slopes of CL12, below Herefordshire Beacon, shows where clearance has resulted in the (re)-invasion of *Agrostis capillaris* (Common Bent) and *Festuca ovina* (Sheep's-fescue) forming open swards referable to **U1 grassland**. Again, there is a persistence here of characteristic **W23 scrub** species such as *Digitalis purpurea* (Foxglove) *Rubus fruticosus* agg. (Bramble) and *Teucrium scorodonia* (Wood Sage), such that much of it is transitional between scrub and grassland vegetation. On these thin and unstable soils, however, re-growth of cleared *Ulex europaeus* (Gorse) appears to be less of a problem than on the deeper soils of the north hills. The tendency here is for the development of very open grassland referable to **U1b *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland, typical sub-community, open variant**, sometimes transitional to **U2a *Deschampsia flexuosa* grassland, *Festuca ovina*-*Agrostis capillaris* sub-community** where cover of *Deschampsia flexuosa* (Wavy Hair-grass) is high.

On the middle hills clearance is sometimes followed by the invasion of species-poor closed swards, often dominated by *Agrostis capillaris* (Common Bent), but sometimes with associated calcifugous grassland species such as *Festuca ovina* (Sheep's-fescue) and more mesic species including *Festuca rubra* (Red Fescue) and *Holcus lanatus* (Yorkshire-fog). On older areas of this type there is some affinity with **U4b *Festuca ovina*-*Agrostis capillaris*-*Galium saxatile* grassland, *Holcus lanatus*-*Trifolium repens* sub-community**.

There is a less striking difference between the results of *Ulex europaeus* (Gorse) clearance on the northern hills and the middle hills than there is with *Pteridium aquilinum* (Bracken). There does appear to be a moderately greater tendency towards the development of mesotrophic swards on the northern hills, but this is not so marked as in the case of *Pteridium aquilinum* (Bracken). It can be seen at the foot of North Hill on the western side, where there are large areas of **MG1 *Arrhenatherum elatius* grassland**.



Common to all the hills is that where clearance is followed by subsequent neglect, particularly on steeper and less accessible slopes, *e.g.* at the woodland boundary on the western slope of CL12, there is little significant establishment of calcifugous grassland. In these circumstances clearance is followed by invasion of scrub and semi-ruderal species, particularly *Chamerion angustifolium* (Rosebay Willowherb) and *Rubus fruticosus* agg. (Bramble). These areas are not directly referable to a particular NVC type, though they bear some affinities with **W24 *Rubus fruticosus*-*Holcus lanatus* underscrub** and **OV27 *Epilobium angustifolium* community**. Other species that are abundant under these circumstances include *Ceratocarpus claviculata* (Climbing Corydalis) and associates of **W23 scrub** such as *Digitalis purpurea* (Foxglove) and *Teucrium scorodonia* (Wood Sage).

5.3.3 *Future Management Priorities*

In the case of cleared areas on the northern hills, the priority should be to maintain grazing and prevent re-invasion of *Ulex europaeus* (Gorse). This can be particularly effective if applied in winter, when gorse may be preferentially grazed by cattle. The success of this can be measured by the development of **U2a grassland** in areas where initial clearance has been successful. In those areas classified as transitional between **W23 scrub** and calcifugous grassland vegetation, the aim should be to restore these to grassland NVC types through the eradication of species associated with **W23 scrub**, particularly *Digitalis purpurea* (Foxglove), *Teucrium scorodonia* (Wood Sage), *Rubus fruticosus* agg. (Bramble) and *Ulex europaeus* (Gorse). Grazing intensity may need to remain high in these situations, in order to prevent the development of mesotrophic swards where tall coarse grasses such as *Arrhenatherum elatius* (False Oat-grass) and *Holcus lanatus* (Yorkshire-fog) can gain a foothold.

On steep slopes with thin soils on the middle hills, where there has been successful clearance of *Ulex europaeus* (Gorse), maintenance of calcifugous grassland swards may be achieved through periodic grazing of lower intensity than that required on the northern hills. Where there is significant invasion of *Rubus fruticosus* agg. (Bramble) into cleared areas, there is a lower potential for management through grazing. In this case it may be more realistic to attempt the creation of mosaic vegetation where open areas of calcifugous grassland are mixed with some dense scrub.

5.4 **Woodland**

5.4.1 *General*

In general it can be seen through comparison with aerial photographs that scrub and mature trees have encroached into adjacent areas of sub-shrub and grassland vegetation beyond 1990 levels. In addition there has been canopy closure in places where saplings have matured. In most cases this has occurred in areas where access is



difficult, such as at the interface between woodland and adjacent scrub vegetation on steep slopes, and saplings have been able to expand their canopy cover particularly where they occur in large areas of dense scrub. These are generally low-priority areas.

Initial approaches to control woodland invasion are relatively straightforward, but the results are not easy to interpret over the short time scales since much of the clearance has been undertaken.

Significant areas of invasion by species-poor *Betula pendula* (Silver Birch) dominated woodland was observed on the eastern slopes of the middle hills during the 2006 NVC survey. This has been an apparently very rapid process involving the colonisation of large areas previously shown as high quality open grassland (Countryside Consultants 2003; and aerial photographs).

5.4.2 *Effectiveness of Current Management*

Where shrubs and mature trees have been cleared from previously open hill-top grassland, it is often followed establishment of species-poor sheets of *Agrostis capillaris* (Common Bent) or *Rumex acetosella* (Sheep's Sorrel). It is not immediately clear how these non-NVC vegetation types will develop over time, with much depending on intensity of management.

In older cleared areas there is often succession to mosaics of tall-herb and scrub vegetation dominated by *Chamerion angustifolium* (Rosebay Willowherb) and *Rubus fruticosus* agg. (Bramble) respectively, and non-NVC grassland vegetation with *Agrostis capillaris* (Common Bent) and *Holcus lanatus* (Yorkshire-fog). These areas are unlikely to change rapidly if grazing is maintained, but give some indication of the results that can be achieved through clearance of mature trees and shrubs.

Some evidence was seen of clearance of some *Betula pendula* (Silver Birch) on the middle hills, but invasion is apparently continuing and of significant concern.

5.4.3 *Future Management Priorities*

Continued grazing of areas cleared of mature shrubs and trees is important for the maintenance of open vegetation, particularly on hill-top grasslands. Extensive woodland clearance may be detrimental to the character of the Malvern Hills, and should primarily aim to reduce the cover of incipient scrub and non-native species such as *Acer pseudoplatanus* (Sycamore), particularly on hill-top grassland/woodland interfaces.

High priority should be given to managing the encroachment of *Betula pendula* (Silver Birch) on the eastern slopes of the middle hills. The loss of good quality calcifugous grassland is significant in area and is an apparently rapid, ongoing process.



5.5 *Mesotrophic Grassland*

5.5.1 *General*

During the 2006 survey it was seen that there has been an element of transition from calcifugous grassland towards *Arrhenatherion* swards, particularly around car-parks and well-used footpaths, but also over some areas of the northern hills. In the former cases this is clearly related to nutrient enrichment of the soils, principally by dogs. Under-grazing (of both cleared scrub and existing open grassland) has also contributed to the development of mesotrophic grasslands on the northern hills.

Where eutrophication occurs along well used footpaths and around car parks it often results in the establishment of tall-herb vegetation referable to **MG1a *Arrhenatherum elatius* grassland, *Festuca rubra* sub-community *Chamerion angustifolium* variant**. Such swards on the lower slopes of the Malvern Hills are principally derived from **U4 *Festuca ovina*-*Agrostis capillaris*-*Galium saxatile* grassland** and from **OV23a *Lolium perenne*-*Dactylis glomerata* community, typical sub-community** through invasion of *Arrhenatherum elatius* (False Oat-grass) and *Chamerion angustifolium* (Rosebay Willowherb). These typically form very species-poor vegetation types, with few species besides the principal dominants.

Transitions from **U2a grassland** to *Arrhenatherion* swards were observed on the middle and lower slopes of the northern hills. The most obvious feature is an abundance of *Arrhenatherum elatius* (False Oat-grass), but this is often accompanied by other coarse and mesophytic grasses such as *Dactylis glomerata* (Cock's-foot) and *Holcus lanatus* (Yorkshire-fog). This results in the exclusion of typical calcifugous species and eventual transition to species-poor **MG1a *Arrhenatherum elatius* grassland, *Festuca rubra* sub-community**. In addition to this, *Arrhenatherum elatius* (False Oat-grass) can be seen to be invading areas of open *Pteridium aquilinum* (Bracken) scrub, *e.g.* on the lower north western slope of North Hill. This is also seen around the foot of north hill on the western side, where **MG1a grassland** forms extensive stands with minor transitions to **U2a grassland** and **W23 scrub**.

5.5.2 *Effectiveness of Current Management*

Cattle grazing appears to be insufficient at present to prevent the development of some areas of mesotrophic grassland on the northern hills. In some cases this may be due to the cattle having preference for more level ground, so that the steeper slopes go ungrazed and taller, more robust grass species are able to out-compete the characteristic **U2 grassland** species. This represents only a small proportion of the affected area; there is extensive development of mesotrophic grassland on more gentle slopes. This may simply be related to under-grazing but there is a concentration of mesotrophic grassland about the sheltered area running between Table Hill and North Hill, and on to the western slope of Sugarloaf Hill. It is possible that these areas are favoured by



cattle sheltering from the prevailing winds, with a consequent increase in dunging in this area.

5.5.3

Future Management Priorities

Where mesotrophic grassland occurs in close association with **U2 grassland** on the northern hills, as identified in the NVC survey, it should be prioritised for more intensive grazing. These areas represent a significant loss in the total area of calcifugous grassland.

Where mesotrophic grassland occurs along path-sides and on the lower slopes, generally in close association with scrub, it is of a lower priority. While these areas do represent a loss of calcifugous grassland, it is generally of a more widespread type such as **U4b *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland, *Holcus lanatus-Trifolium repens* sub-community**. Management in this case should aim to reduce nutrient inputs from external sources such as littering and dog fouling.



6

CONDITION ASSESSMENT

6.1

General

Condition assessments were conducted for 14 of the units of the Malvern Hills SSSI. The completed forms are provided in a separate *Annex*.

In general there was little change in the condition of the units between the 2003 assessment and the present one.

Table 6.1. Results of condition assessments from 2003 and 2006.

Unit	2003	2006
1	Unfavourable – no change	Unfavourable – recovering
2	Unfavourable – declining	Unfavourable – declining
4	Unfavourable – declining	Unfavourable – no change
7	Unfavourable – declining	Unfavourable – improving
8	Unfavourable – declining	Unfavourable – declining
9	Unfavourable – declining	Unfavourable – declining
17	Unfavourable – improving	Unfavourable – no change
19	Unfavourable – improving	Unfavourable – improving
20	Unfavourable – partially destroyed	Unfavourable – declining
21	Unfavourable – declining	Unfavourable – improving
22	Unfavourable – declining	Unfavourable – improving
23	Unfavourable – declining	Unfavourable – improving

None of the units met all of the mandatory attributes, and technically it was therefore necessary to assess them as being in ‘unfavourable’ condition. In several there has indeed been a moderate decline in the total area of calcifugous grassland, mainly through encroachment of *Pteridium aquilinum* (Bracken) into ridge-top grassland. In addition, Unit 2 has suffered from a decline in the total area of calcifugous grassland due to encroachment of incipient *Betula pendula* (Silver Birch) woodland.

A number of units were assessed as ‘improving’ in 2006, either because they were by then within the range of acceptable limits for mandatory attributes that they failed in the 2003 assessment, or because they have been subject to scrub clearance, resulting in moderate increases in the total area of calcifugous grassland.

Unit 20 was assessed as partially destroyed in 2003, but no evidence of recent irreversible destruction was seen in 2006. This unit was re-classified as unfavourable declining – despite the obvious improvement on the 2003 condition there has been some encroachment of *Pteridium aquilinum* (Bracken) into ridge-top grassland.

**REFERENCES**

- Alma, P.J. (1999). *Management Plan for the Land Managed by the Malvern Hills Conservators 2000-2005*. Unpublished report.
- Amphlett, J. & Rea, C. (1909). *The Botany of Worcestershire*. Cornish, Birmingham.
- Barnett, K. & Garner, P.G. (2005). *Notable Flora on the Malvern Hills Conservator's Land*. Report to the Malvern Hills Conservators.
- Countryside Consultants (2003). *National Vegetation Classification (NVC) Phase II Survey of Grassland within the Malvern Hills Site of Special Scientific Interest*. Report to the Malvern Hills Conservators and English Nature.
- Davies, S. (1994). *The Malvern Hills SSSI: Feasibility Study for the Re-introduction of Grazing*. M.Sc. Thesis, University College London.
- Day, J.J. (1988). *A Checklist of the Worcestershire Flora*. Worcestershire Flora Project, Worcester.
- English Nature (2000). *Monitoring the Condition of Lowland Grassland SSSIs 1: English Nature's Rapid Assessment Method*. English Nature Research Reports **315**, English Nature, Peterborough.
- Gilbert, O. (2000). *Lichens*. Collins, London.
- Herefordshire Botanical Society (2001). *An Atlas of the Vascular Plants of Herefordshire*. Herefordshire Botanical Society.
- Lees, E. (1843). *The Botany of the Malvern Hills*. David Bogue, London.
- Lees, E. (1852). *The Botany of the Malvern Hills*, 2nd edition. David Bogue, London.
- Lees, E. (1867). *The Botany of Worcestershire*. Worcestershire Naturalists' Club, Worcester.
- Lees, E. (1868). *The Botany of the Malvern Hills*, 3rd edition. David Bogue, London.
- Malloch, A.J.C. (1999). *Match II*. University of Lancaster, Lancaster.
- Paton, J.A. (1999). *The Liverwort Flora of the British Isles*. Harley Books, Colchester.



- Purchas, W.H. & Ley, A. (1889). *A Flora of Herefordshire*. Jakeman & Carver, Hereford.
- Purvis, O.W., Coppins, B.J., Hawksworth, D.L., James, P.W. & Moore, D.M. (1992). *The Lichen Flora of Great Britain and Ireland*. Natural History Museum Publications, London.
- Rodwell, J.S. (1991a). *British Plant Communities 1: Woodlands and Scrub*. Cambridge University Press, Cambridge.
- Rodwell, J.S. (1991b). *British Plant Communities 2: Mires and Heaths*. Cambridge University Press, Cambridge.
- Rodwell, J.S. (1992). *British Plant Communities 3: Grasslands and Montane Communities*. Cambridge University Press, Cambridge.
- Rodwell, J.S. (2000). *British Plant Communities 5: Maritime Communities and Vegetation of Open Habitats*. Cambridge University Press, Cambridge.
- Rodwell, J.S. (2006). *National Vegetation Classification - User's Handbook*. Joint Nature Conservation Committee, Peterborough.
- Rodwell, J.S., Dring, J.C., Averis, A.B.G., Proctor, M.C.F., Malloch, A.J.C., Schaminee, J.H.J. & Dargie, T.C.D. (2000). *Review of Coverage of the National Vegetation Classification*. Joint Nature Conservation Committee, Peterborough.
- Schaminée, J.H.J., Stortelder, A.H.F. & Westhoff, V. (1995). *De Vegetatie van Nederland 1: Inleiding tot de Plantensociologie – Grondslagen, Methoden en Toepassingen*. Opulus Press, Uppsala.
- Sell, P.D. & Murrell, G. (1996). *Flora of Great Britain and Ireland 5: Butomaceae-Orchidaceae*. Cambridge University Press, Cambridge.
- Sell, P.D. & Murrell, G. (2006). *Flora of Great Britain and Ireland 4: Campanulaceae-Asteraceae*. Cambridge University Press, Cambridge.
- Smith, A.J.E. (2004). *The Moss Flora of Britain and Ireland*, 2nd edition. Cambridge University Press, Cambridge.
- Stace, C.A. (1997). *New Flora of the British Isles*, 2nd edition. Cambridge University Press, Cambridge.
- Whitehead, L.E. (1976). *Plants of Herefordshire*. Herefordshire Botanical Society.



ANNEX 1 – NVC TABLES

Table 1. NVC table for 5 two-metre square quadrats in species-rich, turf in glade in thorn scrub on the west facing slope below Clutters Cave (CG10a).

Species	Q1	Q2	Q3	Q4	Q5	Frq.	Cov.
<i>Agrostis capillaris</i>	7	8	7	6	7	V	6-8
<i>Rumex acetosella</i>	3	4	3	4	5	V	3-5
<i>Festuca ovina</i>	2	2	2	4	5	V	2-5
<i>Hypnum</i> cf. <i>lacunosum</i>	4	4	5	4	2	V	2-5
<i>Pseudoscleropodium purum</i>	4	4	5	4	2	V	2-5
<i>Thymus polytrichus</i>	4	3	2	4	5	V	2-5
<i>Veronica officinalis</i>	4	5	4	2	3	V	2-5
<i>Galium saxatile</i>	2	4	1	4	5	V	1-5
<i>Pilosella officinarum</i>	4	2	2	4	4	V	2-4
<i>Aphanes australis</i>	2	3	1	3	2	V	1-3
<i>Cerastium fontanum</i>	3	1	1	1	1	V	1-3
<i>Luzula campestris</i>	4	-	1	1	2	IV	1-4
<i>Campanula rotundifolia</i>	3	3	3	1	-	IV	1-3
<i>Viola riviniana</i>	-	1	1	3	2	IV	1-3
<i>Myosotis discolor</i>	2	2	1	-	1	IV	1-2
<i>Aira praecox</i>	1	1	-	1	1	IV	1
<i>Veronica chamaedrys</i>	3	-	4	4	-	III	3-4
<i>Galium verum</i>	2	-	4	4	-	III	2-4
<i>Lotus corniculatus</i>	2	-	-	2	3	III	2-3
<i>Cladonia rangiformis</i>	2	2	-	-	1	III	1-2
<i>Rhytidiadelphus squarrosus</i>	1	1	2	-	-	III	1-2
<i>Veronica arvensis</i>	1	2	-	-	1	III	1-2
<i>Dicranum scoparium</i>	1	1	-	-	1	III	1
<i>Potentilla sterilis</i>	-	-	4	1	-	II	1-4
<i>Festuca rubra</i>	3	3	-	-	-	II	3
<i>Sagina procumbens</i>	3	-	-	1	-	II	1-3
<i>Cirsium arvense</i>	-	-	2	1	-	II	1-2
<i>Polytrichum piliferum</i>	2	1	-	-	-	II	1-2
<i>Trifolium repens</i>	2	1	-	2	-	II	1-2
<i>Achillea millefolium</i>	-	-	-	1	1	II	1
<i>Vulpia bromoides</i>	1	-	-	-	1	II	1
<i>Rumex acetosa</i>	-	-	-	-	3	I	3
<i>Carex caryophylla</i>	-	-	-	2	-	I	2
<i>Aira caryophylla</i>	-	-	1	-	-	I	1
<i>Anthoxanthum odoratum</i>	-	-	-	-	1	I	1
<i>Ceratodon purpureus</i>	-	-	-	-	1	I	1
<i>Cladonia</i> cf. <i>foliacea</i>	-	-	-	-	1	I	1
<i>Holcus lanatus</i>	1	-	-	-	-	I	1
<i>Potentilla erecta</i>	-	-	-	1	-	I	1
<i>Taraxacum</i> sect. <i>Ruderalia</i> species	-	1	-	-	-	I	1



<i>Trisetum flavescens</i>	-	-	-	-	1	I	1
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Matching coefficients: CG10a 50.9, U4a 49.1, U1 undifferentiated 47.4, U4 undifferentiated 47.1, CG10 undifferentiated 45.4, U1b 45.4, U4c 45.2, U1d 45.2, U4b 44.3, U20a 44.0

Diagnosis. This stand agrees with **CG10a *Festuca ovina*-*Agrostis capillaris*-*Thymus praecox* grassland, *Trifolium repens*-*Luzula campestris* sub-community** in the dominance of *Agrostis capillaris*, *Festuca ovina* and *Thymus polytrichus* in association with mesic species such as *Cerastium fontanum*, *Campanula rotundifolia*, *Galium verum*, *Luzula campestris* and *Rumex acetosa* - all of which are among the sub-community character species in the NVC table in Rodwell (1992), and mildly calcifugous species such as *Galium saxatile*, *Rumex acetosella* and *Veronica officinalis*. The presence of character species for **U1 *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland**, especially *Pilosella officinarum* and *Rumex acetosella* (which are common in CG10a) together with spring ephemerals such as *Myosotis discolor* suggests that **U4a *Festuca ovina*-*Agrostis capillaris*-*Galium saxatile* grassland, typical sub-community** would be an inappropriate diagnosis. It is best assigned to CG10a, though it lacks species that are characteristic of more calcifugous upland-fringe stands, e.g. *Carex pulicaris*, *Polygala serpyllifolia*.



Table 2. NVC table for 5 two-metre square quadrats in species-rich, open turf intermediate between calcicolous and calcifugous types, on rocks close to Clutters Cave (CG10a - U1-undifferentiated).

Species	Q6	Q7	Q8	Q9	Q10	Frq.	Cov.
<i>Agrostis capillaris</i>	3	5	7	6	4	V	3-7
<i>Festuca ovina</i>	5	5	5	5	6	V	5-6
<i>Thymus polytrichus</i>	3	4	5	5	4	V	3-5
<i>Filago minima</i>	4	4	2	3	3	V	2-4
<i>Rumex acetosella</i>	2	3	4	4	4	V	2-4
<i>Aira praecox</i>	3	3	3	3	3	V	3
<i>Cladonia cf. foliacea</i>	3	3	2	1	1	V	1-3
<i>Pilosella officinarum</i>	-	4	5	3	2	IV	2-5
<i>Cladonia cf. rangiformis</i>	3	4	4	4	-	IV	3-4
<i>Moenchia erecta</i>	-	3	3	3	3	IV	3
<i>Vulpia bromoides</i>	3	3	-	3	3	IV	3
<i>Hypnum cf. lacunosum</i>	3	2	3	3	-	IV	2-3
<i>Cladonia cf. furcata</i>	2	2	2	2	-	IV	2
<i>Polytrichum juniperinum</i>	3	4	-	2	-	III	2-4
<i>Aphanes australis</i>	3	-	2	-	2	III	2-3
<i>Cerastium glomeratum</i>	1	-	1	-	3	III	1-3
<i>Cladonia cf. chlorophaea</i>	3	2	-	1	-	III	1-3
<i>Galium verum</i>	-	2	1	-	-	II	1-2
<i>Veronica arvensis</i>	2	-	1	-	-	II	1-2
<i>Polytrichum piliferum</i>	4	-	-	-	-	I	4
<i>Potentilla neumanniana</i>	-	-	-	-	4	I	4
<i>Lotus corniculatus</i>	-	-	-	2	-	I	2
<i>Cladonia cf. floerkeana</i>	1	-	-	-	-	I	1
<i>Coelocaulon aculeatum</i>	1	-	-	-	-	I	1
<i>Luzula campestris</i>	-	-	1	-	-	I	1
<i>Potentilla erecta</i>	-	-	-	1	-	I	1
<i>Taraxacum Sect. Erythrosperma</i>	-	-	-	1	-	I	1

Matching coefficients: U1 undifferentiated 39.7, U1b 39.4, U1e 33.5, U1c 33.2, H11a 32.2, U1d 31.4, U1a 27.9

Diagnosis. The conspicuously low matching coefficients suggest that this sward does not correspond closely to any NVC type. Though the sward has many characteristics of **U1 *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland**, the abundance of *Thymus polytrichus* and the presence of the calcicole *Potentilla neumanniana* are inconsistent with U1. In view of the presence of **CG10a *Festuca ovina*-*Agrostis capillaris*-*Thymus praecox* grassland**, ***Trifolium repens*-*Luzula campestris* sub-community** swards on slopes below this site, it is probably best regarded as lying towards the U1 end of the transition from CG10a to U1.



Table 3. NVC table for 5 two-metre square quadrats in short turf intermediate between calcicolous and calcifugous types at Hangman's Hill (CG10a - U1-undifferentiated).

Species	Q11	Q12	Q13	Q14	Q15	Frq.	Cov.
<i>Festuca ovina</i>	7	8	7	7	6	V	6-8
<i>Thymus polytrichus</i>	4	4	3	6	8	V	3-8
<i>Pseudoscleropodium purum</i>	4	4	4	3	5	V	3-5
<i>Agrostis capillaris</i>	4	3	5	3	2	V	2-5
<i>Achillea millefolium</i>	5	1	4	4	1	V	1-5
<i>Rhytidadelphus squarrosus</i>	4	4	3	2	3	V	2-4
<i>Luzula campestris</i>	3	2	2	3	2	V	2-3
<i>Rumex acetosella</i>	3	2	3	3	2	V	2-3
<i>Dicranum scoparium</i>	2	2	1	3	3	V	1-3
<i>Trisetum flavescens</i>	3	2	1	3	3	V	1-3
<i>Galium saxatile</i>	3	2	5	-	1	IV	1-5
<i>Pilosella officinarum</i>	1	2	2	-	4	IV	1-4
<i>Lotus corniculatus</i>	2	3	2	-	2	IV	2-3
<i>Cerastium fontanum</i>	2	-	-	1	3	III	1-3
<i>Galium verum</i>	3	-	-	1	1	III	1-3
<i>Veronica chamaedrys</i>	1	-	3	-	3	III	1-3
<i>Aira praecox</i>	-	1	-	1	2	III	1-2
<i>Anthoxanthum odoratum</i>	-	-	4	3	-	II	3-4
<i>Pleurozium schreberi</i>	-	-	2	4	-	II	2-4
<i>Carex flacca</i>	3	3	-	-	3	II	3
<i>Trifolium repens</i>	2	-	-	-	3	II	2-3
<i>Calluna vulgaris</i>	2	-	-	-	2	II	2
<i>Deschampsia flexuosa</i>	-	2	2	-	-	II	2
<i>Potentilla sterilis</i>	-	1	-	-	2	II	1-2
<i>Cerastium glomeratum</i>	-	1	-	1	-	II	1
<i>Cirsium arvense</i>	1	-	-	-	1	II	1
<i>Vulpia bromoides</i>	-	1	-	-	1	II	1
<i>Campanula rotundifolia</i>	-	4	-	-	-	I	4
<i>Aira caryophyllea</i>	-	-	-	-	2	I	2
<i>Carex caryophyllea</i>	-	-	-	2	-	I	2
<i>Potentilla erecta</i>	-	-	2	-	-	I	2
<i>Ceratodon purpureus</i>	-	-	1	-	-	I	1
<i>Moenchia erecta</i>	-	1	-	-	-	I	1
<i>Myosotis discolor</i>	-	-	-	1	-	I	1
<i>Rumex acetosa</i>	1	-	-	-	-	I	1
<i>Stellaria graminea</i>	-	1	-	-	-	I	1
<i>Veronica arvensis</i>	-	-	-	1	-	I	1

Matching coefficients: U4a 53.0, U1 undifferentiated 52.1, U1e 52.0, CG10a 51.2, U1d 51.1, U4 undifferentiated 50.1, U20a 46.4

Diagnosis. Despite the moderately high matching coefficient with **U4a *Festuca ovina*-*Agrostis capillaris*-*Galium saxatile* grassland, typical sub-community**, this sward contains, at high levels of



constancy, species typical of **U1 *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland** and absent from U4, including *Aira praecox*, *Pilosella officinarum* and *Rumex acetosella*. The abundance of *Thymus polytrichus* is suggestive of **CG10a *Festuca ovina-Agrostis capillaris-Thymus praecox* grassland, *Trifolium repens-Luzula campestris* sub-community**, and other species found in CG10a but neither in U1 or U4 include *Carex flacca* and *Potentilla sterilis*. Species suggestive of U4 rather than U1 are shared with CG10a, e.g. *Achillea millefolium*, *Anthoxanthum odoratum*, *Campanula rotundifolia*, *Luzula campestris*. This sward is therefore best regarded as intermediate between U1-undifferentiated and CG10a.



Table 4. NVC table for 5 two-metre square quadrats in species-rich, open turf on the southern tip of Swinyard Hill intermediate between calcicolous and calcifugous types (CG10a-U1 undifferentiated).

Species	Q16	Q17	Q18	Q19	Q20	Frq.	Cov.
<i>Festuca ovina</i>	7	6	1	8	7	V	1-8
<i>Agrostis capillaris</i>	7	7	4	6	4	V	4-7
<i>Rumex acetosella</i>	3	1	7	5	2	V	1-7
<i>Rhytidiadelphus squarrosus</i>	6	5	5	5	4	V	4-6
<i>Thymus polytrichus</i>	5	4	4	3	3	V	3-5
<i>Aira praecox</i>	4	2	1	4	4	V	1-4
<i>Pilosella officinarum</i>	2	3	2	2	2	V	2-3
<i>Luzula campestris</i>	-	5	2	3	1	IV	1-5
<i>Sagina apetala</i>	3	2	2	1	-	IV	1-3
<i>Aphanes australis</i>	1	1	1	-	2	IV	1-2
<i>Lotus corniculatus</i>	3	3	-	4	-	III	3-4
<i>Campanula rotundifolia</i>	4	2	-	-	3	III	2-4
<i>Vulpia bromoides</i>	-	-	3	3	3	III	3
<i>Trifolium repens</i>	2	3	3	-	-	III	2-3
<i>Coelocaulon aculeatum</i>	1	-	-	3	1	III	1-3
<i>Plantago lanceolata</i>	2	2	2	-	-	III	2
<i>Myosotis discolor</i>	1	1	-	-	2	III	1-2
<i>Moenchia erecta</i>	3	-	-	-	4	II	3-4
<i>Achillea millefolium</i>	-	3	3	-	-	II	3
<i>Cerastium fontanum</i>	-	3	1	-	-	II	1-3
<i>Taraxacum</i> sect. <i>Erythrosperma</i>	-	1	-	-	1	II	1
<i>Festuca rubra</i>	-	-	6	-	-	I	6
<i>Anthoxanthum odoratum</i>	-	4	-	-	-	I	4
<i>Hypnum lacunosum</i>	3	-	-	-	-	I	3
<i>Trisetum flavescens</i>	-	-	3	-	-	I	3
<i>Cynosurus cristatus</i>	-	2	-	-	-	I	2
<i>Poa annua</i>	2	-	-	-	-	I	2
<i>Trifolium dubium</i>	-	2	-	-	-	I	2
<i>Veronica arvensis</i>	1	-	-	-	-	I	1

Matching coefficients: U1b 49.3, U1 undifferentiated 47.3, U1d 44.7, U1e 42.7, CG10a 41.0, U4a 39.3, CG10 undifferentiated 38.7

Diagnosis. This sward is somewhat too rich in spring ephemerals and lichens for **U1b *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland, typical sub-community**, and the presence of species such as *Campanula rotundifolia*, *Luzula campestris* and *Thymus polytrichus* suggests slight affinities with **CG10a *Festuca ovina*-*Agrostis capillaris*-*Thymus praecox* grassland, *Trifolium repens*-*Luzula campestris* sub-community**. It is probably best treated as transitional from CG10a to U1 undifferentiated, though it is well towards the U1 end of the gradient.



Table 5. NVC table for 5 two-metre square quadrats in species-rich grassland on the western side of the crest south of Clutters Cave (either U4a or CG10a - U4b).

Species	Q21	Q22	Q23	Q24	Q25	Frq.	Cov.
<i>Agrostis capillaris</i>	7	7	6	6	7	V	6-7
<i>Festuca ovina</i>	5	7	6	3	6	V	3-7
<i>Anthoxanthum odoratum</i>	4	3	6	3	3	V	3-6
<i>Pseudoscleropodium purum</i>	2	5	2	4	1	V	1-5
<i>Rhytidadelphus squarrosus</i>	4	5	1	4	4	V	1-5
<i>Galium saxatile</i>	4	4	1	4	4	V	1-4
<i>Achillea millefolium</i>	3	1	2	2	1	V	1-3
<i>Deschampsia flexuosa</i>	1	2	3	3	3	V	1-3
<i>Holcus lanatus</i>	4	2	-	2	1	IV	1-4
<i>Campanula rotundifolia</i>	1	-	3	2	2	IV	1-3
<i>Luzula campestris</i>	-	3	2	1	2	IV	1-3
<i>Pleurozium schreberi</i>	-	1	3	1	2	IV	1-3
<i>Veronica chamaedrys</i>	1	1	-	2	2	IV	1-2
<i>Potentilla erecta</i>	-	-	2	2	4	III	2-4
<i>Lotus corniculatus</i>	-	3	3	1	-	III	1-3
<i>Cirsium arvense</i>	1	-	1	1	-	III	1
<i>Pilosella officinarum</i>	-	2	1	-	-	II	1-2
<i>Stellaria graminea</i>	1	2	-	-	-	II	1-2
<i>Rumex acetosa</i>	-	-	-	1	1	II	1
<i>Thymus polytrichus</i>	-	-	4	-	-	I	4
<i>Rumex acetosella</i>	-	-	2	-	-	I	2
<i>Carex caryophyllea</i>	-	1	-	-	-	I	1
<i>Cerastium fontanum</i>	-	-	-	-	1	I	1
<i>Dicranum scoparium</i>	-	1	-	-	-	I	1
<i>Festuca rubra</i>	-	-	-	-	1	I	1
<i>Poa humilis</i>	-	-	-	-	1	I	1
<i>Potentilla sterilis</i>	-	-	-	1	-	I	1
<i>Trifolium repens</i>	-	-	-	1	-	I	1
<i>Veronica officinalis</i>	-	-	1	-	-	I	1

Matching coefficients: U4a 65.6, U20a 64.2, U4b 57.7, U4c 56.2, CG10a 54.8, U1e 52.6

Diagnosis. Despite the high matching coefficient with **U4a Festuca ovina-Agrostis capillaris-Galium saxatile grassland, typical sub-community**, this sward contains species found in **U1 Festuca ovina-Agrostis capillaris-Rumex acetosella grassland** but not U4, especially *Pilosella officinarum* and *Rumex acetosella*. Almost all other species are shared between U4 and **CG10a Festuca ovina-Agrostis capillaris-Thymus praecox grassland, Trifolium repens-Luzula campestris sub-community**, and most are mentioned by Rodwell (1992) in the discussion of CG10 as typical of CG10, e.g. *Campanula rotundifolia*, or CG10a, e.g. *Luzula campestris*. It even contains *Potentilla sterilis* recorded only from CG10 among all grassland NVC types. CG10a would not itself be an acceptable diagnosis, owing to the lack of calcicoles. But it is an open question as to whether this sward is best assigned to U4a, or whether it is best regarded as transitional between U1 and CG10a (or perhaps U1, CG10a and **U4b Festuca ovina-Agrostis capillaris-Galium saxatile grassland, Holcus lanatus-Trifolium repens sub-community**, which is common on lower slopes). Assignment to U4a would be acceptable, but appears not to be essential in view of variation in nearby swards.



Table 6. NVC table for 5 two-metre square quadrats in closed, short, calcifugous turf on the lower ramparts at the north-western corner of British Camp (U1b).

Species	Q26	Q27	Q28	Q29	Q30	Freq.	Cover
<i>Agrostis capillaris</i>	9	6	3	4	5	V	3-9
<i>Festuca ovina</i>	5	8	8	8	8	V	5-8
<i>Pilosella officinarum</i>	6	4	5	5	4	V	4-6
<i>Rumex acetosella</i>	5	6	4	5	5	V	4-6
<i>Aira praecox</i>	3	3	4	2	3	V	2-4
<i>Hypnum</i> cf. <i>lacunosum</i>	4	4	4	2	4	V	2-4
<i>Moenchia erecta</i>	3	4	2	1	2	V	1-4
<i>Aphanes australis</i>	-	3	2	4	4	IV	2-4
<i>Vulpia bromoides</i>	3	1	1	3	-	IV	1-3
<i>Achillea millefolium</i>	4	2	3	-	-	III	2-4
<i>Galium verum</i>	2	4	3	-	-	III	2-4
<i>Cerastium semidecandrum</i>	-	-	1	3	2	III	1-3
<i>Polytrichum piliferum</i>	-	-	1	2	1	III	1-2
<i>Ceratodon purpureus</i>	-	-	1	4	-	II	1-4
<i>Veronica arvensis</i>	2	1	-	-	-	II	1-2
<i>Galium saxatile</i>	1	-	2	-	-	II	1
<i>Deschampsia flexuosa</i>	1	-	1	-	-	II	1
<i>Taraxacum</i> sect. <i>Erythrosperma</i>	1	-	-	-	1	II	1
<i>Campanula rotundifolia</i>	-	-	4	-	-	I	4
<i>Trifolium dubium</i>	-	4	-	-	-	I	4
<i>Myosotis discolor</i>	2	-	-	-	-	I	2
<i>Cerastium glomeratum</i>	-	-	1	-	-	I	1
<i>Cladonia</i> cf. <i>foliacea</i>	-	-	-	1	-	I	1
<i>Dicranum scoparium</i>	1	-	-	-	-	I	1
<i>Erophila verna</i>	-	-	-	-	1	I	1

Matching coefficients: **U1b 46.4**, U1 undifferentiated 44.5, U1e 43.9, U1d 41.6, U1c 36.5, U1f 32.4, SD12b 29.8

Diagnosis. This vegetation is fairly clearly referable to the NVC type **U1b *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland, typical sub-community** though the wide range of annuals is includes taxa that are slightly atypical, albeit characteristic of the Malvern Hills.



Table 7. NVC table for 5 two-metre square quadrats in species-poor and open calcifugous grassland between Black Hill and Pinnacle Hill (U1b).

Species	Q31	Q32	Q33	Q34	Q35	Frq.	Cov.
<i>Polytrichum piliferum</i>	3	8	6	8	6	V	3-8
<i>Agrostis capillaris</i>	7	5	6	6	6	V	5-7
<i>Rumex acetosella</i>	7	4	4	3	1	V	1-7
<i>Vulpia bromoides</i>	3	2	4	2	1	V	1-4
<i>Cladonia cf. furcata</i>	2	3	2	2	1	V	1-3
<i>Aira praecox</i>	2	2	3	3	2	V	2-3
<i>Cladonia cf. chlorophaea</i>	-	1	2	1	1	IV	1-2
<i>Galium saxatile</i>	4	2	-	2	-	III	2-4
<i>Festuca ovina</i>	4	2	1	-	-	III	1-4
<i>Peltigera cf. lactucifolia</i>	3	-	1	-	-	II	1-3
<i>Cerastium glomeratum</i>	-	-	1	1	-	II	1
<i>Rubus fruticosus</i> agg.	1	-	-	-	1	II	1
<i>Teucrium scorodonia</i>	1	-	-	-	1	II	1
<i>Anthoxanthum odoratum</i>	-	-	-	-	3	I	3
<i>Holcus mollis</i>	-	-	-	-	3	I	3
<i>Campylopus introflexus</i>	-	-	1	-	-	I	1
<i>Ceratodon purpureus</i>	-	-	-	1	-	I	1
<i>Chamerion angustifolium</i>	-	-	-	-	1	I	1
<i>Cladonia cf. rangiformis</i>	-	-	-	1	-	I	1
<i>Hypochaeris radicata</i>	-	-	-	-	1	I	1

Matching coefficients: **U1b 44.4**, U1e 40.7, U2a 38.6, U1f 34.7, U1a 34.2

Diagnosis: This is best assigned to **U1b *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland, typical sub-community**, though it is atypical in the abundance of mosses and lichens, and in the paucity of vascular plant associates.



Table 8. NVC table for five 2m-square quadrats in species-poor open calcifugous grassland on the eastern slope of Swinyard Hill

Species	Q36	Q37	Q38	Q39	Q40	Frq.	Cov.
<i>Festuca ovina</i>	7	7	6	5	7	V	5-7
<i>Aira praecox</i>	6	3	4	4	4	V	3-6
<i>Rumex acetosella</i>	5	5	4	4	5	V	4-5
<i>Hypnum lacunosum</i>	4	4	4	3	1	V	1-4
<i>Agrostis capillaris</i>	7	8	5	5	-	IV	5-8
<i>Moenchia erecta</i>	3	1	2	3	-	IV	1-3
<i>Poa annua</i>	2	1	1	1	-	IV	1-2
<i>Polytrichum piliferum</i>	-	-	3	3	4	III	3-4
<i>Polytrichum juniperinum</i>	4	3	2	-	-	III	2-4
<i>Scleranthus annuus</i>	-	-	2	2	3	III	2-3
<i>Pilosella officinarum</i>	1	3	-	-	2	III	1-3
<i>Galium saxatile</i>	-	5	1	-	-	II	1-5
<i>Cladonia cf. rangiformis</i>	-	-	-	3	3	II	3
<i>Cladonia cf. foliacea</i>	-	-	-	3	3	II	3
<i>Coelocaulon aculeatum</i>	-	-	-	2	3	II	2-3
<i>Dicranum scoparium</i>	1	1	-	-	-	II	1
<i>Quercus robur</i> (s)	-	1	-	1	-	II	1
<i>Holcus lanatus</i>	1	-	-	-	-	I	1

Matching coefficients: **U1b 49.4**, U1 undifferentiated 48.6, U1a 43.3, U1d 40.2, U1e 39.5, U1f 38.7, U1c 35.8

Diagnosis. This is broadly referable to **U1b *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland, typical sub-community**, though it is atypical in the abundance of mosses and lichens and in the paucity of vascular plant associates. It is best referable to **U1b *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland, typical sub-community, open variant**.



Table 9. NVC table for 5 two-metre square quadrats in short, open, calcifugous turf on the north-western flanks of British Camp (U1b).

Species	Q41	Q42	Q43	Q44	Q45	Frq.	Cov.
<i>Agrostis capillaris</i>	8	5	4	6	3	V	3-8
<i>Rumex acetosella</i>	7	4	4	5	4	V	4-7
<i>Festuca ovina</i>	3	5	6	6	5	V	3-5
<i>Aira praecox</i>	3	4	3	3	3	V	3-4
<i>Cladonia</i> cf. <i>foliacea</i>	1	3	3	3	3	V	1-3
<i>Deschampsia flexuosa</i>	1	3	3	1	2	V	1-3
<i>Polytrichum piliferum</i>	-	4	4	3	8	IV	3-8
<i>Ceratodon purpureus</i>	1	3	-	4	1	IV	1-4
<i>Thymus polytrichus</i>	2	-	4	2	1	IV	1-4
<i>Cladonia</i> cf. <i>furcata</i>	-	1	2	3	3	IV	1-3
<i>Galium saxatile</i>	1	-	3	3	1	IV	1-3
<i>Cladonia</i> cf. <i>rangiformis</i>	-	1	1	1	1	IV	1
<i>Cladonia</i> cf. <i>chlorophaea</i>	-	3	-	3	-	II	3
<i>Cladonia</i> cf. <i>portentosa</i>	-	-	1	1	-	II	1
<i>Dicranum scoparium</i>	-	-	1	-	-	I	1
<i>Hypnum</i> cf. <i>lacunosum</i>	-	-	-	-	1	I	1
<i>Pilosella officinarum</i>	-	-	-	-	1	I	1
<i>Poa annua</i>	1	-	-	-	-	I	1
<i>Pseudoscleropodium purum</i>	-	-	-	-	1	I	1

Matching coefficients: U1e 46.3, **U1b 44.8**, U1 undifferentiated 43.0, U2a 40.6, u1a 39.4, H11 undifferentiated 35.4

Diagnosis. The dominance of *Festuca ovina* and *Agrostis capillaris* in association with *Rumex acetosella* places this sward clearly in **U1 *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland**. It does not, however, have the closed character of **U1e *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland, *Galium saxatile*-*Potentilla erecta* sub-community**. Moreover, the high incidence of annuals, mosses and lichens is inconsistent with U1e, and while it would generally be consistent with **U1a *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland, *Cornicularia aculeata*-*Cladonia arbuscula* sub-community** it happens that the wrong individual species are involved. This sward must therefore be assigned to **U1b *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland, typical sub-community**, though it is hardly a typical example.



Table 10. NVC-style table for 5 two metre-square quadrats recorded in calcifugous grassland on the west-facing slope of Ragged Stone Hill (U1b lichen-rich variant).

Species	Q46	Q47	Q48	Q49	Q50	Frq.	Cov.
<i>Rumex acetosella</i>	7	8	8	6	4	V	4-8
<i>Agrostis capillaris</i>	7	8	5	6	6	V	5-8
<i>Dicranum scoparium</i>	1	1	8	5	5	V	1-8
<i>Festuca ovina</i>	4	2	3	7	6	V	2-7
<i>Cladonia</i> cf. <i>rangiformis</i>	6	5	5	5	4	V	4-6
<i>Cladonia</i> cf. <i>portentosa</i>	2	1	2	1	4	V	1-4
<i>Aira praecox</i>	4	5	2	3	2	V	2-5
<i>Galium saxatile</i>	-	-	4	8	8	III	4-8
<i>Teucrium scorodonia</i>	1	1	4	-	-	III	1-4
<i>Cladonia</i> cf. <i>foliacea</i>	3	3	1	-	-	III	1-3
<i>Luzula campestris</i>	-	-	-	3	3	II	3
<i>Polytrichum piliferum</i>	3	-	1	-	-	II	1-3
<i>Moenchia erecta</i>	1	1	-	-	-	II	1
<i>Cerastium glomeratum</i>	1	-	-	-	1	II	1
<i>Veronica arvensis</i>	1	-	-	-	-	I	1
<i>Rubus fruticosus</i> agg.	-	-	1	-	-	I	1
<i>Ptilidium ciliare</i>	-	-	-	-	1	I	1
<i>Myosotis discolor</i>	1	-	-	-	-	I	1
<i>Hypnum cupressiforme</i>	1	-	-	-	-	I	1
<i>Hyacinthoides non-scripta</i>	1	-	-	-	-	I	1
<i>Crataegus monogyna</i> (s)	1	-	-	-	-	I	1
<i>Campylopus introflexus</i>	-	-	-	1	-	I	1

Matching coefficients: U1 undifferentiated 45.6, U1a 44.6, U1b 44.2.

Diagnosis. This vegetation is clearly a U1 *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland, but it is too open, and too lichen-rich to be considered typical. Despite affinities with U1a *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland, *Cornicularia aculeata*-*Cladonia arbuscula* sub-community, it has a different suite of lichen species to this community, which is basically a Breckland speciality. Further, it is more species-poor and has fewer spring ephemeral species than is typical of U1a. It is best referred to U1b *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland, typical sub-community, lichen-rich variant.



Table 11. NVC table for 5 two-metre square quadrats in short calcifugous turf on the south-western face of the lowest rampart of British Camp (U1b-U1e).

Species	Q51	Q52	Q53	Q54	Q55	Freq.	Cover
<i>Rumex acetosella</i>	3	6	5	7	6	V	3-7
<i>Dicranum scoparium</i>	2	5	7	7	4	V	2-7
<i>Festuca ovina</i>	6	5	6	4	5	V	4-6
<i>Hypnum</i> cf. <i>lacunosum</i>	6	6	4	1	4	V	1-6
<i>Agrostis capillaris</i>	4	4	5	5	5	V	4-5
<i>Aira praecox</i>	3	4	3	3	3	V	3-4
<i>Deschampsia flexuosa</i>	2	4	1	4	2	V	1-4
<i>Galium saxatile</i>	-	2	4	2	5	IV	2-5
<i>Rhytidiadelphus squarrosus</i>	-	1	1	1	1	IV	1
<i>Pilosella officinarum</i>	6	-	2	-	4	III	2-6
<i>Polytrichum piliferum</i>	-	3	-	4	4	III	3-4
<i>Luzula campestris</i>	1	-	4	-	4	III	1-4
<i>Vulpia bromoides</i>	4	1	-	-	1	III	1-4
<i>Holcus mollis</i>	-	3	1	2	-	III	1-3
<i>Hypochaeris radicata</i>	2	1	-	-	1	III	1-2
<i>Campylopus</i> cf. <i>pyriformis</i>	-	-	-	1	4	II	1-4
<i>Aphanes australis</i>	3	-	1	-	-	II	1-3
<i>Carex caryophylla</i>	-	-	-	-	4	I	4
<i>Achillea millefolium</i>	3	-	-	-	-	I	3
<i>Poa annua</i>	2	-	-	-	-	I	2
<i>Arrhenatherum elatius</i>	-	-	-	-	1	I	1
<i>Cerastium glomeratum</i>	1	-	-	-	-	I	1
<i>Ceratodon purpureus</i>	-	-	-	-	1	I	1
<i>Cytisus scoparius</i> (g)	-	-	-	-	1	I	1

Matching coefficients: U1e 48.8, U1b 43.8, U2a 43.6, U1 undifferentiated 43.4, U2 undifferentiated 38.8, SD12a 38.5

Diagnosis. This sward agrees fairly well with **U1e *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland, *Galium saxatile*-*Potentilla erecta* sub-community** in being dominated by the grasses *Agrostis capillaris* and *Festuca ovina* and the dicotyledonous herbs *Galium saxatile* and *Rumex acetosella* with some admixture of the grass *Deschampsia flexuosa*. The high cover of mosses is not however consistent with U1e, and neither is the high frequency of the annual grasses *Aira praecox* and *Vulpia bromoides*. This sward is therefore best regarded as transitional from **U1b *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland, typical sub-community** to U1e.



Table 12. NVC table for 5 two-metre square quadrats in short, closed calcifugous turf on Broad Down (U1-undifferentiated).

Species	Q56	Q57	Q58	Q59	Q60	Frq.	Cov.
<i>Festuca ovina</i>	9	8	8	9	9	V	8-9
<i>Aira praecox</i>	4	5	4	3	3	V	3-5
<i>Rumex acetosella</i>	3	4	4	3	3	V	3-4
<i>Agrostis capillaris</i>	3	2	2	4	3	V	2-4
<i>Galium saxatile</i>	4	1	2	3	2	V	1-4
<i>Deschampsia flexuosa</i>	3	2	1	1	3	V	1-3
<i>Luzula campestris</i>	3	1	1	1	1	V	1-3
<i>Dicranum scoparium</i>	1	-	1	2	1	IV	1-2
<i>Ptilidium ciliare</i>	1	1	1	-	1	IV	1
<i>Polytrichum juniperinum</i>	-	3	-	2	3	III	2-3
<i>Cladonia cf. furcata</i>	-	1	2	1	-	III	1-2
<i>Coelocaulon aculeatum</i>	-	1	1	2	-	III	1-2
<i>Cladonia cf. chlorophaea</i>	-	1	-	1	1	III	1
<i>Pilosella officinarum</i>	-	-	4	-	1	II	1-4
<i>Carex caryophyllea</i>	-	-	-	3	-	I	3
<i>Anthoxanthum odoratum</i>	-	-	-	-	1	I	1
<i>Cladonia cf. foliacea</i>	-	1	-	-	-	I	1
<i>Holcus lanatus</i>	1	-	-	-	-	I	1
<i>Hypnum cupressiforme</i>	-	-	-	-	1	I	1
<i>Hypnum cf. lacunosum</i>	-	-	-	-	1	I	1
<i>Pleurozium schreberi</i>	-	-	1	-	-	I	1
<i>Pseudoscleropodium purum</i>	1	-	-	-	-	I	1
<i>Rhytidiadelphus squarrosus</i>	-	-	-	-	1	I	1

Matching coefficients: U1 undifferentiated 51.1, U1a 50.1, U1e 48.6, U1b 46.9, H11a 43.9, U4e 43.5, H11 undifferentiated 43.2, U20b 41.8

Diagnosis. This is clearly **U1 *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland** grassland, and is probably best assigned to U1-undifferentiated. The closed grassy sward with low cover of mosses and lichens is inappropriate for **U1a *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland**, ***Cornicularia aculeata*-*Cladonia arbuscula* sub-community**. The wide range of mosses and lichens is inappropriate for **U1e *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland**, ***Galium saxatile*-*Potentilla erecta* sub-community** and for **U1b *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland**, **typical sub-community**.



Table 13. NVC table for 5 two-metre square quadrats in open, calcifugous grassland on the southern side of Herefordshire Beacon (U1-undifferentiated).

Species	Q61	Q62	Q63	Q64	Q65	Freq.	Cover
<i>Rumex acetosella</i>	8	8	8	4	8	V	4-8
<i>Polytrichum piliferum</i>	1	2	2	8	4	V	1-8
<i>Agrostis capillaris</i>	4	4	5	1	6	V	1-6
<i>Dicranum scoparium</i>	1	4	5	5	6	V	1-6
<i>Festuca ovina</i>	5	5	5	5	5	V	5
<i>Aira praecox</i>	3	3	4	1	3	V	1-4
<i>Cladonia</i> cf. <i>foliacea</i>	2	1	2	4	2	V	1-4
<i>Cladonia</i> cf. <i>portentosa</i>	3	1	3	2	3	V	1-3
<i>Deschampsia flexuosa</i>	1	3	1	3	3	V	1-3
<i>Galium saxatile</i>	4	1	4	4	-	IV	1-4
<i>Ceratodon purpureus</i>	3	4	-	2	-	III	2-4
<i>Hypnum</i> cf. <i>lacunosum</i>	4	2	4	-	-	III	2-4
<i>Galium verum</i>	1	1	-	-	-	II	1
<i>Aphanes australis</i>	2	-	-	-	-	I	2
<i>Cladonia</i> cf. <i>rangiformis</i>	-	-	2	-	-	I	2
<i>Moenchia erecta</i>	2	-	-	-	-	I	2
<i>Vulpia bromoides</i>	2	-	-	-	-	I	2
<i>Campylopus</i> cf. <i>pyriformis</i>	-	-	-	1	-	I	1
<i>Coelocaulon aculeatum</i>	-	-	1	-	-	I	1
<i>Hypnum cupressiforme</i>	1	-	-	-	-	I	1
<i>Pilosella officinarum</i>	1	-	-	-	-	I	1
<i>Poa annua</i>	1	-	-	-	-	I	1
<i>Poa humilis</i>	1	-	-	-	-	I	1
<i>Thymus polytrichus</i>	1	-	-	-	-	I	1
<i>Veronica arvensis</i>	1	-	-	-	-	I	1

Matching coefficients: U1 undifferentiated 46.1, U1e 45.7, U1b 44.2, U2a 43.7, H11 undifferentiated 41.5, H11a 40.9, U1a 39.7

Diagnosis. From the abundance of *Rumex acetosella* plus the grasses *Agrostis capillaris* and *Festuca ovina* this is clearly **U1 Festuca ovina-Agrostis capillaris-Rumex acetosella grassland**. In the complete absence of *Deschampsia flexuosa*, **U2a Deschampsia flexuosa grassland, Festuca ovina-Agrostis capillaris sub-community** is not an acceptable diagnosis. Neither in the absence of *Calluna vulgaris* and *Carex arenaria* is **H11 Calluna vulgaris-Carex arenaria heath** an acceptable diagnosis; it is among the top matches only because of the abundance of mosses and lichens in the sward. Among U1 sub-communities, **U1e Festuca ovina-Agrostis capillaris-Rumex acetosella grassland, Galium saxatile-Potentilla erecta sub-community** is not an acceptable diagnosis owing to the open character of the sward, and to the abundance of mosses, lichens and annual vascular plants. These characteristics are so pronounced that this sward is probably best regarded as U1-undifferentiated, or else as atypical **U1b Festuca ovina-Agrostis capillaris-Rumex acetosella grassland, typical sub-community**.



Table 14. NVC table for 5 two-metre square quadrats in closed, short, calcifugous turf on the lower ramparts at the north-western corner of British Camp (U1-undifferentiated).

Species	Q66	Q67	Q68	Q69	Q70	Freq.	Cover
<i>Festuca ovina</i>	7	7	7	6	6	V	6-7
<i>Galium saxatile</i>	4	4	5	4	5	V	4-5
<i>Agrostis capillaris</i>	5	4	5	3	4	V	3-5
<i>Dicranum scoparium</i>	5	5	3	5	5	V	3-5
<i>Rumex acetosella</i>	4	5	4	3	4	V	3-5
<i>Aira praecox</i>	3	3	2	4	3	V	2-4
<i>Cladonia cf. rangiformis</i>	1	2	1	1	1	V	1-2
<i>Holcus mollis</i>	-	3	3	4	3	IV	3-4
<i>Luzula campestris</i>	3	2	3	4	-	IV	2-4
<i>Polytrichum piliferum</i>	3	4	4	1	-	IV	1-4
<i>Thymus polytrichus</i>	2	2	-	1	4	IV	1-4
<i>Hypnum cf. lacunosum</i>	3	3	3	3	-	IV	3
<i>Deschampsia flexuosa</i>	-	1	1	2	1	IV	1-2
<i>Pilosella officinarum</i>	5	5	2	-	-	III	2-5
<i>Polytrichum juniperinum</i>	1	1	2	-	-	III	1-2
<i>Pleurozium schreberi</i>	1	1	-	1	-	III	1
<i>Calluna vulgaris</i>	-	2	-	4	-	II	2-4
<i>Cladonia cf. portentosa</i>	3	-	1	-	-	II	1-3
<i>Aphanes australis</i>	-	-	2	-	1	II	1-2
<i>Anthoxanthum odoratum</i>	-	-	1	1	-	II	1
<i>Pseudoscleropodium purum</i>	1	-	-	1	-	II	1
<i>Carex caryophyllea</i>	-	-	-	-	2	I	2
<i>Veronica officinalis</i>	-	-	2	-	-	I	2
<i>Cladonia cf. foliacea</i>	-	-	1	-	-	I	1
<i>Rhytidiadelphus squarrosus</i>	1	-	-	-	-	I	1
<i>Veronica arvensis</i>	-	-	-	-	1	I	1

Matching coefficients: U1e 47.2, U4e 46.4, U1 undifferentiated 46.3, U20b 45.3, U20 undifferentiated 43.9, U1b 43.8, SD12a 43.3

Diagnosis. The abundance of species such as *Aira praecox*, *Pilosella officinarum* and *Rumex acetosella* places this in **U1 *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland** rather than **U4 *Festuca ovina*-*Agrostis capillaris*-*Galium saxatile* grassland**. The sward is rather too species-rich for **U1e *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland**, ***Galium saxatile*-*Potentilla erecta* sub-community**, and the abundance and range of mosses, lichens and annual vascular plants is somewhat too great. This sward is therefore best assigned to U1-undifferentiated.



Table 15. NVC table for 5 two-metre square quadrats in gaps among *Pteridium aquilinum* below British Camp (U1-undifferentiated but affinities with U20a).

Species	Q71	Q72	Q73	Q74	Q75	Frq.	Cov.
<i>Galium saxatile</i>	6	7	7	7	7	V	6-7
<i>Festuca ovina</i>	6	6	5	5	4	V	4-6
<i>Agrostis capillaris</i>	3	6	3	3	3	V	3-6
<i>Deschampsia flexuosa</i>	1	5	5	5	6	V	1-6
<i>Pseudoscleropodium purum</i>	2	5	6	1	5	V	1-6
<i>Pleurozium schreberi</i>	3	5	4	3	5	V	3-5
<i>Holcus mollis</i>	2	3	4	4	2	V	2-4
<i>Rumex acetosella</i>	3	2	3	3	3	V	2-3
<i>Pteridium aquilinum</i>	1	2	-	3	5	IV	1-5
<i>Dicranum scoparium</i>	2	4	4	3	-	IV	2-4
<i>Pilosella officinarum</i>	-	2	2	1	2	IV	1-2
<i>Teucrium scorodonia</i>	2	2	-	-	3	III	2-3
<i>Thymus polytrichus</i>	4	-	4	-	-	II	4
<i>Luzula campestris</i>	3	3	-	-	-	II	3
<i>Polytrichum juniperinum</i>	1	-	-	2	-	II	1-2
<i>Anthoxanthum odoratum</i>	1	-	-	-	1	II	1
<i>Aira praecox</i>	2	-	-	-	-	I	2
<i>Aphanes australis</i>	2	-	-	-	-	I	2
<i>Ceratodon purpureus</i>	-	-	-	-	2	I	2
<i>Myosotis discolor</i>	2	-	-	-	-	I	2
<i>Moenchia erecta</i>	-	-	-	1	-	I	1
<i>Veronica officinalis</i>	-	1	-	-	-	I	1

Matching coefficients: U20b 52.1, U20 undifferentiated 50.5, U1e 49.9, U20a 49.6, U4e 47.8, **U1 undifferentiated 44.6**

Diagnosis. Despite not especially low matching coefficients, none of the top six matches are entirely satisfactory diagnoses. **U20b *Pteridium aquilinum*-*Galium saxatile* community, *Vaccinium myrtillus*-*Dicranum scoparium* sub-community** is not an acceptable diagnosis as the stand largely lacks ericaceous shrubs and other heath associates, save for weak indications such as the abundance of *Deschampsia flexuosa* and the mosses *Dicranum scoparium*, *Pleurozium schreberi* and *Pseudoscleropodium purum*. The cover of *Pteridium aquilinum* (Bracken) is barely sufficient for any of the U20 matches. The general sward composition is consistent with **U1 *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland**, but the scatter of annuals is not especially consistent with **U1e *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland, *Galium saxatile*-*Potentilla erecta* sub-community**. A scatter of *Pteridium aquilinum* is acceptable in U1 (Rodwell 1992), but the high constancy of *Pteridium* here is atypical, though it could be an artefact of sampling in a small area. On balance this vegetation is probably best assigned to U1 undifferentiated, though it may fairly be regarded as transitional to **U20a *Pteridium aquilinum*-*Galium saxatile* community, *Anthoxanthum odoratum* sub-community**.



Table 16. NVC table for 5 two-metre square quadrats in calcifugous grassland on the lower ramparts of British Camp (U1-undifferentiated - U4-undifferentiated).

Species	Q76	Q77	Q78	Q79	Q80	Freq.	Cover
<i>Agrostis capillaris</i>	5	7	6	7	8	V	5-8
<i>Galium saxatile</i>	7	7	5	8	7	V	5-8
<i>Festuca ovina</i>	2	4	6	5	4	V	2-5
<i>Rhynchospora squarrosus</i>	4	5	1	5	5	V	1-5
<i>Poa humilis</i>	3	4	3	3	4	V	3-4
<i>Pleurozium schreberi</i>	4	1	1	3	1	V	1-4
<i>Rumex acetosella</i>	2	1	1	3	2	V	1-3
<i>Deschampsia flexuosa</i>	5	2	1	1	-	IV	1-5
<i>Festuca rubra</i>	4	4	5	-	-	III	4-5
<i>Achillea millefolium</i>	-	-	5	4	1	III	1-5
<i>Holcus mollis</i>	-	5	3	4	4	III	3-5
<i>Pseudoscleropodium purum</i>	4	-	1	3	-	III	1-4
<i>Dicranum scoparium</i>	1	-	1	-	1	III	1
<i>Galium verum</i>	1	1	1	-	-	III	1
<i>Hypnum</i> cf. <i>lacunosum</i>	-	2	5	-	-	II	2-5
<i>Pilosella officinarum</i>	-	1	4	-	-	II	1-4
<i>Aira praecox</i>	-	1	3	-	-	II	1-3
<i>Campanula rotundifolia</i>	-	-	-	1	3	II	1-3
<i>Anthoxanthum odoratum</i>	3	-	-	3	-	II	3
<i>Luzula campestris</i>	1	-	1	-	-	II	1
<i>Moenchia erecta</i>	-	1	1	-	-	II	1
<i>Aphanes australis</i>	-	-	2	-	-	I	1
<i>Carex muricata</i> ssp. <i>lamprocarpa</i>	-	-	-	-	1	I	1
<i>Myosotis discolor</i>	-	-	-	-	1	I	1
<i>Veronica arvensis</i>	-	-	1	-	-	I	1

Matching coefficients: SD12b 55.4, U4a 53.2, U20 undifferentiated 51.2, U20a 50.3, U4e 49.7, U4 undifferentiated 49.7, U1e 49.2

Diagnosis. This is neither sand-dune nor bracken vegetation, and matches with **SD12 *Carex arenaria-Festuca ovina-Agrostis capillaris* dune grassland** and **U20 *Pteridium aquilinum-Galium saxatile* community** are unacceptable. The presence of a wide range of grasses including *Anthoxanthum odoratum*, *Festuca rubra* and *Holcus mollis* together with mesic dicotyledonous herbs such as *Achillea millefolium* places this sward close to **U4a *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland, typical sub-community** (and with **U4b *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland, *Holcus lanatus-Trifolium repens* sub-community** though this does not appear among the matching coefficients). However, U1 preferentials such as *Aira praecox*, *Pilosella officinarum* and *Rumex acetosella* are common, and a scatter of annuals such as *Moenchia erecta*, *Myosotis discolor* and *Veronica arvensis* reinforces this the view that there are affinities with **U1 *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland**. This sward is therefore best regarded as transitional between U1-undifferentiated and U4-undifferentiated.



Table 17. NVC table for 5 two metre-square quadrats in from calcifugous grassland on Ragged Stone Hill (U1u-U4u).

Species	Q81	Q82	Q83	Q84	Q85	Frq.	Cov.
<i>Festuca ovina</i>	8	7	7	8	7	V	7-8
<i>Hylocomium splendens</i>	6	8	8	6	8	V	6-8
<i>Galium saxatile</i>	7	7	7	8	5	V	5-8
<i>Agrostis capillaris</i>	4	5	6	4	7	V	4-7
<i>Cladonia cf rangiformis</i>	5	1	1	2	1	V	1-5
<i>Luzula campestris</i>	2	4	4	5	5	V	2-5
<i>Deschampsia flexuosa</i>	4	2	4	3	3	V	2-4
<i>Dicranum scoparium</i>	4	1	1	1	3	V	1-4
<i>Rumex acetosella</i>	3	3	3	2	3	V	2-3
<i>Anthoxanthum odoratum</i>	2	3	1	4	-	IV	1-4
<i>Aira praecox</i>	1	1	-	-	3	III	1-3
<i>Cladonia cf. portentosa</i>	-	1	1	-	1	III	1
<i>Rhytidiadelphus squarrosus</i>	-	-	-	5	4	II	4-5
<i>Fraxinus excelsior</i> (s)	-	-	-	2	2	II	2
<i>Hyacinthoides non-scripta</i>	-	-	-	2	1	II	1-2
<i>Veronica arvensis</i>	-	2	-	-	-	I	2
<i>Sorbus aucuparia</i> (s)	1	-	-	-	-	I	1
<i>Myosotis discolor</i>	-	1	-	-	-	I	1
<i>Sagina procumbens</i>	-	1	-	-	-	I	1
<i>Vulpia bromoides</i>	-	1	-	-	-	I	1
<i>Acer pseudoplatanus</i> (s)	-	-	1	-	-	I	1
<i>Veronica officinalis</i>	-	-	-	1	-	I	1
<i>Polytrichum juniperinum</i>	-	-	-	-	1	I	1
<i>Cladonia cf. foliacea</i>	-	-	-	-	1	I	1

Matching coefficient: U1e 44.3, U5a 44.0, U1 undifferentiated

Diagnosis. This vegetation has a high constancy of three species of conflicting associations, namely *Deschampsia flexuosa* with both *Galium saxatile* and *Rumex acetosella*. It is a relatively tall, closed sward with abundant mosses, similar to **U1e Festuca ovina-Agrostis capillaris-Rumex acetosella grassland**, **Galium saxatile-Potentilla erecta sub-community**, but without any *Potentilla erecta*. And the high constancy of *Rumex acetosella* precludes any definite match with **U4 Festuca ovina-Agrostis capillaris-Galium saxatile grassland**, despite broad similarities. It is best referable to a transition between U1-undifferentiated and U4-undifferentiated.



Table 18. NVC table for 5 two-metre square quadrats in grassy heather to the east of British Camp (U1-undifferentiated - U20b).

Species	Q86	Q87	Q88	Q89	Q90	Frq.	Cov.
<i>Calluna vulgaris</i>	8	8	7	8	9	V	7-9
<i>Pleurozium schreberi</i>	4	3	4	5	5	V	3-5
<i>Festuca ovina</i>	4	4	4	4	4	V	4
<i>Galium saxatile</i>	4	3	4	4	3	V	3-4
<i>Deschampsia flexuosa</i>	4	2	4	4	4	V	2-4
<i>Anthoxanthum odoratum</i>	3	3	2	1	2	V	1-3
<i>Rumex acetosella</i>	1	1	2	3	2	V	1-3
<i>Luzula campestris</i>	1	-	1	2	-	III	1-2
<i>Pseudoscleropodium purum</i>	2	2	1	-	-	III	1-2
<i>Agrostis capillaris</i>	-	-	4	1	-	II	1-4
<i>Aira praecox</i>	-	1	1	-	-	II	1
<i>Aphanes australis</i>	-	-	2	-	-	I	2
<i>Dicranum scoparium</i>	2	-	-	-	-	I	2
<i>Polytrichum juniperinum</i>	-	-	-	-	2	I	2
<i>Veronica officinalis</i>	-	-	-	-	2	I	2
<i>Cerastium glomeratum</i>	-	-	1	-	-	I	1
<i>Ceratodon purpureus</i>	-	-	-	-	1	I	1
<i>Rhytidadelphus squarrosus</i>	-	1	-	-	-	I	1
<i>Sagina procumbens</i>	-	1	-	-	-	I	1
<i>Veronica arvensis</i>	-	-	1	-	-	I	1

Matching coefficients: U20b 52.0, U1e 50.8, U20 undifferentiated 50.1, U2 undifferentiated 49.1, U5a 48.9, U4e 48.6, U1 undifferentiated 47.5, H8e 47.5.

Diagnosis. Despite reasonably high matching coefficients, none of the top six matches are satisfactory diagnoses. The **U20 *Pteridium aquilinum-Galium saxatile* community** types are unsatisfactory owing to the complete lack of *Pteridium aquilinum*. The **U1 *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland** and **U2 *Deschampsia flexuosa* grassland** types are unsatisfactory owing to the high cover of *Calluna*. And **H8e *Calluna vulgaris-Ulex gallii* heath, *Vaccinium myrtillus* sub-community** is unsatisfactory owing to high grass cover and the lack of *Ulex gallii* and *Vaccinium myrtillus*. This is probably best regarded as transitional from U1 undifferentiated to **U20b *Pteridium aquilinum-Galium saxatile* community, *Vaccinium myrtillus-Dicranum scoparium* sub-community** or **H8e *Calluna vulgaris-Ulex gallii* heath, *Vaccinium myrtillus* sub-community**.



Table 19. NVC table for 5 two-metre square quadrats in short calcifugous turf to the north of British Camp (U1-undifferentiated - U2a).

Species	Q91	Q92	Q93	Q94	Q95	Freq.	Cover
<i>Festuca ovina</i>	8	8	7	8	6	V	6-8
<i>Galium saxatile</i>	7	8	7	6	6	V	6-8
<i>Agrostis capillaris</i>	5	4	8	6	6	V	4-8
<i>Rumex acetosella</i>	4	4	7	3	5	V	3-7
<i>Hypnum cupressiforme</i>	4	4	2	6	5	V	2-6
<i>Deschampsia flexuosa</i>	6	3	1	3	6	V	1-6
<i>Hypnum</i> cf. <i>lacunosum</i>	3	5	4	5	5	V	3-5
<i>Luzula campestris</i>	3	-	1	4	4	IV	1-4
<i>Rhynchospora squarrosa</i>	-	1	2	3	4	IV	1-4
<i>Dicranum scoparium</i>	5	2	-	2	-	III	2-5
<i>Festuca rubra</i>	-	-	4	-	4	II	4
<i>Aira praecox</i>	-	1	-	3	-	II	1-3
<i>Holcus mollis</i>	-	3	1	-	-	II	1-3
<i>Pleurozium schreberi</i>	4	-	-	-	-	I	4
<i>Anthoxanthum odoratum</i>	-	-	-	1	-	I	1

Matching coefficients: U4e 54.4, U5a 49.6, U1e 49.3, U20b 48.3, U2 undifferentiated 48.2, U2a 47.9, U4a 47.8, U20a 47.4

Diagnosis. Most of the species in this sward are common to **U1 *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland**, **U2 *Deschampsia flexuosa* grassland** and **U4 *Festuca ovina*-*Agrostis capillaris*-*Galium saxatile* grassland**, and the species-poor sward lacks species that would differentiate between these communities. The abundance of *Rumex acetosella* is sufficient to eliminate **U4 *Festuca ovina*-*Agrostis capillaris*-*Galium saxatile* grassland** given that U1 and U2 are just as acceptable. With *Deschampsia flexuosa* at moderate levels of abundance this sward is probably best regarded as transitional from **U1 *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland** to **U2a *Deschampsia flexuosa* grassland, *Festuca ovina*-*Agrostis capillaris* sub-community**.



Table 20. NVC table for 5 two-metre square quadrats in short calcifugous turf on level ground in the northern part of British Camp (U1-undifferentiated - U2a).

Species	Q96	Q97	Q98	Q99	Q100	Freq.	Cover
<i>Deschampsia flexuosa</i>	6	8	9	8	7	V	6-9
<i>Galium saxatile</i>	7	7	7	8	8	V	7-8
<i>Festuca ovina</i>	8	6	3	3	6	V	3-8
<i>Hypnum cupressiforme</i>	1	4	1	4	1	V	1-4
<i>Luzula campestris</i>	4	3	3	1	3	V	1-4
<i>Rumex acetosella</i>	2	1	1	2	3	V	1-3
<i>Dicranum scoparium</i>	-	1	4	6	6	IV	1-6
<i>Pleurozium schreberi</i>	1	-	2	1	-	III	1-2
<i>Rhytidiadelphus squarrosus</i>	6	1	-	-	-	II	1-6
<i>Agrostis capillaris</i>	5	4	-	-	-	II	4-5
<i>Aira praecox</i>	-	2	-	-	3	II	2-3
<i>Hypnum</i> cf. <i>lacunosum</i>	-	3	1	-	-	II	1-3
<i>Danthonia decumbens</i>	-	-	-	1	1	II	1
<i>Anthoxanthum odoratum</i>	-	-	3	-	-	I	3
<i>Campanula rotundifolia</i>	2	-	-	-	-	I	2
<i>Holcus mollis</i>	-	2	-	-	-	I	2
<i>Ceratodon purpureus</i>	-	-	-	-	1	I	1

Matching coefficients: U20b 53.8, U4e 53.8, U5a 50.4, U2 50.3, H1c 49.4, H18c 48.5, U1e 47.9, U2a 47.3

Diagnosis. From the dominance of *Deschampsia flexuosa* this vegetation clearly has affinities with **U2a *Deschampsia flexuosa* grassland, *Festuca ovina*-*Agrostis capillaris* sub-community**. The matches with **U20 *Pteridium aquilinum*-*Galium saxatile* community** are unacceptable owing to the complete absence of *Pteridium aquilinum*; those with **U5 *Nardus stricta*-*Galium saxatile* grassland** are unacceptable owing to the complete lack of *Nardus stricta*; and those with **H1c *Calluna vulgaris*-*Festuca ovina* heath, *Teucrium scorodonia* sub-community** and **H18 *Vaccinium myrtillus*-*Deschampsia flexuosa* heath** are unacceptable owing to the complete lack of *Vaccinium myrtillus*. This is simply not bracken, mat-grass or heath vegetation. The high matching coefficients with these NVC types probably result from its extremely species-poor character. The presence *Agrostis capillaris*, *Festuca ovina* and *Rumex acetosella* at moderate to high levels of abundance suggests affinities with **U1 *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland** rather than **U4 *Festuca ovina*-*Agrostis capillaris*-*Galium saxatile* grassland**, but all of the species in this sward are common to U1 and U2. This grassland is close to U2a but best assigned to the transition from U1-undifferentiated to U2a.



Table 21. NVC table for 5 two-metre square quadrats in short calcifugous turf on the northern slope of Herefordshire Beacon (U1u-U2a).

Species	Q101	Q102	Q103	Q104	Q105	Freq.	Cover
<i>Deschampsia flexuosa</i>	8	8	4	8	8	V	4-8
<i>Galium saxatile</i>	7	5	4	7	6	V	4-7
<i>Pleurozium schreberi</i>	7	2	2	4	4	V	2-7
<i>Festuca ovina</i>	4	5	6	4	4	V	4-6
<i>Agrostis capillaris</i>	1	2	1	5	2	V	1-5
<i>Rhynchospora squarrosus</i>	3	2	1	4	2	V	1-4
<i>Luzula campestris</i>	1	1	2	1	1	V	1-2
<i>Dicranum scoparium</i>	5	2	5	-	2	IV	2-5
<i>Rumex acetosella</i>	3	4	5	-	-	III	3-5
<i>Holcus lanatus</i>	3	3	3	-	-	III	3
<i>Aira praecox</i>	1	3	3	-	-	III	1-3
<i>Fraxinus excelsior</i> (s)	-	-	-	1	3	II	1-3
<i>Hypnum cupressiforme</i>	-	1	1	-	-	II	1
<i>Polytrichum juniperinum</i>	-	1	-	-	1	II	1
<i>Polytrichum piliferum</i>	1	-	1	-	-	II	I
<i>Anthoxanthum odoratum</i>	-	-	6	-	-	I	6
<i>Hypnum lacunosum</i>	-	-	-	-	3	I	3
<i>Campylopus</i> species	-	-	-	-	2	I	2
<i>Pilosella officinarum</i>	-	-	2	-	-	I	2
<i>Ptilidium ciliare</i>	-	-	-	-	2	I	2
<i>Teucrium scorodonia</i>	-	-	2	-	-	I	2
<i>Ceratodon purpureus</i>	-	-	1	-	-	I	1

Matching coefficients: U20b 53.5, U4e 52.4, U5a 51.9, U1e 51.3, U20a 49.8, U2 undifferentiated 48.7, U2a 47.9

Diagnosis. From the dominance of *Deschampsia flexuosa* this vegetation clearly has affinities with **U2a *Deschampsia flexuosa* grassland, *Festuca ovina*-*Agrostis capillaris* sub-community**. The matches with **U20 *Pteridium aquilinum*-*Galium saxatile* community** are unacceptable owing to the complete absence of *Pteridium aquilinum*; those with **U4e *Festuca ovina*-*Agrostis capillaris*-*Galium saxatile* grassland, *Vaccinium myrtillus*-*Deschampsia flexuosa* sub-community** are unacceptable due to the high constancy of *Rumex acetosella*. The presence *Agrostis capillaris*, *Festuca ovina* and *Rumex acetosella* at moderate to high levels of abundance suggests affinities with **U1 *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland** rather than **U4 *Festuca ovina*-*Agrostis capillaris*-*Galium saxatile* grassland**, but all of the species in this sward are common to U1 and U2. Due to the high dominance of *Deschampsia flexuosa* and other typical associates, this vegetation is best referable to a transition from U1 to U2a.



Table 22. NVC table for 5 two-metre square quadrats in closed, species-poor, calcifugous grassland at the northern end of Millenium Hill (U2a).

Species	Q106	Q107	Q108	Q109	Q110	Freq.	Cover
<i>Deschampsia flexuosa</i>	8	8	8	7	8	V	7-8
<i>Festuca ovina</i>	6	5	6	7	6	V	5-7
<i>Luzula campestris</i>	2	5	3	4	4	V	2-5
<i>Dicranum scoparium</i>	1	1	1	2	5	V	1-5
<i>Anthoxanthum odoratum</i>	4	4	1	4	4	V	1-4
<i>Pleurozium schreberi</i>	4	1	2	1	2	V	1-4
<i>Galium saxatile</i>	7	7	8	7	-	IV	7-8
<i>Agrostis capillaris</i>	-	4	2	4	2	IV	2-4
<i>Potentilla erecta</i>	2	1	-	-	-	II	1-2
<i>Hypnum cupressiforme</i>	-	-	-	1	1	II	1
<i>Poa humilis</i>	-	-	-	4	-	I	4
<i>Aira praecox</i>	-	-	-	-	1	I	1

Matching coefficients: U20b 57.2, U5a 56.1, U4e 56.1, U20 undifferentiated 53.3, U4a 51.7, U20a 51.5, U2 undifferentiated 50.8, U1e 48.6, H18 undifferentiated 48.5

Diagnosis. From the dominance of *Deschampsia flexuosa* this vegetation is probably best assigned to **U2a *Deschampsia flexuosa* grassland, *Festuca ovina*-*Agrostis capillaris* sub-community** even though this NVC type does not appear among the matching coefficients. The matches with **U20 *Pteridium aquilinum*-*Galium saxatile* community** are unacceptable owing to the complete absence of *Pteridium aquilinum*; those with **U5 *Nardus stricta*-*Galium saxatile* grassland** are unacceptable owing to the complete lack of *Nardus stricta*; and those with **H18 *Vaccinium myrtillus*-*Deschampsia flexuosa* heath** are unacceptable owing to the complete lack of *Vaccinium myrtillus*. This is simply not bracken, mat-grass or heath vegetation. The high matching coefficients with these NVC types probably result from its extremely species-poor character. The presence of the grasses *Agrostis capillaris* and *Festuca ovina* suggests some affinities with **U1 *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland** and - in the absence of *Rumex acetosella* - with **U4 *Festuca ovina*-*Agrostis capillaris*-*Galium saxatile* grassland**, but all of the species in this sward are common to U1, U2 and U4, and while there may be a degree of transition towards U1, which occurs nearby, it is not sufficient to justify assignment of the sward to the transition rather than U2a.



Table 23. NVC table for 5 two-metre square quadrats in in short calcifugous turf on the western face of the lowest rampart of British Camp(U2a).

Species	Q111	Q112	Q113	Q114	Q115	Freq.	Cover
<i>Deschampsia flexuosa</i>	8	8	8	7	7	V	7-8
<i>Galium saxatile</i>	5	7	6	7	5	V	5-7
<i>Pleurozium schreberi</i>	7	6	1	4	3	V	1-7
<i>Festuca ovina</i>	3	1	3	4	5	V	1-5
<i>Anthoxanthum odoratum</i>	2	2	2	3	-	IV	2-3
<i>Dicranum scoparium</i>	1	3	-	2	2	IV	1-3
<i>Rumex acetosella</i>	1	1	-	3	1	IV	1-3
<i>Hypnum cupressiforme</i>	-	-	8	1	1	III	1-8
<i>Hypnum</i> cf. <i>lacunosum</i>	2	-	-	1	4	III	1-4
<i>Rhytidiadelphus squarrosus</i>	-	-	1	1	4	III	1-4
<i>Luzula campestris</i>	-	3	2	-	1	III	1-3
<i>Agrostis capillaris</i>	-	-	-	4	4	II	4
<i>Holcus mollis</i>	1	3	-	-	-	II	1-3
<i>Polytrichastrum formosum</i>	2	-	-	-	-	I	2
<i>Aira praecox</i>	-	-	-	1	-	I	1

Matching coefficients: U20b 59.8, U5a 57.9, U4e 56.2, U20 undifferentiated 54.9, U20a 51.9, U2 undifferentiated 50.8, H18 undifferentiated 49.3, U5b 48.2, H18c 48.0, **U2a 47.8**.

Diagnosis. The matches with **U20 *Pteridium aquilinum-Galium saxatile* community** are unacceptable owing to the complete absence of *Pteridium aquilinum*; those with **U5 *Nardus stricta-Galium saxatile* grassland** are unacceptable owing to the complete lack of *Nardus stricta*; and those with **H18 *Vaccinium myrtillus-Deschampsia flexuosa* heath** are unacceptable owing to the complete lack of *Vaccinium myrtillus*. This is simply not bracken, mat-grass or heath vegetation. The high matching coefficients with these NVC types probably result from its extremely species-poor character. Neither in the absence of heath associates would **U2 *Deschampsia flexuosa* grassland** undifferentiated be a preferable diagnosis to **U2a *Deschampsia flexuosa* grassland, *Festuca ovina-Agrostis capillaris* sub-community**. For U2a this grassland is species-poor, and atypical in the high cover of pleurocarpous mosses, but U2a is the only acceptable diagnosis.



Table 24. NVC table for 5 two-metre square quadrats in short turf close to the reservoir (U4b).

Species	Q116	Q117	Q118	Q119	Q120	Frq.	Cov.
<i>Festuca ovina</i>	6	8	6	7	6	V	6-8
<i>Agrostis capillaris</i>	7	6	7	7	7	V	6-7
<i>Rhynchospora squarrosus</i>	4	6	4	7	6	V	4-7
<i>Trifolium repens</i>	2	3	4	5	4	V	2-5
<i>Luzula campestris</i>	4	4	4	4	4	V	4
<i>Holcus lanatus</i>	4	4	2	4	2	V	2-4
<i>Galium saxatile</i>	1	3	4	1	2	V	1-4
<i>Pilosella officinarum</i>	-	2	3	1	6	IV	1-6
<i>Anthoxanthum odoratum</i>	4	-	3	3	-	III	3-4
<i>Carex hirta</i>	-	4	4	3	-	III	3-4
<i>Cerastium fontanum</i>	3	2	-	-	1	III	1-3
<i>Lotus corniculatus</i>	3	-	1	1	-	III	1-3
<i>Trifolium dubium</i>	1	-	2	-	1	III	1-2
<i>Potentilla erecta</i>	3	-	-	5	-	II	3-5
<i>Cirsium arvense</i>	4	1	-	-	-	II	1-4
<i>Danthonia decumbens</i>	-	-	-	1	1	II	1
<i>Trisetum flavescens</i>	-	1	1	-	-	II	1
<i>Veronica chamaedrys</i>	5	-	-	-	-	I	5
<i>Festuca rubra</i>	4	-	-	-	-	I	4
<i>Hypnum</i> cf. <i>lacunosum</i>	-	-	-	-	4	I	4
<i>Leontodon saxatilis</i>	-	-	-	-	4	I	4
<i>Achillea millefolium</i>	-	3	-	-	-	I	3
<i>Rumex acetosella</i>	-	3	-	-	-	I	3
<i>Scorzoneroides autumnalis</i>	-	-	-	-	3	I	3
<i>Calluna vulgaris</i>	-	-	-	-	2	I	2
<i>Poa humilis</i>	-	-	2	-	-	I	2
<i>Polytrichum juniperinum</i>	-	-	-	-	2	I	2
<i>Aira caryophylla</i>	-	-	-	-	1	I	1
<i>Aira praecox</i>	-	-	-	-	1	I	1
<i>Carex flacca</i>	-	-	-	1	-	I	1
<i>Myosotis discolor</i>	-	-	-	-	1	I	1
<i>Plantago lanceolata</i>	-	-	1	-	-	I	1
<i>Poa annua</i>	-	-	-	-	1	I	1
<i>Ranunculus repens</i>	-	-	1	-	-	I	1
<i>Sagina procumbens</i>	-	-	-	-	1	I	1
<i>Vulpia bromoides</i>	-	-	-	-	1	I	1

Matching coefficients: **U4b 52.7**, U1e 52.3, U4a 52.3, U20a 48.5 CG10a 48.2

Diagnosis. This is probably best assigned to **U4b *Festuca ovina*-*Agrostis capillaris*-*Galium saxatile* grassland, *Holcus lanatus*-*Trifolium repens* sub-community**, though it is atypical in the presence of species characteristic of **U1 *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland**, especially *Aira praecox* and *Pilosella officinarum*, suggesting a small degree of transition towards U1.



Table 25. NVC table for 5 two-metre square quadrats in grass at the Black Hill car park (U4b).

Species	Q1221	Q122	Q123	Q124	Q125	Frq.	Cov.
<i>Festuca rubra</i>	7	8	6	8	7	V	6-8
<i>Rumex acetosa</i>	3	2	7	2	5	V	2-7
<i>Holcus lanatus</i>	2	4	6	4	2	V	2-6
<i>Anthoxanthum odoratum</i>	5	4	2	4	5	V	2-5
<i>Achillea millefolium</i>	4	4	3	4	4	V	3-4
<i>Agrostis capillaris</i>	4	3	4	4	4	V	3-4
<i>Ranunculus bulbosus</i>	4	4	1	3	3	V	1-4
<i>Campanula rotundifolia</i>	1	3	3	2	1	V	1-3
<i>Rhytidadelphus squarrosus</i>	1	4	-	6	4	IV	1-6
<i>Poa pratensis</i>	3	4	-	4	5	IV	3-5
<i>Plantago lanceolata</i>	5	5	2	4	-	IV	2-5
<i>Luzula campestris</i>	3	3	-	2	4	IV	2-4
<i>Conopodium majus</i>	-	3	3	3	3	IV	3
<i>Dactylis glomerata</i>	3	1	2	-	1	IV	1-3
<i>Trifolium repens</i>	3	3	-	3	-	III	3
<i>Poa trivialis</i>	3	2	3	-	-	III	2-3
<i>Veronica chamaedrys</i>	6	-	-	-	5	II	5-6
<i>Hyacinthoides non-scripta</i>	-	-	-	1	2	II	1-2
<i>Potentilla erecta</i>	1	2	-	-	-	II	1-2
<i>Centaurea nigra</i>	4	-	-	-	-	I	4
<i>Galium verum</i>	2	-	-	-	-	I	2
<i>Arrhenatherum elatius</i>	-	-	-	-	1	I	1
<i>Galium saxatile</i>	-	-	-	-	1	I	1
<i>Heracleum sphondylium</i>	1	-	-	-	-	I	1
<i>Pilosella officinarum</i>	-	-	-	1	-	I	1
<i>Pseudoscleropodium purum</i>	-	-	-	1	-	I	1
<i>Rubus fruticosus</i> agg.	-	1	-	-	-	I	1
<i>Stellaria graminea</i>	-	-	-	-	1	I	1
<i>Taraxacum</i> sect. <i>Ruderalia</i> species	1	-	-	-	-	I	1
<i>Viola riviniana</i>	-	-	-	-	1	I	1

Matching coefficients: **U4b 60.7**, MG6b 53.7, MG5 undifferentiated 52.4, MG3 undifferentiated 51.8, MG5c 50.7, MG1e 50.6

Diagnosis. This stand is clearly referable to the NVC type **U4b *Festuca ovina*-*Agrostis capillaris*-*Galium saxatile* grassland, *Holcus lanatus*-*Trifolium repens* sub-community**. **MG6b *Lolium perenne*-*Cynosurus cristatus* grassland, *Anthoxanthum odoratum* sub-community** and **MG5 *Cynosurus cristatus*-*Centaurea nigra* grassland** are not acceptable diagnoses owing to the lack of *Cynosurus cristatus* and *Lolium perenne*.



Table 26. NVC table for 5 two-metre square quadrats in heath and bracken vegetation south of the reservoir (U20b).

Species	Q126	Q127	Q128	Q129	Q130	Frq.	Cov.
<i>Pleurozium schreberi</i>	8	5	8	8	8	V	5-8
<i>Deschampsia flexuosa</i>	6	6	7	6	7	V	6-7
<i>Calluna vulgaris</i>	6	4	4	6	2	V	2-6
<i>Pteridium aquilinum</i>	4	1	1	4	5	V	1-5
<i>Galium saxatile</i>	1	4	3	1	4	V	1-4
<i>Hypnum cupressiforme</i>	2	-	1	2	1	IV	1-2
<i>Fraxinus excelsior</i> (g)	1	1	1	-	1	IV	1
<i>Anthoxanthum odoratum</i>	-	1	4	-	4	III	1-4
<i>Dicranum scoparium</i>	1	1	-	1	-	III	1
<i>Cladonia</i> cf. <i>furcata</i>	-	4	-	2	-	II	2-4
<i>Quercus robur</i> (g)	-	-	1	1	-	II	1
<i>Teucrium scorodonia</i>	-	1	1	-	-	II	1
<i>Festuca ovina</i>	-	4	-	-	-	I	4
<i>Potentilla erecta</i>	-	-	-	-	2	I	2
<i>Agrostis capillaris</i>	-	3	-	-	-	I	1
<i>Holcus mollis</i>	-	-	-	-	1	I	1
<i>Pseudoscleropodium purum</i>	-	-	-	-	1	I	1
<i>Rhytidadelphus squarrosus</i>	-	-	1	-	-	I	1
<i>Rumex acetosella</i>	-	1	-	-	-	I	1
<i>Sorbus aucuparia</i> (g)	1	-	-	-	-	I	1

Matching coefficients: **U20b 62.1**, U2 undifferentiated 57.8, H8e 53.5, U20c 52.8, H9d 52.3, U2a 52.4

Diagnosis. Owing to its species-poor character, this stand might acceptably be assigned to any of the first three matches, between which there is little to choose in the absence of a quorum of diagnostic species. The absence of *Vaccinium myrtillus* is a major discrepancy between this stand on the one hand and **U20b Pteridium aquilinum-Galium saxatile community**, *Vaccinium myrtillus-Dicranum scoparium sub-community* and **H8e Calluna vulgaris-Ulex gallii heath, Vaccinium myrtillus sub-community** on the other. The high constancy of *Pteridium aquilinum* is a discrepancy between this stand on the one hand and **U2 Deschampsia flexuosa grassland** and **H8e Calluna vulgaris-Ulex gallii heath, Vaccinium myrtillus sub-community** on the other, while the high constancy of *Calluna vulgaris* is a discrepancy between this stand and U20b (though the high levels of *Calluna* cover are not at all inconsistent with U20b). These high constancies may be misleading, since they could simply be an artefact of sampling in a small area. The absence of *Ulex gallii* argues somewhat against H8e. The high cover of the moss *Pleurozium schreberi* is not consistent with any of the communities, though it is a common species in all of them. On balance the stand is probably best assigned to U20b, especially as it is surrounded by denser *Pteridium*, but abundant *Calluna* gives it a very heath-like character, and it might fairly be regarded as somewhat transitional to H8e.



Table 27. NVC table for 5 two-metre square quadrats in mixed vegetation on the northern slopes of Broad Down (non-NVC type).

Species	Q131	Q132	Q133	Q134	Q135	Frq.	Cov.
<i>Agrostis capillaris</i>	2	7	8	4	8	V	2-8
<i>Juncus effusus</i>	4	5	4	7	4	V	4-7
<i>Rubus fruticosus</i> agg.	4	4	5	5	2	V	2-5
<i>Holcus lanatus</i>	9	4	1	2	-	IV	1-9
<i>Brachytheceium rutabulum</i>	1	-	2	3	2	IV	1-3
<i>Poa trivialis</i>	1	-	3	3	3	IV	1-3
<i>Chamerion angustifolium</i>	-	1	1	1	1	IV	1
<i>Anthoxanthum odoratum</i>	-	2	-	3	2	III	2-3
<i>Carex ovalis</i>	2	2	-	-	2	III	2
<i>Veronica officinalis</i>	2	-	2	2	-	III	2
<i>Cerastium fontanum</i>	-	1	-	1	1	III	1
<i>Digitalis purpurea</i>	1	-	1	1	-	III	1
<i>Rumex acetosella</i>	-	-	-	4	3	II	3-4
<i>Oxalis acetosella</i>	3	-	-	-	1	II	1-3
<i>Deschampsia flexuosa</i>	-	1	-	1	-	II	1
<i>Kindbergia praelonga</i>	1	-	1	-	-	II	1
<i>Hyacinthoides non-scripta</i>	-	1	1	-	-	II	1
<i>Poa annua</i>	-	1	1	-	-	II	1
<i>Rhytidadelphus squarrosus</i>	1	-	-	-	1	II	1
<i>Pteridium aquilinum</i>	2	-	-	-	-	I	2
<i>Aira praecox</i>	-	-	-	-	1	I	1
<i>Arrhenatherum elatius</i>	-	-	-	1	-	I	1
<i>Ceratocarpus claviculata</i>	-	-	-	1	-	I	1
<i>Dryopteris dilatata</i>	-	1	-	-	-	I	1
<i>Epilobium obscurum</i>	-	-	-	1	-	I	1
<i>Galium aparine</i>	-	-	1	-	-	I	1
<i>Galium saxatile</i>	-	-	1	-	-	I	1
<i>Poa pratensis</i>	-	-	-	-	1	I	1
<i>Urtica dioica</i>	1	-	-	-	-	I	1
<i>Veronica serpyllifolia</i>	-	-	-	1	-	I	1

Matching coefficients: OV27 undifferentiated 49.2, OV27b 46.5, W23 undifferentiated 46.3, W23a 45.7, W23b 42.9, OV27c 42.7, W25b 40.1

Diagnosis. Despite moderately high matching coefficients, none of the matches are remotely satisfactory diagnoses as this is neither scrub nor tall-herb vegetation. It is successional vegetation in areas affected by scrub or tree clearance, and may have affinities with **OV27 *Epilobium angustifolium* community** and **W24 *Rubus fruticosus*-*Holcus lanatus* underscrub**, but the abundance of *Agrostis capillaris* suggests that it might develop towards a mosaic of such types on the one hand and **U1 *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland** on the other. Essentially however it is too confused to be placed in any NVC type.



Table 28. NVC table for 5 two-metre square quadrats in mesotrophic grassland near Rhydd Common.

Species	Q136	Q137	Q138	Q139	Q140	Freq.	Cover
<i>Trifolium pratense</i>	4	5	7	5	4	V	4-7
<i>Agrostis capillaris</i>	6	5	6	4	4	V	4-6
<i>Cynosurus cristatus</i>	5	5	5	5	5	V	5
<i>Holcus lanatus</i>	5	4	4	3	4	V	3-5
<i>Centaurea nigra</i>	2	5	4	4	4	V	2-5
<i>Lotus corniculatus</i>	2	2	4	3	4	V	2-4
<i>Anthoxanthum odoratum</i>	1	4	3	3	4	V	1-4
<i>Potentilla reptans</i>	3	1	3	3	3	V	1-3
<i>Silaum silaus</i>	4	3	-	3	3	IV	3-4
<i>Alopecurus pratensis</i>	3	1	1	1	-	IV	1-3
<i>Briza media</i>	3	-	1	3	1	IV	1-3
<i>Festuca pratensis</i>	3	-	3	1	2	IV	1-3
<i>Ranunculus acris</i>	3	3	-	1	1	IV	1-3
<i>Lathyrus pratensis</i>	1	1	2	1	-	IV	1-2
<i>Agrostis stolonifera</i>	1	1	1	1	-	IV	1
<i>Vicia cracca</i>	4	5	-	1	-	III	1-5
<i>Galium verum</i>	-	-	4	4	3	III	3-4
<i>Cerastium fontanum</i>	-	-	3	2	1	III	1-3
<i>Trifolium repens</i>	-	1	2	2	-	III	1-2
<i>Trisetum flavescens</i>	-	-	2	1	1	III	1-2
<i>Deschampsia cespitosa</i>	1	-	1	1	-	III	1
<i>Hordeum secalinum</i>	-	-	-	3	3	II	3
<i>Dactylis glomerata</i>	-	-	-	1	2	II	1-2
<i>Genista tinctoria</i>	-	2	1	-	-	II	1-2
<i>Rumex acetosa</i>	-	1	-	-	1	II	1
<i>Stellaria graminea</i>	-	1	1	-	-	II	1
<i>Achillea millefolium</i>	-	-	-	-	2	I	2
<i>Leontodon saxatilis</i>	2	-	-	-	-	I	2
<i>Leucanthemum vulgare</i>	-	-	-	2	-	I	2
<i>Agrimonia eupatoria</i>	-	-	-	1	-	I	1
<i>Festuca rubra</i>	-	-	-	1	-	I	1
<i>Plantago lanceolata</i>	-	-	-	-	1	I	1
<i>Phleum bertolonii</i>	-	-	1	-	-	I	1

Matching coefficients: **MG5a 54.6**, MG5 53.8, MG5b 53.0, MG4 52.7, MG9 undifferentiated 51.9, MG9a 51.4, MG1e 50.7, MG5c 50.1, MG6b 49.0

Diagnosis. This vegetation is referable to the NVC type **MG5a *Cynosurus cristatus*-*Centaurea nigra* grassland, *Lathyrus pratensis* sub-community** on account of its overall species-richness, the high cover and diversity of forbs, and the presence of preferential species typical of slightly damper soils, especially *Silaum silaus* and *Vicia cracca*.



Table 29. NVC table for 5 two-metre square quadrats in mesotrophic grassland on the common.

Species	Q141	Q142	Q143	Q144	Q145	Freq.	Cover
<i>Agrostis capillaris</i>	7	8	6	8	7	V	6-8
<i>Trifolium repens</i>	4	5	7	4	1	V	1-7
<i>Cynosurus cristatus</i>	5	2	6	5	4	V	2-6
<i>Trifolium pratense</i>	5	4	4	4	5	V	4-5
<i>Festuca rubra</i>	3	5	3	3	4	V	3-5
<i>Holcus lanatus</i>	4	2	3	2	5	V	2-5
<i>Anthoxanthum odoratum</i>	3	1	4	4	4	V	1-4
<i>Lotus corniculatus</i>	3	4	4	3	1	V	1-4
<i>Lolium perenne</i>	1	1	1	3	3	V	1-3
<i>Rumex acetosa</i>	1	3	2	2	1	V	1-3
<i>Plantago lanceolata</i>	-	1	2	4	1	IV	1-4
<i>Trifolium dubium</i>	2	1	-	4	1	IV	1-4
<i>Alopecurus pratensis</i>	1	-	1	1	1	IV	1
<i>Trisetum flavescens</i>	1	1	-	1	1	IV	1
<i>Hypochaeris radicata</i>	-	1	-	2	4	III	1-4
<i>Galium verum</i>	3	3	3	-	-	III	3
<i>Ranunculus acris</i>	2	-	1	-	1	III	1-2
<i>Cerastium fontanum</i>	1	-	-	1	1	III	1
<i>Leontodon saxatilis</i>	-	-	4	3	-	II	3-4
<i>Achillea millefolium</i>	-	1	-	-	1	II	1
<i>Taraxacum</i> sect. <i>Ruderalia</i>	-	1	-	-	1	II	1
<i>Bromus hordeaceus</i> ssp. <i>hor.</i>	-	-	-	-	1	I	1
<i>Centaurea nigra</i>	-	-	1	-	-	I	1
<i>Geranium dissectum</i>	-	-	-	-	1	I	1
<i>Ranunculus bulbosus</i>	-	-	-	-	1	I	1
<i>Sonchus asper</i>	-	-	-	-	1	I	1
Matching coefficients: <i>MG6b</i> 67.7, <i>MG6</i> undifferentiated 64.3, <i>MG5</i> 63.3, <i>MG5a</i> 61.9, <i>MG5b</i> 61.5, <i>MG6a</i> 61.1, <i>MG5c</i> 56.9, <i>MG6c</i> 56.9, <i>MG4</i> 55.6, <i>MG3a</i> 53.2							

Diagnosis. This vegetation is intermediate between the NVC types **MG5b** *Cynosurus cristatus*-*Centaurea nigra* grassland, *Galium verum* sub-community and **MG6b** *Lolium perenne*-*Cynosurus cristatus* grassland, *Anthoxanthum odoratum* sub-community. The high cover of forbs is typical of *MG5*, but the limited range of common species is more typical of *MG6*. This sward is surrounded by examples of *MG5*, *MG6* and *MG7*, making transition likely.



Table 30. NVC table for 5 two-metre square quadrats mesotrophic on the common.

Species	Q146	Q147	Q148	Q149	Q150	Freq.	Cover
<i>Agrostis capillaris</i>	4	4	7	7	8	V	4-8
<i>Trifolium pratense</i>	7	5	6	7	7	V	5-7
<i>Galium verum</i>	7	4	5	2	5	V	2-7
<i>Trisetum flavescens</i>	3	5	4	3	3	V	3-5
<i>Arrhenatherum elatius</i>	2	4	2	4	3	V	2-4
<i>Festuca rubra</i>	4	1	1	2	2	V	1-4
<i>Holcus lanatus</i>	4	4	1	1	2	V	1-4
<i>Dactylis glomerata</i>	3	2	1	1	2	V	1-3
<i>Plantago lanceolata</i>	3	1	2	1	2	V	1-3
<i>Vicia sativa</i>	3	3	3	3	1	V	1-3
<i>Alopecurus pratensis</i>	1	1	1	1	1	V	1
<i>Phleum bertolonii</i>	-	2	1	1	1	IV	1-2
<i>Lotus corniculatus</i>	-	1	-	6	3	III	1-6
<i>Poa pratensis</i>	1	-	2	1	-	III	1-2
<i>Potentilla reptans</i>	-	1	1	-	1	III	1
<i>Centaurea nigra</i>	-	1	-	1	1	III	1
<i>Ranunculus acris</i>	1	1	1	-	-	III	1
<i>Taraxacum</i> cf. sect. <i>Hamata</i>	1	-	1	1	-	III	1
<i>Trifolium dubium</i>	1	1	-	1	-	III	1
<i>Cerastium fontanum</i>	-	2	4	-	-	II	2-4
<i>Elytrigia repens</i>	-	-	4	-	2	II	2-4
<i>Achillea millefolium</i>	3	-	-	3	-	II	3
<i>Anthoxanthum odoratum</i>	-	-	1	-	1	II	1
<i>Convolvulus arvensis</i>	-	1	1	-	-	II	1
<i>Hordeum secalinum</i>	1	-	-	-	1	II	1
<i>Luzula campestris</i>	-	-	-	1	1	II	1
<i>Geranium dissectum</i>	-	2	-	-	-	I	2
<i>Cynosurus cristatus</i>	-	1	-	-	-	I	1
<i>Lathyrus nissolia</i>	1	-	-	-	-	I	1
<i>Rhinanthus minor</i> ssp. <i>minor</i>	1	-	-	-	-	I	1
<i>Rumex acetosa</i>	1	-	-	-	-	I	1
<i>Tragopogon pratensis</i>	1	-	-	-	-	I	1
<i>Vicia hirsuta</i>	-	-	-	1	-	I	1

Matching coefficients: MG1e 55.6, **MG5b 54.5**, MG5 undifferentiated 53.4, MG6 undifferentiated 51.0, MG6c 50.8, MG5a 50.5, MG6b 50.5, MG1a 48.8, MG6a 47.9

Diagnosis. This vegetation is referable to the NVC type **MG5b *Cynosurus cristatus*-*Centaurea nigra* grassland, *Galium verum* sub-community**. The wide range of grasses and high cover of forbs, especially *Galium verum* is consistent with this. The constancy of *Arrhenatherum elatius* creates slight affinities with **MG1e *Arrhenatherum elatius* grassland, *Centaurea nigra* sub-community**, but *Arrhenatherum elatius* commonly occurs at low levels of abundance in MG5b. Similarly, a lack of the more distinctive and calcicolous Mesobromion species, especially *Carex flacca*, creates affinities with **MG6 *Lolium perenne*-*Cynosurus cristatus* grassland** but the high and diverse forb cover is more consistent with MG5b.



Table 31. NVC table for 5 two-metre square quadrats in mesotrophic grassland on the common.

Species	Q151	Q152	Q153	Q154	Q155	Freq.	Cover
<i>Cynosurus cristatus</i>	4	3	4	5	4	V	3-5
<i>Hordeum secalinum</i>	4	2	4	5	4	V	2-5
<i>Holcus lanatus</i>	3	4	4	4	4	V	3-4
<i>Dactylis glomerata</i>	1	2	3	2	4	V	1-4
<i>Poa trivialis</i>	3	2	1	3	4	V	1-4
<i>Vicia sativa</i> ssp. <i>segetalis</i>	1	1	3	3	1	V	1-3
<i>Agrostis stolonifera</i>	6	7	6	2	-	IV	2-7
<i>Lolium perenne</i>	4	3	5	4	-	IV	3-5
<i>Arrhenatherum elatius</i>	-	1	2	1	4	IV	1-4
<i>Trifolium pratense</i>	-	1	1	3	1	IV	1-3
<i>Ranunculus acris</i>	-	1	2	2	2	IV	1-2
<i>Geranium dissectum</i>	1	1	1	1	-	IV	1
<i>Trisetum flavescens</i>	1	-	-	1	4	III	1-4
<i>Alopecurus pratensis</i>	3	-	-	3	3	III	3
<i>Phleum bertolonii</i>	-	1	1	-	1	III	1
<i>Agrostis capillaris</i>	-	-	-	3	5	II	3-5
<i>Festuca pratensis</i>	-	2	1	-	-	II	1-2
<i>Cerastium fontanum</i>	-	-	1	-	1	II	1
<i>Festuca rubra</i>	-	-	1	-	1	II	1
<i>Ranunculus repens</i>	1	1	-	-	-	II	1
<i>Rumex acetosa</i>	-	1	-	-	1	II	1
<i>Trifolium dubium</i>	-	-	-	1	1	II	1
<i>Lathyrus pratensis</i>	-	-	4	-	-	I	4
<i>Cirsium arvense</i>	-	-	-	2	-	I	2
<i>Elytrigia repens</i>	-	-	-	-	2	I	2
<i>Stellaria graminea</i>	-	2	-	-	-	I	2
<i>Heracleum sphondylium</i>	-	-	-	1	-	I	1
<i>Phleum pratense</i>	-	1	-	-	-	I	1
<i>Poa pratensis</i>	-	-	-	1	-	I	1
<i>Trifolium repens</i>	-	-	-	1	-	I	1

Matching coefficients: **MG6a 59.8**, MG9b 58.4, MG9 56.8, MG7c 56.4, MG6 undifferentiated 55.8, MG7d 55.6, MG9a 54.8, MG6b 52.4, MG6c 50.3, MG1c 50.2

Diagnosis. This vegetation is referable to the NVC type **MG6a *Lolium perenne*-*Cynosurus cristatus* grassland, typical sub-community**, being grass-dominated with a moderately wide range of common grassland forbs at low to moderate levels of abundance. The presence of coarse grasses such as *Arrhenatherum elatius* and *Dactylis glomerata* creates slight affinities with **MG9 *Holcus lanatus*-*Deschampsia cespitosa* grassland** but in the absence of *Deschampsia cespitosa* this is not an acceptable diagnosis.

**ANNEX 2 – SPRING EPHEMERAL TARGET NOTES****9.1****CL10**

Target Note 1. Paths at the southern end of Chase End have a well-trampled sward approximately 5 cm tall, dominated by *Agrostis capillaris* (Common Bent) with smaller amounts of *Achillea millefolium* (Yarrow), *Pilosella officinarum* (Mouse-ear Hawkweed), *Teucrium scorodonia* (Wood Sage), *Rumex acetosella* (Sheep Sorrel), *Thymus polytrichus* (Wild Thyme), *Stellaria media* (Common Chickweed), *Trifolium repens* (White Clover), *Veronica serpyllifolia* (Thyme-leaved Speedwell), *Luzula campestris* (Field Wood-rush). There are also a large number of spring ephemeral species including *Aira* species (a Hair-grass), *Cerastium glomeratum* (Sticky Mouse-ear), *Montia fontana* subsp. *chondrosperma* (Blinks), *Ornithopus perpusillus* (Bird's-foot), *Myosotis discolor* (Changing Forget-me-not), *Poa annua* (Annual Meadow-grass) and *Veronica arvensis* (Wall Speedwell). Both *Aphanes* cf. *australis* (Slender Parsley-piert) and *Moenchia erecta* (Upright Chickweed) were also recorded, though they were not in flower. The mosses *Brachythecium albicans* and *Rhytidiadelphus squarrosus* are scattered in the sward.

Target Note 1a. Further up the slope from vegetation described in *Target Note 1* there are small amounts of the common annual *Cardamine hirsuta* (Hairy Bittercress).

Target Note 1b. Away from the paths the sward is closed, approximately 8 cm high and has few ephemerals. It mostly consists of larger annual species including *Aphanes* cf. *australis* (Slender Parsley-piert), *Cerastium glomeratum* (Sticky Mouse-ear), *Montia fontana* subsp. *chondrosperma* (Blinks), *Myosotis discolor* (Changing Forget-me-not) and *Stellaria media* (Common Chickweed).

Target Note 1c. On the mid-slopes the paths are very heavily eroded and ephemerals are reduced to the more common species such as *Aphanes* cf. *australis* (Slender Parsley-piert), *Cerastium glomeratum* (Sticky Mouse-ear), *Montia fontana* ssp. *chondrosperma* (Blinks), *Poa annua* (Annual Meadow-grass) and *Sagina procumbens* (Procumbent Pearlwort). This tight sward is mostly found at the path edges.

Target Note 2. Short turf approximately 3 cm high at the top of an east-facing slope. The turf is dominated by *Festuca ovina* (Sheep's-fescue) with *Agrostis capillaris* (Common Bent), *Poa* species (a Meadow-grass), *Rumex acetosella* (Sheep's Sorrel) and the ephemerals *Aira* species (a Hair-grass), *Aphanes* cf. *australis* (Slender Parsley-piert), *Cerastium glomeratum* (Sticky mouse-ear), *Erophila majuscula* (a Whitlowgrass), *Moenchia erecta* (Upright chickweed), *Poa annua* (Annual Meadow-grass) and *Sagina procumbens* (Procumbent Pearlwort). The mosses *Brachythecium albicans*, *Campylopus introflexus*, *Hypnum* cf. *lacunosum* and *Polytrichum piliferum* were also recorded.



Where found, *Moenchia erecta* (Upright chickweed) was simple-stemmed approximately 5 mm tall with one pair of leaves ≤ 5 mm long with single flowers ≤ 5 mm. The whole plant did not exceed approximately 8 mm high. Some specimens had three pairs of leaves ≤ 6 mm long, crowded at the base of the plant and one pair of stem leaves ≤ 4 mm long situated below the inflorescence. This species was found growing in amongst *Aira* species (a Hair-grass) which made it extremely inconspicuous. Both *Aphanes* cf. *australis* (Slender Parsley-piert) and *Cerastium semidecandrum* (Little Mouse-ear) were also abundant in this area.

Target Note 3. A short turf approximately 4 cm tall comprises a matrix of *Agrostis capillaris* (Common Bent) and *Festuca ovina* (Sheep's-fescue). It is species-rich and contains several lichen species. The quadrat below is taken from an ESE-facing slope on an angle of approximately 10° .

9.2

CL11

Target Note 4. Spring ephemerals are scattered throughout a short turf comprising a matrix of *Agrostis capillaris* (Common Bent) and *Festuca ovina* (Sheep's-fescue). Spring ephemeral species include the larger, widespread spring annuals *Aira praecox* (Early Hair-grass), *Poa annua* (Annual Meadow-grass) and *Spergularia rubra* (Sand Spurrey).

Target Note 5. Species-rich turf on the crest of Ragged Stone Hill dominated by *Agrostis capillaris* (Common Bent) and *Rumex acetosa* (Common Sorrel). It is a species-rich closed sward on shallow, slightly organic soils on a NE-facing 7° slope. Spring ephemerals are abundant throughout the sward, which is approximately 2-10 cm high.

Target Note 6. Species-rich calcifugous grassland on an east-facing 15° slope of the Shire Ditch. The turf is dominated by *Agrostis capillaris* (Common Bent) and *Festuca ovina* (Sheep's-fescue). The most widespread spring annual here is *Moenchia erecta* (Upright Chickweed), which is thinly scattered throughout. There is some soil slippage but otherwise the turf is more or less closed.

Target Note 7. A very open sward on thin soils over the southern ridge of Ragged Stone Hill. Broad-leaved herbs make up the majority of the vegetation and grasses such as *Agrostis capillaris* (Common Bent) and *Aira praecox* (Early Hair-grass) are only a minor element. It is broadly referable to **U1b *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland, typical sub-community** open variant.

Target Note 8. Species-rich turf with a large proportion of the recorded spring ephemeral species including the common species such as *Aira praecox* (Early Hair-



grass) and *Poa annua* (Annual Meadow-grass) along with the less-common ones such as *Moenchia erecta* (Upright Chickweed) and *Stellaria pallida* (Lesser Chickweed).

Target Note 9. Species-rich turf on a south-east facing slope of around 15°. It has a broken sward due to soil-slippage, which is dominated by *Agrostis capillaris* (Common Bent) and *Festuca ovina* (Sheep's-fescue). There are numerous spring ephemerals including the less-common species *Moenchia erecta* (Upright Chickweed) and *Stellaria pallida* (Lesser Chickweed).

Target Note 10. A relatively tall, closed sward of *Agrostis capillaris* (Common Bent) and *Festuca ovina* (Sheep's-fescue) with abundant spring ephemerals in an open area surrounded by dense *Pteridium aquilinum* (Bracken). Ephemerals include the less common species *Moenchia erecta* (Upright Chickweed), *Ornithopus perpusillus* (Bird's-foot) and *Stellaria pallida* (Lesser Chickweed).

Target Note 11. Scattered spring ephemerals in closed swards of *Agrostis capillaris* (Common Bent) and *Festuca ovina* (Sheep's-fescue) are frequent on the lower slopes of Ragged Stone Hill. The most common species here are mostly the larger and more abundant species such as *Aphanes australis* (Slender Parsley-piert), *Cerastium glomeratum* (Sticky Mouse-ear) and *Poa annua* (Annual Meadow-grass), particularly on well-trampled paths. Away from the paths there are several of the less common species including *Moenchia erecta* (Upright Chickweed) and *Myosotis discolor* (Changing Forget-me-not).

9.3

CLI2

Target Note 12. Short turf on a well-trampled path. Common ephemerals such as *Aphanes australis* (Slender Parsley-piert), *Montia fontana* ssp. *chondrosperma* (Blinks) and *Poa annua* (Annual Meadow-grass) are concentrated in the trampled parts of the path. A short distance up the path there is a dense population of *Aira* species (Hair-grass).

Target Note 13. A closed sward on a 15° east-facing slope just above the path on the inside face of the lowest rampart of British Camp. On the whole, the turf here is too deep and too closed to have any ephemerals other than *Aira* species (Hair-grass). Therefore the ephemerals on the northern part of Herefordshire Beacon are mainly restricted to paths and small patches.

Target Note 14. A severely eroding north-northwest facing bank on a 35° slope below the main path edge. Vegetation cover is only 50%, with loose soil on small terraces spilling down. Where intact, the turf is relatively deep *Festuca ovina* (Sheep's-fescue) with some *Holcus lanatus* (Yorkshire-fog). There is a large population of *Cerastium glomeratum* (Sticky Mouse-ear) with some *Cardamine hirsuta* (Hairy Bitter-cress),



Veronica arvensis (Wall Speedwell) and *Stellaria media* (Common Chickweed). *Campanula rotundifolia* (Harebell) is locally abundant in patches.

Target Note 15. A very short trampled turf, very open and with a sward height of around 2 cm. Grasses are generally subordinate in cover here, and bryophytes such as *Ceratodon purpureus* and *Hypnum cupressiforme* make up a large proportion of the sward. There are some spring ephemerals including *Aphanes australis* (Slender Parsley-piert) and *Erophila verna* (Common Whitlowgrass).

Target Note 16. A deep turf of dominated by *Festuca ovina* (Sheep's-fescue) on a north-east facing 35° slope adjacent to the main path. The ground is terraced and eroding, with loose soil on the terraces spilling down. The spring annual *Cerastium semidecandrum* (Little Mouse-ear) is frequent throughout the sward.

Target Note 17. A species-rich open turf on a south-facing slope near the summit of Herefordshire Beacon. There is approximately 10% bare ground, and a notable absence of bryophytes. The annual species *Moenchia erecta* (Upright Chickweed), although not present in the quadrat, appears by the path and is much less developed here than previous examples lower down the slope. Other common spring annuals are occasional throughout the sward.

Target Note 17a. Species-rich turf in the saddle between Herefordshire Beacon and Millennium Hill includes *Festuca* species (Fescues), *Rumex acetosella* (Sheep's Sorrel) and the bryophytes *Ceratodon purpureus*, *Hypnum* species and *Polytrichum piliferum*. There are also large populations of the spring ephemeral species *Aira* species (Hair-grass), *Cerastium semidecandrum* (Little Mouse-ear), smaller amounts of *Aphanes australis* (Slender Parsley-piert).

Target Note 18. Species-poor turf in an area recently cleared of scrub. It is dominated by a matrix of *Agrostis capillaris* (Common Bent) and *Rumex acetosella* (Sheep's Sorrel). The spring ephemerals *Aphanes australis* (Slender Parsley-piert), *Poa annua* (Annual Meadow-grass), *Myosotis discolor* (Changing Forget-me-not) and *Veronica arvensis* (Wall Speedwell) were also present at moderate levels of abundance. There are smaller amounts of *Cerastium glomeratum* (Sticky Mouse-ear), *Cerastium semidecandrum* (Little Mouse-ear), *Montia fontana* (Blinks) and *Polytrichum juniperinum* (a bryophyte) along the path-side. The weak scrambler *Ceratocarpus claviculata* (Climbing Corydalis) is frequent amongst the cut-back scrub.

Target Note 18a. Between Hangman's Hill and Shire Ditch, the only abundant spring ephemeral is *Aira* species (Hair-grass). There is some young *Calluna vulgaris* (Heather) in places. The rocks north of Potter's cave support mainly *Aira* species (Hair-grass) in vegetation referable to the NVC type **U1b *Festuca ovina*-*Agrostis capillaris*-*Rumex acetosella* grassland, typical sub-community, lichen-rich**



variant, although *Cerastium semidecandrum* (Little Mouse-ear) is quite abundant below the path.

Target Note 18b. Open turf immediately adjacent to Clutter's Cave is species-rich with small amounts of *Aphanes australis* (Slender Parsley-piert), *Cerastium semidecandrum* (Little Mouse-ear), *Moenchia erecta* (Upright Chickweed), *Potentilla neumanniana* (Spring cinquefoil) and *Stellaria pallida* (Lesser Chickweed).

Target Note 19. Short turf amongst patchy scrub of *Crataegus monogyna* (Hawthorn) and *Ulex gallii* (Western Gorse) below the main path. This turf extends for around 20 m to the bottom of the bank, wherever there are gaps amongst the scrub. However, the diversity is not quite as rich as previous target notes, there is greater abundance of *Luzula campestris* (Field Wood-rush) and *Viola riviniana* (Common Dog-violet) is occasional under the scrub.

Target Note 20. Species-rich short turf on a south-east facing slope. It has *Montia fontana* ssp. *chondrosperma* (Blinks) and a *Taraxacum* species (a Dandelion) with very finely divided leaves like those of *Taraxacum oxoniense*, though it was not in flower. The paths are dominated by *Aphanes* cf. *australis* (Slender Parsley-piert) and *Poa annua* (Annual Meadow-grass) with few other spring ephemerals.

Target Note 21. A species-rich, open sward surrounded by dense under-scrub. The sward is dominated by *Festuca ovina* (Sheep's-fescue) and *Agrostis capillaris* (Common Bent) and there are smaller amounts of the common annual species *Arabidopsis thaliana* (Thale cress) and *Cardamine hirsuta* (Hairy Bitter-cress) with abundant *Polytrichum piliferum* and *Rumex acetosella* (Sheep's Sorrel).

Target Note 22. A lichen-rich, closed sward approximately 5 cm tall on deep soils on the south side of a path, dominated by *Agrostis capillaris* (Common Bent) and *Festuca ovina* (Sheep's-fescue). Very dense populations of the spring ephemeral species *Moenchia erecta* (Upright chickweed) are present in the sward. It is in patches with approximately 4000 stems per m² at peak density, though the stems do not necessarily represent individual plants.

Target Note 23. Dense populations of the spring ephemeral species *Stellaria pallida* (Lesser Chickweed) on anthills. The sward is dominated by *Agrostis capillaris* (Common Bent) and *Rumex acetosella* (Sheep's Sorrel) with *Dicranum scoparium*, *Moenchia erecta* (Upright chickweed), *Myosotis discolor* (Changing Forget-me-not), *Poa annua* (Annual Meadow-grass) and *Polytrichum piliferum*. Grassland on the ridge of Swinyard Hill from this point onwards is generally closed and species-poor, with very few spring ephemeral species. The sward is short and heavily dominated by *Festuca ovina* (Sheep's-fescue), with some very eroded areas on the main paths where bare ground is approximately 60%. The majority of species-rich vegetation is restricted to the slopes either side of the ridge.



Target Note 24. Lichen-rich, closed turf on an ENE-facing slope of the Shire Ditch earthworks. It is dominated by *Agrostis capillaris* (Common Bent), *Festuca ovina* (Sheep's-fescue) and *Rumex acetosella* (Sheep's Sorrel), and there are abundant spring ephemerals including *Aira* cf. *praecox* (Early Hair-grass) and *Moenchia erecta* (Upright Chickweed).

Target Note 25. A closed sward dominated by *Agrostis capillaris* (Common Bent) and *Festuca ovina* (Sheep's-fescue) with a small cushion of *Calluna vulgaris* (Heather) on a north-facing slope.

Target Note 26. A small patch of *Stellaria pallida* (Lesser Chickweed) approximately 1 m² in turf dominated by *Agrostis capillaris* (Common Bent) and *Festuca ovina* (Sheep's-fescue) on a north-facing slope.

Target Note 27. Anthills on the slope have some of the common ephemerals including *Aira* species (a Hair-grass), *Aphanes* cf. *australis* (Slender Parsley-piert), *Cerastium glomeratum* (Sticky Mouse-ear) and *Poa annua* (Annual Meadow-grass) set in a dense springy turf dominated by *Festuca ovina* (Sheep's-fescue).

Target Note 28. There are anthills that have a similar assemblage of plants to those at *Target Note 27* but with some *Montia fontana* subsp. *chondrosperma* (Blinks) in a matrix of *Agrostis capillaris* (Common Bent) and *Rumex acetosella* (Sheep's Sorrel) with abundant *Poa annua* (Annual Meadow-grass) and spring ephemerals. The spring ephemerals include *Aira* species (a Hair-grass), *Aphanes* cf. *australis* (Slender Parsley-piert), *Cerastium glomeratum* (Sticky Mouse-ear), *Montia fontana* subsp. *chondrosperma* (Blinks), *Stellaria pallida* (Lesser Chickweed) and *Veronica arvensis* (Wall Speedwell).

Target Note 29. A short, closed sward dominated by *Festuca ovina* (Sheep's-fescue) and *Rumex acetosella* (Sheep's Sorrel) with *Achillea millefolium* (Yarrow), *Agrostis capillaris* (Common Bent), *Campanula rotundifolia* (Harebell), *Luzula campestris* (Field Wood-rush), *Poa pratensis/humilis* (Smooth/Spreading Meadow-grass) and the spring ephemerals *Aira* species (a Hair-grass), *Aphanes* cf. *australis* (Slender Parsley-piert) and *Moenchia erecta* (Upright chickweed).

Target Note 29a. A short, closed sward dominated by *Festuca ovina* (Sheep's-fescue) and *Rumex acetosella* (Sheep's Sorrel) on the opposite side of a track to that described in *Target Note 29*. It is similar to that described in *Target Note 29* but with abundant *Aira* species (a Hair-grass), *Cerastium glomeratum* (Sticky Mouse-ear), *Cerastium semidecandrum* (Little Mouse-ear), *Moenchia erecta* (Upright Chickweed) and *Veronica arvensis* (Wall Speedwell).



Target Note 30. The spring ephemeral *Erophila majuscula* (a Whitlowgrass) is present here in vegetation broadly similar to that described in *Target Note 29*.

Target Note 31. Rabbit scrapes dominated by *Agrostis capillaris* (Common Bent) with *Aphanes* cf. *australis* (Slender Parsley-piert), *Cerastium glomeratum* (Sticky Mouse-ear), *Myosotis discolor* (Changing Forget-me-not), *Stellaria pallida* (Lesser Chickweed) and *Veronica arvensis* (Wall Speedwell).

Target Note 32. The grassland beyond this point has a broadly similar structure and composition to that described in the preceding *Target Notes*, but it is a more closed sward and there are only very scattered spring ephemerals.

Target Note 33. A small population of *Cerastium semidecandrum* (Little Mouse-ear) by a wooden seat.

Target Note 34. A closed, species-rich sward approximately 5 cm tall on the banks of earthworks. Spring ephemerals include *Moenchia erecta* (Upright chickweed), *Montia fontana* subsp. *chondrosperma* (Blinks) and *Myosotis discolor* (Changing Forget-me-not). There are also small amounts of *Cerastium glomeratum* (Sticky Mouse-ear), *Lotus corniculatus* (Common Bird's-foot-trefoil), *Stellaria pallida* (Lesser Chickweed), *Myosotis discolor* (Changing Forget-me-not) and *Aphanes* cf. *australis* (Slender Parsley-piert). This 'good' sward continues for some distance.

Target Note 35. An open, lichen-rich sward on an exposed west-facing slope of Hangman's Hill. There is abundant *Aira* species (a Hair-grass) with *Cladonia* cf. *foliacea*, *Poa annua* (Annual Meadow-grass) and rare *Filago* cf. *minima* (Small cudweed), *Moenchia erecta* (Upright chickweed) and *Thymus polytrichus* (Wild Thyme).

Target Note 36. A west-south-west facing slope with abundant ephemerals in a closed sward dominated by *Agrostis capillaris* (Common Bent) and *Festuca ovina* (Sheep's-fescue). Spring ephemerals include abundant *Cerastium semidecandrum* (Little Mouse-ear), *Moenchia erecta* (Upright chickweed) and *Myosotis discolor* (Changing Forget-me-not) with *Taraxacum* cf. *oxoniense* (Dandelion) and *Potentilla neumanniana* (Spring Cinquefoil).

Target Note 37. Species-rich, open turf on a rocky outcrop approximately 30 m from Clutter's Cave. It has virtually all of the notable spring ephemeral species in a sward dominated by *Agrostis capillaris* (Common Bent) and *Festuca ovina* (Sheep's-fescue). Grasses only make up a small proportion of the ground cover, and lichens, bryophytes and broad-leaved herbs are all prominent. The uncommon *Potentilla neumanniana* (Spring Cinquefoil) is present at low abundance.



Target Note 38. A closed sward dominated by *Agrostis capillaris* (Common Bent) and *Festuca ovina* (Sheep's-fescue) in a woodland glade on Midsummer Hill. There are several spring ephemerals including *Aphanes australis* (Slender Parsley-piert), *Cerastium glomeratum* (Sticky Mouse-ear), *Montia fontana* (Blinks), *Myosotis discolor* (Changing Forget-me-not), *Poa annua* (Annual Meadow-grass) and *Veronica arvensis* (Wall Speedwell).

Target Note 39. A closed sward approximately 4 cm tall dominated by *Agrostis capillaris* (Common Bent). It has many of the larger and more common spring ephemerals such as *Aira praecox* (Early Hair-grass), *Aphanes australis* (Slender Parsley-piert) and *Poa annua* (Annual Meadow-grass), along with smaller amounts of *Moenchia erecta* (Upright Chickweed), *Montia fontana* ssp. *chondrosperma* (Blinks) and *Myosotis discolor* (Changing Forget-me-not).

Target Note 40. A closed sward approximately 2 m high dominated by *Agrostis capillaris* (Common Bent), *Pilosella officinarum* (Mouse-ear-hawkweed) and *Rumex acetosella* (Sheep's Sorrel). There are large amounts of *Moenchia erecta* (Upright Chickweed), *Myosotis discolor* (Changing Forget-me-not), *Aphanes australis* (Slender Parsley-piert) and *Montia fontana* ssp. *chondrosperma* (Blinks).

Target Note 41. A closed sward dominated by *Agrostis capillaris* (Common Bent) and *Festuca ovina* (Sheep's-fescue) near the summit of Midsummer Hill. It has *Moenchia erecta* (Upright Chickweed) along with *Aira* species (a Hair-grass), *Aphanes australis* (Slender Parsley-piert), *Cerastium glomeratum* (Sticky Mouse-ear), *Cerastium semidecandrum* (Little Mouse-ear), *Erophila verna* (Common Whitlowgrass), *Montia fontana* (Blinks), *Myosotis discolor* (Changing Forget-me-not), *Poa annua* (Annual Meadow-grass) and *Stellaria pallida* (Lesser Chickweed). The only spring ephemerals on the western side of the summit are some *Aira* species (a Hair-grass) and a little *Moenchia erecta* (Upright Chickweed).

Target Note 42. Species-rich open turf approximately 2 cm tall dominated by *Festuca ovina* (Sheep's-fescue) on an east-facing 10° slope. There are numerous spring ephemerals including the commoner species such as *Aira praecox* (Early Hair-grass) and *Poa annua* (Annual Meadow-grass) along with the less common ones such as *Moenchia erecta* (Upright Chickweed) and *Stellaria pallida* (Lesser Chickweed).

Target Note 43. Populations of *Moenchia erecta* (Upright Chickweed) and *Stellaria pallida* (Lesser Chickweed) extend to approximately this point from where they were recorded at *Target Note 42*.

Target Note 44. A closed sward dominated by *Agrostis capillaris* (Common Bent) and *Festuca ovina* (Sheep's-fescue). It has *Moenchia erecta* (Upright Chickweed) along with *Aira* species (a Hair-grass), *Aphanes australis* (Slender Parsley-piert), *Cerastium glomeratum* (Sticky Mouse-ear), *Cerastium semidecandrum* (Little Mouse-



ear), *Erophila verna* (Common Whitlowgrass), *Montia fontana* (Blinks), *Myosotis discolor* (Changing Forget-me-not), *Poa annua* (Annual Meadow-grass) and *Stellaria pallida* (Lesser Chickweed).

Target Note 45. Broken turf on the slope of a path-side bank. *Aira* species (a Hair-grass) is frequent but *Aphanes australis* (Slender Parsley-piert), *Cerastium glomeratum* (Sticky Mouse-ear), *Moenchia erecta* (Upright Chickweed), *Montia fontana* (Blinks), *Myosotis discolor* (Changing Forget-me-not) and *Poa annua* (Annual Meadow-grass) are only present in small quantities.

Target Note 46. A species-rich sward dominated by *Agrostis capillaris* (Common Bent) and *Festuca ovina* (Sheep's-fescue) with abundant *Luzula campestris* (Field Wood-rush). There are smaller amounts of *Aira* species (a hair-grass), *Aphanes* cf. *australis* (Slender Parsley-piert), *Calluna vulgaris* (Heather), *Carex hirta* (Hairy Sedge), *Cerastium glomeratum* (Sticky Mouse-ear), *Cerastium semidecandrum* (Little Mouse-ear), *Galium saxatile* (Heath Bedstraw), *Myosotis discolor* (Changing Forget-me-not), *Pilosella officinarum* (Mouse-ear Hawkweed), *Pteridium aquilinum* (Bracken), *Rumex acetosella* (Sheep's Sorrel), *Teucrium scorodonia* (Wood Sage), *Thymus polytrichus* (Wild Thyme) and *Veronica arvensis* (Wall Speedwell).

Target Note 47. A strip of grassland approximately 0.5 m wide and 15 m long at the edge of a path. It has a closed sward approximately 2 cm high with some bare earth on eroded ground. The sward is a matrix dominated by *Festuca ovina* (Sheep's-fescue) with smaller amounts of *Agrostis capillaris* (Common Bent), *Aphanes* cf. *australis* (Slender Parsley-piert), *Carex hirta* (Hairy Sedge), *Cerastium diffusum* (Sea Mouse-ear), *Cerastium semidecandrum* (Little Mouse-ear), *Erophila verna* (Common Whitlowgrass), *Luzula campestris* (Field Wood-rush), *Myosotis discolor* (Changing Forget-me-not), *Rumex acetosella* (Sheep's Sorrel) and *Trifolium repens* (White Clover).

Target Note 48. Species-rich grassland on ant hills at the side of a path. There are the spring ephemerals *Aphanes* cf. *australis* (Slender Parsley-piert), *Myosotis discolor* (Changing Forget-me-not), *Poa annua* (Annual Meadow-grass) and *Sagina procumbens* (Procumbent Pearlwort) in a matrix of *Agrostis capillaris* (Common Bent), *Festuca ovina* (Sheep's-fescue) and *Rumex acetosella* (Sheep's Sorrel). There is also a small amount of *Holcus lanatus* (Yorkshire-fog).

Target Note 49. An open sward dominated by *Festuca ovina* (Sheep's-fescue) with abundant *Agrostis capillaris* (Common Bent) and *Rumex acetosella* (Sheep's Sorrel). There are large amounts of *Moenchia erecta* (Upright Chickweed) throughout the sward to a height of 4 cm. Also recorded were *Aira* species (a Hair-grass) and *Taraxacum* sect. *Erythrosperma* (a Dandelion). The uncommon *Stellaria pallida* (Lesser Chickweed) forms a dense a population on a nearby ant hill.



Target Note 50. A very short sward dominated by *Festuca ovina* (Sheep's-fescue) with *Aira* species (a Hair-grass), *Agrostis capillaris* (Common Bent), *Aphanes* cf. *australis* (Slender Parsley-piert), *Cerastium semidecandrum* (Little Mouse-ear), *Poa annua* (Annual Meadow-grass), *Polytrichum piliferum* and *Rumex acetosella* (Sheep's Sorrel). There is approximately 25% bare ground. It becomes much more species-poor towards the summit with tight turf dominated by *Festuca ovina* (Sheep's-fescue) and *Agrostis capillaris* (Common Bent). The only ephemerals are very infrequent *Aphanes* cf. *australis* (Slender Parsley-piert) and *Cerastium semidecandrum* (Little Mouse-ear).

Target Note 51. A tall, springy turf on the east to north-east facing bank of an earthworks on Millenium Hill. It has some disturbed areas in amongst dense *Ulex europaeus* (Gorse) on the top of the bank. It is dominated by *Agrostis capillaris* (Common Bent) with *Festuca ovina* (Sheep's-fescue), *Galium saxatile* (Heath Bedstraw), *Rhytidadelphus squarrosus* and *Rumex acetosella* (Sheep's Sorrel). The disturbed ground has *Dicranum scoparium* and *Montia fontana* ssp. *chondrosperma* (Blinks) in a mosaic covering approximately 7 m by 2 m between patches of *Ulex europaeus* (Gorse). Elsewhere on the bank there are small amounts of *Myosotis discolor* (Changing Forget-me-not) and patches dominated by *Aira* species (a hair-grass).

Target Note 51a. A path at the bottom of the earthworks described in *Target Note 51*. It is dominated by *Aira* species (a Hair-grass) with *Agrostis capillaris* (Common Bent), *Poa annua* (Annual Meadow-grass) and *Rumex acetosella* (Sheep's Sorrel) in a very short closed sward approximately 1 cm high.

Target Note 52. A closed, short sward on the south-east face of an earth bank. It has a matrix of *Agrostis capillaris* (Common Bent) and *Festuca ovina* (Sheep's-fescue) with *Achillea millefolium* (Yarrow), *Hypnum lacunosum*, *Luzula campestris* (Field Wood-rush) and *Rumex acetosella* (Sheep's Sorrel). There is some soil slippage dominated by the moss *Polytrichum piliferum* with scattered *Aira* species (a Hair-grass), *Aphanes* cf. *australis* (Slender Parsley-piert), *Cerastium semidecandrum* (Little Mouse-ear), *Myosotis discolor* (Changing Forget-me-not) and *Veronica arvensis* (Wall Speedwell).

Target Note 53. A short fine sward approximately 2 cm high on a path. It is dominated by *Festuca ovina* (Sheep's-fescue) with *Agrostis capillaris* (Common Bent), *Aphanes* cf. *australis* (Slender Parsley-piert), *Cerastium semidecandrum* (Little Mouse-ear), *Erophila verna* (Common Whitlowgrass), *Hypnum lacunosum*, *Poa annua* (Annual Meadow-grass), *Rumex acetosella* (Sheep's Sorrel), *Sagina procumbens* (Procumbent Pearlwort) and *Veronica arvensis* (Wall Speedwell).

Target Note 53a. Very fine turf on a path leading south from *Target Note 53*. It is dominated by *Festuca ovina* (Sheep's-fescue) with *Hypnum lacunosum*, *Rumex acetosella* (Sheep's Sorrel) and *Polytrichum piliferum* on bare ground. It is mostly



species-poor but has some *Agrostis capillaris* (Common Bent) and *Poa annua* (Annual Meadow-grass). The ephemerals *Aphanes* cf. *australis* (Slender Parsley-piert) and *Cerastium semidecandrum* (Little Mouse-ear) are frequent at the edges of paths but are lost from the sward within approximately 1 m from the path.

Target Note 54. A closed sward dominated by *Agrostis capillaris* (Common Bent), *Festuca ovina* (Sheep's-fescue) and *Rumex acetosella* (Sheep's Sorrel) on an ant hill. It has smaller amounts of the spring ephemerals *Aira* species (a Hair-grass), *Aphanes* cf. *australis* (Slender Parsley-piert), *Cerastium glomeratum* (Sticky Mouse-ear), *Moenchia erecta* (Upright Chickweed), *Myosotis discolor* (Changing Forget-me-not), *Poa annua* (Annual Meadow-grass) and *Stellaria pallida* (Lesser Chickweed).

Target Note 55. A closed sward dominated by *Agrostis capillaris* (Common Bent), *Festuca ovina* (Sheep's-fescue), and *Hypnum lacunosum* with *Myosotis discolor* (Changing Forget-me-not) on an ant hill. There are smaller amounts of *Galium saxatile* (Heath Bedstraw) and *Stellaria pallida* (Lesser Chickweed). The same matrix with *Myosotis discolor* (Changing Forget-me-not) is found on many of the surrounding ant hills, with approximately 10% bare ground.

Target Note 56. A species-rich sward dominated by *Agrostis capillaris* (Common Bent) with smaller amounts of *Festuca ovina* (Sheep's-fescue) and *Rumex acetosella* (Sheep's Sorrel) on a steep (ca. 35°) south-east facing slope with lots of soil slippage. Several lichen species are present at low levels of abundance and there are numerous spring ephemerals.

Target Note 57. A dense population of *Stellaria pallida* (Lesser Chickweed) interspersed with *Agrostis capillaris* (Common Bent) and *Rumex acetosella* (Sheep's Sorrel) on an ant hill.

Target Note 58. A closed, species-rich sward on an east-facing slope with abundant ant hills, soil slippages, mounds and ridges. It is dominated by *Agrostis capillaris* (Common Bent), *Festuca ovina* (Sheep's-fescue) and *Rumex acetosella* (Sheep's Sorrel) with *Aira* species (a Hair-grass), *Aphanes* cf. *australis* (Slender Parsley-piert), *Calluna vulgaris* (Heather), *Campanula rotundifolia* (Harebell), *Cardamine hirsuta* (Hairy Bittercress), *Luzula campestris* (Field Wood-rush), *Galium saxatile* (Heath Bedstraw), *Hypnum lacunosum* (a moss) and *Veronica arvensis* (Wall Speedwell). On the upper slope there is a high density of *Moenchia erecta* (Upright Chickweed) and this continues to approximately 10 m below the top of the earthworks. There is frequent *Myosotis discolor* (Changing Forget-me-not) throughout the sward and a single population of *Stellaria pallida* (Lesser Chickweed) on an ant hill.

Target Note 59. A very short, close-grazed sward dominated by *Festuca ovina* (Sheep's-fescue) on a footpath with some spring ephemerals. It has smaller amounts of *Aira* species (a Hair-grass), *Poa annua* (Annual Meadow-grass) and *Rumex*



acetosella (Sheep's Sorrel). At this point there is locally abundant *Erophila verna* (Common Whitlowgrass) with *Aphanes* cf. *australis* (Slender Parsley-piert), *Cerastium semidecandrum* (Little Mouse-ear), *Cerastium diffusum* (Sea Mouse-ear), *Sagina procumbens* (Procumbent Pearlwort), *Poa annua* (Annual Meadow-grass), *Pilosella officinarum* (Mouse-ear-hawkweed), *Polytrichum piliferum* (), *scorionoroides* and *Veronica arvensis* (Wall Speedwell).

Target Note 59a. A narrow channel to the west of a path described in *Target Note 59*. It has an annual-rich sward with *Aira* species (a Hair-grass), *Aphanes* cf. *australis* (Slender Parsley-piert), *Cerastium semidecandrum* (Little Mouse-ear), *Erophila verna* (Common Whitlowgrass) and *Veronica arvensis* (Wall Speedwell) in a matrix of *Agrostis capillaris* (Common Bent), *Festuca ovina* (Sheep's-fescue) and *Rumex acetosella* (Sheep's Sorrel).

Target Note 60. A species-rich closed sward dominated by *Agrostis capillaris* (Common Bent) and *Festuca ovina* (Sheep's-fescue). It has large amounts of the common spring ephemeral species *Aphanes australis* (Slender Parsley-piert), *Erophila verna* (Common Whitlowgrass) and *Veronica arvensis* (Wall Speedwell). A large population of *Stellaria pallida* (Lesser Chickweed) stands approximately 20 m downhill from this point.

Target Note 60a. A taller, closed sward approximately 7 cm tall adjacent to that described above, with numerous of the larger spring ephemerals including *Aphanes* cf. *australis* (Slender Parsley-piert), *Cerastium glomeratum* (Sticky Mouse-ear), *Cerastium semidecandrum* (Little Mouse-ear), *Erophila verna* (Common Whitlowgrass), *Poa annua* (Annual Meadow-grass), *Polytrichum piliferum* (a moss), *Senecio sylvaticus* (Heath Groundsel), *Stellaria pallida* (Lesser Chickweed) and *Veronica arvensis* (Wall Speedwell).

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Target Note 61. A relatively open sward, adjacent to a path, with numerous spring ephemerals including *Aphanes australis* (Slender Parsley-piert), *Cerastium glomeratum* (Sticky Mouse-ear), *Moenchia erecta* (Upright Chickweed), *Myosotis discolor* (Changing Forget-me-not), *Poa annua* (Annual Meadow-grass), *Senecio sylvaticus* (Heath Groundsel), *Stellaria pallida* (Lesser Chickweed) and *Veronica arvensis* (Wall Speedwell). An east-facing slope nearby has a large number of ant hills. The turf here is broken in places but there is little bare ground, and several of the above spring ephemerals are patchily abundant.

Target Note 62. An open sward adjacent to a path with numerous spring ephemerals including *Aira* species (a Hair-grass), *Aphanes australis* (Slender Parsley-piert), *Cerastium glomeratum* (Sticky Mouse-ear), *Cerastium semidecandrum* (Little Mouse-



ear), *Erophila verna* (Common Whitlowgrass), *Poa annua* (Annual Meadow-grass), and *Veronica arvensis* (Wall Speedwell).

Target Note 63. A closed sward dominated by *Agrostis capillaris* (Common Bent) and *Festuca ovina* (Sheep's-fescue) approximately 6 cm tall on an east-facing 20° slope. The uncommon spring ephemeral *Moenchia erecta* (Upright Chickweed) is particularly abundant here.

Target Note 64. The sward described in *Target Note 63* extends to this point. Upwards the sward is less species-rich with just common spring ephemerals such as *Erophila verna* (Common Whitlowgrass) and *Poa annua* (Annual Meadow-grass).

Target Note 65. A sward dominated by *Agrostis capillaris* (Common Bent), *Festuca ovina* (Sheep's-fescue) and *Rumex acetosella* (Sheep's Sorrel) with approximately 20% bare ground on a crest path. It has few spring ephemerals, and only common species attain appreciable levels of abundance, including *Aira* species (a Hair-grass) and *Poa annua* (Annual Meadow-grass). The open and close-grazed swards of the paths on Perseverance hill are generally poor in spring ephemerals.

Target Note 66. A short sward approximately 5 cm high, on south to south-east facing banks in a bowl-shaped depression. There are some spring ephemeral species, including among the more notable *Cerastium semidecandrum* (Little Mouse-ear) and *Moenchia erecta* (Upright Chickweed).

Target Note 67. Trampled turf on a minor path, approximately 4 cm tall with scattered *Festuca ovina* (Sheep's-fescue) and approximately 10% bare ground. It has *Aira* species (a Hair-grass), *Aphanes* cf. *australis* (Slender Parsley-piert), *Cerastium glomeratum* (Sticky Mouse-ear), *Cerastium semidecandrum* (Little Mouse-ear), *Erophila verna* (Common Whitlowgrass), *Myosotis discolor* (Changing Forget-me-not) and *Veronica arvensis* (Wall Speedwell). It has very abundant *Moenchia erecta* (Upright chickweed) on a west-facing bank that slopes at approximately 15°.

Target Note 67a. The bank and the crest of the hill become more species-poor approximately 15 m south of *Target Note 67*. The sward here is more closed and is dominated by *Festuca ovina* (Sheep's-fescue) with *Rumex acetosella* (Sheep's Sorrel) and *Polytrichum piliferum*.

Target Note 68. A small, dense patch of *Moenchia erecta* (Upright chickweed) on a bank sloping at approximately 10°. It is in a similar situation to that recorded at *Target Note 66*, on the south-west bank of a small depression on the east side at the crest of the hill. It is in a matrix of *Agrostis capillaris* (Common Bent), *Aira* species (a Hair-grass) and *Rumex acetosella* (Sheep's Sorrel).



Target Note 69. A small population of *Stellaria pallida* (Lesser Chickweed) on an east-facing rocky outcrop.

Target Note 70. A relatively tall sward approximately 10cm high on an east-facing bank approximately 1.5 m wide at the path edge. It is mainly closed but there are frequent spring ephemerals in more open patches. It consists of *Agrostis capillaris* (Common Bent), *Capsella bursa-pastoris* (Shepherd's-purse), *Festuca ovina* (Sheep's-fescue), *Rumex acetosella* (Sheep's Sorrel) and *Trifolium repens* (White Clover) with the spring ephemeral species *Aira* species (a Hair-grass), *Cerastium diffusum* (Sea Mouse-ear), *Cerastium semidecandrum* (Little Mouse-ear), *Erophila verna* (Common Whitlowgrass) and *Veronica arvensis* (Wall Speedwell).

Target Note 71. A short sward up to 3 cm high on an east-facing bank at the edge of a path, below the bank described in *Target Note 70*. Open areas of the sward are dominated by *Aira* species (a Hair-grass) with *Agrostis capillaris* (Common Bent), *Festuca ovina* (Sheep's-fescue), *Myosotis discolor* (Changing Forget-me-not), *Pilosella officinarum* (Mouse-ear-hawkweed) and *Rumex acetosella* (Sheep's Sorrel).

Target Note 72. A short (ca. 3 cm), open sward on an east-facing bank approximately 7 m wide. It consists of a matrix of *Agrostis capillaris* (Common Bent), *Festuca ovina* (Sheep's-fescue) and *Rumex acetosella* (Sheep's Sorrel) with *Achillea millefolium* (Yarrow), *Hypochaeris radicata* (Cat's-ear) and *Pilosella officinarum* (Mouse-ear-hawkweed). Spring ephemerals include *Aira* species (a Hair-grass), *Cerastium fontanum* (Common Mouse-ear), *Cerastium glomeratum* (Sticky Mouse-ear), *Cerastium semidecandrum* (Little Mouse-ear), *Ornithopus perpusillus* (Bird's-foot), *Poa annua* (Annual Meadow-grass) and *Veronica arvensis* (Wall Speedwell).

Target Note 73. A short open sward on an east-facing rocky outcrop below a path. The sward is approximately 3 cm high and is dominated by *Aira* species (a hair-grass) with *Agrostis capillaris* (Common Bent), *Festuca ovina* (Sheep's-fescue) and *Rumex acetosella* (Sheep's Sorrel). It has small, dense populations of *Aphanes* cf. *australis* (Slender Parsley-piert) and *Scleranthus annuus* (Annual Knawel).

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CL16

Target Note 74. A closed, mesotrophic sward with *Agrostis capillaris* (Common Bent), *Festuca rubra* (Red Fescue) and *Lolium perenne* (Perennial Rye-grass) in a car park. It has some common spring ephemerals including *Cerastium glomeratum* (Sticky Mouse-ear), *Erophila verna* (Common Whitlowgrass), *Geranium molle* (Dove's-foot Crane's-bill), *Poa annua* (Annual Meadow-grass), *Stellaria media* (Common Chickweed), *Veronica arvensis* (Wall Speedwell) and *Veronica hederifolia* (Ivy-leaved Speedwell).



Target Note 75. A slightly open sward dominated by *Festuca ovina* (Sheep's-fescue) near a path. It has a number of spring ephemerals including *Cardamine hirsuta* (Hairy Bitter-cress), *Cerastium glomeratum* (Sticky Mouse-ear), *Cerastium semidecandrum* (Little Mouse-ear), *Erophila verna* (Common Whitlowgrass), *Sagina apetala* (Annual Pearlwort), *Poa annua* (Annual Meadow-grass) and *Veronica arvensis* (Wall Speedwell).

Target Note 76. An open sward dominated by *Festuca ovina* (Sheep's-fescue) with a similar compliment of spring ephemerals to that described in *Target Note 75*.

Target Note 77. An open, eroded sward with tussocks of *Festuca ovina* (Sheep's-fescue) and the common annual species *Poa annua* (Annual Meadow-grass).

Target Note 78. A heavily-eroded, open sward on a path on the north-eastern side of Worcestershire Beacon. The only spring ephemerals were *Aira* species (a Hair-grass) and *Poa annua* (Annual Meadow-grass).

Target Note 79. An exposed rocky outcrop on the north-east side of Worcestershire Beacon with a matrix of *Deschampsia flexuosa* (Wavy Hair-grass), *Dicranum scoparium*, *Festuca ovina* (Sheep's-fescue), *Polytrichum piliferum* and *Rumex acetosella* (Sheep's Sorrel). It has the common species *Aira* species (a Hair-grass) and *Poa annua* (Annual Meadow-grass), but no other spring ephemerals.

Target Note 80. A relatively closed sward over deep organic soil on an east-facing 25° slope on an under-used path. The uncommon species *Ornithopus perpusillus* (Bird's foot) is present here.

Target Note 81. An open sward on a rocky outcrop on the eastern side of Worcestershire Beacon with the spring ephemerals *Aira* species (a Hair-grass), *Poa annua* (Annual Meadow-grass), *Senecio sylvaticus* (Heath Groundsel) and *Senecio vulgaris* (Groundsel).

Target Note 82. An open sward very similar to that described in *Target Note 81*, on a rocky outcrop further up the hill. This kind of open sward on parched soil might be expected to have a number of spring ephemerals, but the only species is *Aira* species (a Hair-grass).

Target Note 83. Species-rich grassland at the summit of Worcestershire Beacon. The western side of the summit has an open sward with large amounts of bare rock and soil. It has numerous spring ephemerals including *Aira* species (a Hair-grass), *Aphanes* species (a Parsley-piert), *Arenaria serpyllifolia* (Thyme-leaved Sandwort), *Cerastium glomeratum* (Sticky Mouse-ear), *Cerastium semidecandrum* (Little Mouse-ear), *Poa annua* (Annual Meadow-grass) and *Veronica arvensis* (Wall Speedwell).



The common spring ephemeral species *Erophila verna* (Common Whitlowgrass) is abundant right around the summit to the eastern side.

Target Note 84. Species-rich, slightly mesotrophic grassland on the ridge of Worcestershire Beacon. It is a well-trampled sward dominated by *Agrostis capillaris* (Common Bent) and *Festuca ovina* (Sheep's-fescue) with some *Lolium perenne* (Perennial Rye-grass) and *Rumex acetosella* (Sheep's Sorrel). The spring ephemerals *Aira* species (a Hair-grass), *Cerastium semidecandrum* (Little Mouse-ear), *Erophila verna* (Common Whitlowgrass), *Trifolium dubium* (Lesser Trefoil) and *Veronica arvensis* (Wall Speedwell) are frequent throughout.

Target Note 85. A short, open sward approximately 2 cm tall dominated by *Festuca ovina* (Sheep's-fescue) with small amounts of bare ground. It has several spring ephemeral species including *Cerastium semidecandrum* (Little Mouse-ear), *Erophila verna* (Common Whitlowgrass) and *Veronica arvensis* (Wall Speedwell).

Target Note 86. Species-poor vegetation in a recently cleared area. It is dominated by *Agrostis capillaris* (Common Bent), and the spring ephemeral *Aira praecox* (Early Hair-grass) is abundant throughout.

Target Note 87. A short, well trampled sward approximately 1 cm tall dominated by *Agrostis capillaris* (Common Bent), *Festuca ovina* (Sheep's-fescue) and *Rumex acetosella* (Sheep's Sorrel). It has small amounts of uncommon spring ephemerals including *Filago minima* (Small Cudweed) and *Moenchia erecta* (Upright Chickweed), which becomes more abundant down the slope from this point.

Target Note 88. A very large population of the uncommon spring ephemeral *Moenchia erecta* (Upright Chickweed) in a short sward dominated by *Agrostis capillaris* (Common Bent), *Festuca ovina* (Sheep's-fescue) and *Rumex acetosella* (Sheep's Sorrel).

Target Note 89. Species-rich grassland similar to that described in *Target Note 89* continues to this point on the hill. In addition, it has the common annual species *Cerastium glomeratum* (Sticky Mouse-ear), *Poa annua* (Annual Meadow-grass) and *Spergularia rubra* (Sand Spurrey).

Target Note 90. Species-rich grassland with abundant spring ephemerals including *Aira* species (a Hair-grass), *Aphanes* species (a Parsley-piert), *Cerastium glomeratum* (Sticky Mouse-ear), *Cerastium semidecandrum* (Little Mouse-ear), *Moenchia erecta* (Upright Chickweed), *Poa annua* (Annual Meadow-grass), *Stellaria pallida* (Lesser Chickweed) and *Veronica arvensis* (Wall Speedwell).

Target Note 91. A relatively tall sward dominated by *Festuca ovina* (Sheep's-fescue) with large amounts of bare ground. It is species-rich and has some of the uncommon



spring ephemerals including a large population of *Moenchia erecta* (Upright Chickweed) and smaller amounts of *Ornithopus perpusillus* (Bird's-foot).

Target Note 92. Species-rich, open grassland with numerous spring ephemerals including the uncommon species *Moenchia erecta* (Upright Chickweed) and *Teesdalia nudicaulis* (Shepherd's Cress).

Target Note 93. Further down the hill from the grassland described in *Target Note 93* the vegetation becomes slightly more species-poor, but still has some of the more common spring ephemerals including *Cerastium semidecandrum* (Little Mouse-ear), *Myosotis discolor* (Changing Forget-me-not) and the larger annuals such as *Arabidopsis thaliana* (Thale Cress) and *Cardamine hirsuta* (Hairy Bitter-cress).

Target Note 94. Species-rich grassland dominated by *Agrostis capillaris* (Common Bent), *Festuca ovina* (Sheep's-fescue) and *Rumex acetosella* (Sheep's Sorrel) on a path-side bank. It has a large population of *Moenchia erecta* (Upright Chickweed) along with other spring ephemerals such as *Aphanes* species (a Parsley-piert), *Cerastium glomeratum* (Sticky Mouse-ear), *Cerastium semidecandrum* (Little Mouse-ear), *Erophila verna* (Common Whitlowgrass), *Poa annua* (Annual Meadow-grass), *Trifolium cf. dubium* (Lesser Trefoil) and *Veronica arvensis* (Wall Speedwell).

Target Note 95. Moderately species-rich grassland dominated by *Agrostis capillaris* (Common Bent), *Festuca ovina* (Sheep's-fescue) and *Rumex acetosella* (Sheep's Sorrel) in mosaic with *Ulex europaeus* (Gorse) bushes. It has the spring ephemerals *Aira* species (a Hair-grass), *Aphanes* species (a Parsley-piert), *Arabidopsis thaliana* (Thale Cress), *Cerastium glomeratum* (Sticky Mouse-ear), *Erophila verna* (Common Whitlowgrass), *Poa annua* (Annual Meadow-grass), *Senecio sylvaticus* (Heath Groundsel) and *Veronica arvensis* (Wall Speedwell).

Target Note 96. Short, species-rich grassland dominated by *Agrostis capillaris* (Common Bent), *Festuca ovina* (Sheep's-fescue) and *Rumex acetosella* (Sheep's Sorrel). It has the spring ephemerals *Aira* species (a Hair-grass), *Aphanes australis* (Slender Parsley-piert), *Cardamine hirsuta* (Hairy Bitter-cress), *Cerastium glomeratum* (Sticky Mouse-ear), *Erophila verna* (Common Whitlowgrass), *Poa annua* (Annual Meadow-grass) and *Veronica arvensis* (Wall Speedwell).

Target Note 97. A species-rich, open sward dominated by *Agrostis capillaris* (Common Bent) and *Festuca ovina* (Sheep's-fescue) with much bare ground. It has numerous spring ephemerals including *Aira species* (a Hair-grass), *Cerastium fontanum* (Common Mouse-ear), *Cerastium semidecandrum* (Little Mouse-ear), *Erophila verna* (Common Whitlowgrass), *Sagina procumbens* (Procumbent Pearlwort), *Trifolium repens* (White Clover) and *Veronica arvensis* (Wall Speedwell).



Target Note 98. Species-rich grassland dominated by *Agrostis capillaris* (Common Bent) and *Festuca ovina* (Sheep's-fescue) in a strip approximately 2.5 m wide either side of a well-trampled path. It has a closed sward approximately 3.5 cm tall and abundant spring ephemerals including *Aira* species (a Hair-grass), *Aphanes* cf. *australis* (Slender Parsley-piert), *Cerastium diffusum* (Sea Mouse-ear), *Cerastium semidecandrum* (Little Mouse-ear), *Erophila verna* (Common Whitlowgrass), *Poa annua* (Annual Meadow-grass) and *Veronica arvensis* (Wall Speedwell). This species-rich vegetation extends for approximately 20 m up the hill, beyond which the sward becomes more species-poor. The path itself is mostly bare ground, with scattered tussocks of *Festuca ovina* (Sheep's-fescue).

Target Note 98a. Moderately species-rich and slightly mesotrophic grassland beneath a bench beside the path described in *Target Note 98*. It is dominated by *Agrostis capillaris* (Common Bent), *Lolium perenne* (Perennial Rye-grass) and *Poa annua* (Annual Meadow-grass), with smaller amounts of *Rumex acetosella* (Sheep's Sorrel) and the spring ephemerals *Cerastium diffusum* (Sea Mouse-ear), *Cerastium semidecandrum* (Little Mouse-ear) and *Veronica arvensis* (Wall Speedwell).

Target Note 99. A closed, short sward approximately 2.5 cm tall dominated by *Agrostis capillaris* (Common Bent), *Festuca ovina* (Sheep's-fescue) and *Rumex acetosella* (Sheep's Sorrel) on an earth bank. It has very scattered ephemerals including *Aira* species (a Hair-grass), *Aphanes* cf. *australis* (Slender Parsley-piert), *Cerastium semidecandrum* (Little Mouse-ear), *Erophila verna* (Common Whitlowgrass), *Poa annua* (Annual Meadow-grass), *Sagina procumbens* (Procumbent Pearlwort), *Trifolium* species (a clover) and *Veronica arvensis* (Wall Speedwell).

Target Note 100. A tall sward approximately 6 cm high dominated by *Agrostis capillaris* (Common Bent), *Festuca ovina* (Sheep's-fescue) and *Rumex acetosella* (Sheep's Sorrel) on a path-side bank. It has the common spring ephemerals *Aira* species (a Hair-grass), *Aphanes* cf. *australis* (Slender Parsley-piert), *Cerastium glomeratum* (Sticky Mouse-ear), *Erophila verna* (Common Whitlowgrass) and *Veronica arvensis* (Wall Speedwell).

Target Note 101. A species-poor, open sward on the south-facing slope of End Hill. It is dominated by tussocks of *Festuca ovina* (Sheep's-fescue) with *Aira praecox* (Early Hair-grass) and the lichen *Cladonia* cf. *rangiformis* on shallow, broken soils.

Target Note 102. Close-grazed and trampled turf on the main paths of North Hill. It is dominated by *Festuca ovina* (Sheep's-fescue) with scattered *Poa annua* (Annual Meadow-grass). This typically grades into a taller, closed sward a short distance from the path edge. The taller sward is dominated by *Deschampsia flexuosa* (Wavy Hair-grass) with *Galium saxatile* (Heath Bedstraw) and *Rumex acetosella* (Sheep's Sorrel).



Target Note 103. Species-poor open grassland on shallow soil on a rocky outcrop on a south-facing slope on North Hill. The sward is lichen-rich, and has scattered *Festuca ovina* (Sheep's-fescue) and *Rumex acetosella* (Sheep's Sorrel). The spring-ephemeral *Aira praecox* (Early Hair-grass) is dominant in places.

Target Note 104. Species-poor open grassland dominated by *Agrostis capillaris* (Common Bent) and *Festuca ovina* (Sheep's-fescue) on a steep, east-facing slope. It has very small amounts of the spring ephemeral *Ornithopus perpusillus* (Bird's-foot).

Target Note 105. An open sward dominated by *Festuca ovina* (Sheep's-fescue) with *Agrostis capillaris* (Common Bent) below a footpath on North Hill. It has the spring ephemerals *Aira* species (a Hair-grass), *Aphanes* cf. *australis* (Slender Parsley-piert), *Erophila verna* (Common Whitlowgrass) and *Ornithopus perpusillus* (Bird's-foot).

Target Note 106. An open sward on an east-facing slope, below a wooden bench. It is dominated by *Festuca ovina* (Sheep's-fescue), and spring ephemerals include *Aira* cf. *praecox* (a Hair-grass), *Aphanes* cf. *australis* (Slender Parsley-piert), *Cerastium diffusum* (Sea Mouse-ear), *Cerastium glomeratum* (Sticky Mouse-ear), *Cerastium semidecandrum* (Little Mouse-ear), *Erophila verna* (Common Whitlowgrass), *Rumex acetosella* (Sheep's Sorrel) and *Veronica arvensis* (Wall Speedwell).

***ANNEX 3 - AREAS (HA) OF VEGETATION TYPES***

This annex gives areas in hectares of the vegetation types recorded in each site (CL10 to CL18). They are however the areas projected vertically for mapping purposes, and do not take account of the fact that the actual areas of vegetation types on the prevailing steep slopes would be greater, *i.e.* they are the areas of the vegetation mapping compartments in *Figure 4* in *Annex 5*.



Table 1. Areas (ha) of vegetation types at Old Hollow. Column 1 and 2 - vegetation types in GIS database; columns 3 and 4 - grouped vegetation-types in Figure 4.

Vegetation type	Area (ha)	Mapping type	Area (ha)
MG10a	0.715	Not assessed	0.168
MG10b	0.015	MG10	0.730
MG6b	2.005	MG6	2.829
MG6b + MG10a	0.173	OV25	0.035
MG6b-OV25a	0.651	W21	0.71
MG6b-OV25a + W21	0.710	Wood	2.168
Not Assessed	0.168		
OV25a	0.035		
Wood	2.168		



Table 2. Areas (ha) of vegetation types at The Hacketts. Column 1 and 2 - vegetation types in GIS database; columns 3 and 4 - grouped vegetation-types in Figure 4.

Vegetation type	Area (ha)	Mapping type	Area (ha)
MG1a-MG6a	2.233	Not assessed	3.170
MG1b-OV25b	0.007	MG6	12.856
MG6a	3.947	OV24, OV25	0.387
MG6a + MG6b	0.093	Wood	3.813
MG6a-MG6b	5.607		
MG6a-MG7b + OV24a	0.143		
MG6b	0.896		
MG6b-U4b	0.076		
MG6c-U1b	0.004		
MG7b + OV25b	0.034		
Not Assessed	3.170		
OV24a	0.045		
OV24a + OV25a	0.089		
OV24a + OV25b	0.034		
OV25b	0.035		
Wood	3.813		



Table 3. Areas (ha) of vegetation types at Ballards Land. Column 1 and 2 - vegetation types in GIS database; columns 3 and 4 - grouped vegetation-types in Figure 4.

Vegetation type	Area (ha)	Mapping type	Area (ha)
MG10a	0.165	MG10	0.342
MG10b-OV25b	0.177	MG6	2.057
MG1a + W25b	0.030	OV25	0.013
MG6b	0.229	W25	0.985
MG6b + W25b	0.165	Wood	1.955
MG6b-MG10a	0.065		
MG6b-OV25b	1.598		
OV25b	0.013		
W25b	0.955		
Wood	1.955		



Table 4. Areas (ha) of vegetation types at Chase End Hill - CL10. Column 1 and 2 - vegetation types in GIS database; columns 3 and 4 - grouped vegetation-types in Figure 4.

Vegetation type	Area (ha)	Mapping type	Area (ha)
CG10a-U4b	0.139	CG10a	0.139
MG1a	0.015	MG1	0.142
MG1a Cha	0.127	Not Assessed	9.598
Not Assessed	9.598	OV24, OV27	3.585
OV24b	0.004	U1b	1.596
OV27a + W25b	0.264	U1b lichen var.	0.834
OV27b	0.046	U4b	0.032
OV27b + W25b	11.589	W24	0.083
U1b	1.596	W25	10.552
U1b + U1b lichen var.	0.612	Wood	8.94
U1b lichen var.	0.222		
U4b	0.019		
U4u	0.013		
W24u	0.083		
W25b	2.234		
Wood	8.940		



Table 5. Areas (ha) of vegetation types at Ragged Stone Hill - CL11. Column 1 and 2 - vegetation types in GIS database; columns 3 and 4 - grouped vegetation-types in Figure 4.

Vegetation type	Area (ha)	Mapping type	Area (ha)
OV27a + W25b	0.523	OV27	0.022
OV27c	0.022	U1b, U1b open var.	1.479
OV27c + W25a + W25b	0.301	U1b lichen var.	2.067
U1b	0.197	W23	0.272
U1b lichen var.	0.211	W25	10.358
U1b lichen var.-U1u	1.856	Wood	23.002
U1b open var.	0.555		
U1u-U4u	0.727		
U1u-W25a	0.591		
W23a	0.272		
W25a	7.212		
W25b	1.731		
Wood	23.002		



Table 6. Areas (ha) of vegetation types at Midsummer Hill to British Camp - CL12. Column 1 and 2 - vegetation types in GIS database; columns 3 and 4 - grouped vegetation-types in Figure 4.

Vegetation type	Area (ha)	Mapping type	Area (ha)
CG10a	0.539	CG10a	3.867
CG10a-U1b	0.288	MG10	0.008
CG10a-U1b lichen var.	0.307	MG1	0.957
CG10a-U1b lichen var. + U1b lichen var.	0.241	MG6	0.156
CG10a-U1b open var.	0.081	Not assessed	10.529
CG10a-U1u	2.291	OV23	0.105
CG10a-U4a	0.186	OV24, OV27	0.619
Cleared Type 1	0.446	U20	14.324
Cleared Type 2	0.084	U2	11.251
MG10a	0.008	U4a	0.621
MG1a + Wood	0.957	U4b	1.995
MG6b	0.156	U1b, U1u and U1b open var.	13.906
Not Assessed	10.529	U1b lichen var.	0.862
OV23a	0.059	W23	2.109
OV23a + U1b	0.118	W24	0.954
OV23a-U2a	0.024	W25	19.969
OV24a + U1b	0.080	Wood	123.237
OV24b	0.024		
OV24b + U1b	0.063		
Ov25a-U4b	0.081		
OV27a	0.055		
OV27a + U20a	0.809		
OV27a + W24u	0.374		
OV27b-W25b	0.023		
U1b	3.188		
U1b + U1b open var.	0.837		
U1b + U1u	0.147		
U1b + U20a	0.222		
U1b + U2a	0.290		
U1b + U2a-W23u	0.185		
U1b + U4u	0.020		
U1b lichen var.	0.844		
U1b lichen var. + U1b	0.002		
U1b lichen var. + U4b	0.437		
U1b lichen var.-U20a	0.016		
U1b open var.	1.416		
U1b open var. + U2a	0.808		
U1b open var.-U2a	0.256		
U1b-U2a	0.387		
U1b-U2a + U20a	0.193		
U1b-U2a + W23u	0.020		
U1u	2.255		
U1u + U20a	0.074		
U1u + U2a	0.019		
U1u + U2a + U2a + U2a + W25b	0.013		
U1u-U20a	0.274		
U1u-U2a	2.357		



U1u-U2a + U20a	1.634
U1u-U2a + W25b	0.147
U1u-U2b	0.365
U1u-U4u	1.298
U1u-U4u + U20a	0.095
U1u-U4u + U4b	0.159
U20a	5.486
U20a + U20c	0.158
U20a-U20c	0.073
U20a-U2a + U20c	0.791
U20b	0.741
U20c	2.148
U20c + Wood	0.324
U20c-W25b	1.939
U2a	4.720
U2a + OV23a	0.015
U2a + U20a	0.286
U2a + U2a + U1b	0.204
U2a + U2a-U1b	1.736
U2a + U2a-W23u	0.094
U2a + W23u	0.697
U2a-U1u + U20a	0.053
U2a-U20a	0.023
U2a-U2b	1.259
U2a-U4a	0.368
U2a-U4b	0.668
U2a-U4b + U4b	0.010
U2a-U4u	0.285
U2a-U4u + U20a	0.361
U2a-U4u + W25b	0.168
U4a	0.187
U4b	0.424
U4b + U20a	0.005
U4b-U20a	0.096
U4u + U20a	0.207
U4u + U20b	0.038
U4u + W25b	0.033
U4u-U20a	0.022
U4u-U2a + U20a	0.434
W21u + W24u	0.112
W23u	0.702
W23u + W24u	0.509
W23u-W24u	0.634
W23u-W25b	0.446
W24u	0.374
W25a	1.986
W25b	17.635
Wood	123.237



Table 7. Areas (ha) of vegetation types in the Middle Hills - CL14. Column 1 and 2 - vegetation types in GIS database; columns 3 and 4 - grouped vegetation-types in Figure 4.

Vegetation type	Area (ha)	Mapping type	Area (ha)
CG10a	0.016	CG10	0.337
CG10a-MG1a	0.321	Not assessed	0.693
Cleared Type 1	0.015	MG1	4.543
Cleared Type 1 + OV27b	0.558	MG6	0.361
Cleared Type 2	0.825	OV23	0.405
Cleared Type 2-MG1a	0.223	OV27	5.407
Cleared Type 2-W23u	0.138	U1b, U1u and U1b open var.	8.438
Cleared Type 3	0.592	U1b lichen var.	0.402
Cleared Type 3 + MG1a Cha	0.179	U20	13.577
Cleared Type 3 + MG1a Cha	0.166	U2	8.990
Cleared Type 3 + U2a	0.227	U4b	2.480
MG1 Cha	0.038	W16, W24	13.076
MG1a	0.354	W23	2.728
MG1a + MG1b	0.206	W25	14.167
MG1a + U2a	0.025	Wood	64.948
MG1a Cen rub	0.822		
MG1a Cha	0.368		
MG1a Cha + OV27b	0.182		
MG1a Cha + U20a	0.131		
MG1a Cha + U20c	0.022		
MG1a Cha + W25b	0.171		
MG1a Cha-OV27b	0.095		
MG1a Cha-W25b	0.784		
MG1a-U1b	0.010		
MG1a-U1u	0.032		
MG1a-U2a	0.142		
MG1a-U4b	0.057		
MG1a-W16u	0.906		
MG1a-W24u	0.010		
MG1b	0.210		
MG1u Cha	0.057		
MG6a	0.361		
MG6a-U4b	0.224		
Not Assessed	0.693		
OV23a	0.388		
OV23a-U1u	0.017		
OV27a + U1b	0.064		
OV27a-U20c	0.276		
OV27b	2.619		
OV27b + U20c	0.489		
OV27b + U2a	0.085		
OV27b + W23u	0.051		
OV27b + W25b	1.295		
OV27b W25b	0.536		
OV27b-U1u	0.288		
OV27b-U20a	0.045		
OV27b-W23	0.057		
OV27b-W25b	0.017		



U1b	1.937
U1b + U1b open var.	3.535
U1b + U2a	0.337
U1b + W16u	0.252
U1b + W23b	0.028
U1b lichen var.	0.402
U1b open var.	0.077
U1b-U2a	0.348
U1b-U2a + W16u	0.178
U1b-W24u	0.023
U1u	0.369
U1u + U20a	0.113
U1u-U20a	0.035
U1u-U2a	0.311
U1u-U4b	0.105
U1u-U4u	0.386
U1u-U4u + U20a	0.707
U1u-U4u + W24u	0.172
U20a	0.064
U20a + U20c	0.024
U20a + Wood	0.282
U20c	6.011
U20c + W16u	0.250
U20c + W25b	6.211
U20c-W23u	0.216
U2a	6.675
U2a + U20a	0.144
U2a + W16u	0.682
U2a + W23u	0.126
U2a -W25b	0.012
U2a-U20a	0.313
U2a-U2b	0.038
U2a-W23u	0.018
U2a-W25b	0.028
U4b	0.934
U4b + U20a	0.005
W16u	0.150
W16u + U20c	12.736
W23	0.047
W23u	2.414
W23u + W24u	0.123
W23u + W25b	0.167
W23u-W24u	0.018
W24u	0.190
W25b	13.306
Wood	64.666



Table 8. Areas (ha) of vegetation types in the Northern Hills - CL16. Column 1 and 2 - vegetation types in GIS database; columns 3 and 4 - grouped vegetation-types in Figure 4.

Vegetation type	Area (ha)	Mapping type	Area (ha)
Bare ground + U1b open var. + W23u	0.119	Not assessed	17.243
Bare ground + U2a	0.045	MG1	10.445
CG10a-U1b	0.133	MG6	2.870
Cleared Type 3	0.097	OV23, MG7	1.076
Holcus mollis + U2a	0.036	OV24, OV25, OV27	2.806
MG1a	2.759	U1b, U1u and U1b open var.	6.136
MG1a + OV23a	0.044	U20	34.794
MG1a + OV27b	0.046	U2, Cleared Type 3	38.564
MG1a + OV27b + W23u	0.044	U4b	1.450
MG1a + U1b	0.170	Vaccinium	0.964
MG1a + U20a	0.607	W16, W24	2.729
MG1a + U20c	1.533	W23	15.626
MG1a + U2a	2.715	W25	25.388
MG1a + U4b	0.047	Wood	94.144
MG1a + W23u	0.044		
MG1a + W24u	0.032		
MG1a + W25b	2.102		
MG1a Cen rub + MG1a Cha + W23u	0.291		
MG1a Cha	0.650		
MG1a Cha + U2a	0.089		
MG1a Cha + U2a + U20a	0.868		
MG1a Cha + W23u	0.351		
MG1a Cha + W25b	0.963		
MG1a Cha-U20c	0.037		
MG1a Cha-U2a	0.021		
MG1a-MG1b	0.017		
MG1a-OV23a	0.098		
MG1a-U1b	0.037		
MG1a-U20a	0.027		
MG1a-U20c	1.254		
MG1a-U2a	4.219		
MG1a-U4b	0.088		
MG1a-W25b	0.642		
MG1b	0.083		
MG1b + OV23a	0.031		
MG6a	0.731		
MG6b	2.139		
MG7b	0.082		
Not Assessed	17.134		
OV23a	0.810		
OV23a + U2a	0.116		
OV23a-U1b	0.106		
OV23a-U4b	0.135		
OV24a	0.309		
OV24a + W24u	0.020		
OV25b	0.017		
OV27b	0.924		
OV27b + W16b	0.222		



OV27b + W24u	0.051
OV27b + W25b	2.374
OV27b + Wood	0.503
OV27b-W25b	0.060
OV27u	0.010
OV27u + W23u + W25b	0.939
OV27u-W25b	0.008
U1b	4.057
U1b + U1b-CG10a	0.092
U1b + U1b-U1d	0.003
U1b + U2a	0.999
U1b open var.	0.379
U1b open var. + U2a	0.337
U1b open var.-W25b	0.018
U1b-U1d	0.137
U1b-W25b	0.074
U1u-U4u	0.194
U1u-U4u-U20c	0.031
U20a	9.671
U20b	0.170
U20c	18.561
U20c + W23	0.075
U20c + W23u	0.663
U2a	25.651
U2a + U20a	1.724
U2a + U20c	2.465
U2a + U2b	3.783
U2a + U4b	0.020
U2a + W23u	3.870
U2a + W25b	0.397
U2a-U20a	0.852
U2a-U20c	0.679
U2a-W23u	0.321
U2a-W25b	0.024
U2b	2.329
U4b	1.280
Vaccinium	0.964
W16b + W25b	2.588
W23u	9.497
W23u + W24u	0.036
W23u + W25b	1.569
W24u	0.156
W25b	18.836
W25b + Wood	0.560
Wood	94.144



Table 9. Areas (ha) of vegetation types in CL17. Column 1 and 2 - vegetation types in GIS database; columns 3 and 4 - grouped vegetation-types in Figure 4.

Vegetation type	Area (ha)	Mapping type	Area (ha)
MG1a + MG6b	0.833	Not assessed	2.321
MG1a + U20a	1.579	MG1	4.475
MG1a + U20a-U4b	0.020	MG6	4.028
MG1a + W25a	0.205	OV21, OV23, MG7	4.248
MG1a-U4b	3.399	U20	13.162
MG1b	0.162	U4b	2.723
MG1b + OV24a	0.278	W24	0.103
MG1b-U20a	1.238	W25	0.447
MG6b	2.898	Wood	5.454
MG6b-U4b	1.130		
MG7a	1.155		
MG7a + OV23a	1.452		
MG7a-U20a	0.083		
Not Assessed	2.321		
OV21b	0.202		
OV23a	1.356		
OV27b-W25a	0.163		
U20a	10.868		
U4b	0.273		
U4b-MG1a + U20a	1.615		
U4b-U20a	0.095		
W24a + W25a	0.103		
W25a	0.074		
W25b	0.005		
Wood	5.454		



Table 10. Areas (ha) of vegetation types in CL18. Column 1 and 2 - vegetation types in GIS database; columns 3 and 4 - grouped vegetation-types in Figure 4.

Vegetation type	Area (ha)	Mapping type	Area (ha)
MG10a	0.097	Not assessed	45.368
MG1a	2.766	MG10	0.097
MG1a + MG1a-MG5u	0.044	MG1	7.082
MG1a + MG1b	0.559	MG5	7.623
MG1a + MG6a	0.721	MG6	4.482
MG1a + MG6b	0.327	OV23, MG7	11.796
MG1a + OV23a	0.114	OV24, S12a	0.132
MG1a + OV23u	0.179	U1b	0.04
MG1a + U1b	0.040	U4a	0.284
MG1a + U4a	0.443	W21, W24	0.977
MG1a-MG5u	0.351	W25	0.924
MG1a-MG6	0.022	Wood	0.747
MG1a-MG6a	0.069		
MG1a-MG6b	0.017		
MG1a-MG6u	0.132		
MG1a-OV23a	0.083		
MG1a-OV26u	0.478		
MG1a-U4a	0.031		
MG1a-U4b	1.102		
MG1a-W25b	0.316		
MG1b	0.397		
MG1b + MG6a	0.199		
MG1b + OV23a	0.221		
MG1b + OV23u	0.113		
MG1u	0.055		
MG1u-MG5u	0.071		
MG5a	3.138		
MG5a-MG6b	4.621		
MG5u	0.857		
MG5u-OV23u	0.109		
MG6a	0.406		
MG6a-OV23a	0.076		
MG6b	0.570		
MG6b-U4b	0.611		
MG6u-MG7u	0.963		
MG7a	0.439		
MG7u	0.035		
Not Assessed	45.368		
OV23a	10.452		
OV23u	0.353		
OV23u + OV24b	0.024		
OV23u + W25b	0.045		
OV24a	0.065		
OV28 + W24b	0.571		
S12a	0.067		
U4a	0.025		
W21	0.039		
W24a	0.083		
W24b	0.284		



W25b	0.657
Wood	0.747



ANNEX 4 - ENGLISH NATURE GIS STANDARDS FOR PHASE 2 HABITAT SURVEY

1 GIS standards for Phase II Habitat Surveys

The following are English Nature's standards for converting National Vegetation Classification (NVC) survey information into a format that can be used in a Geographical Information System. This provides a minimum standard and additional requirements may be specified for individual surveys.

The components of this specification required for particular surveys will be clarified in the contract specification for that survey.

1.1 Standard data model for vegetation data

The following outline the standard method of managing different types of data.

1.1.1 Vegetation data

NVC vegetation boundaries should be represented as a single GIS layer of polygons.

NVC mosaics, where unavoidable owing to scale of mapping, should be represented as a single polygon with a unique polygon ID. This will then be linked to a secondary table containing the mosaic composition information (see below).

All polygons should be digitised according to the standards in Section 4.1.

Each polygon should have the following attributes (the data type for each attribute is shown in brackets):

site_code (*character 16*) - each polygon should be attributed with the agreed site code for the site surveyed; this code will be repeated for different polygons relating to the same site; the site codes will be provided by the project officer;

GID (*integer*) - for designated sites or site units the corresponding GID should be stored. This will be supplied by English Nature. Where possible vegetation boundaries should be digitised against individual site units.

polygon_ID (*character 16*) - each polygon within a site should be given a unique sequential numeric value;



vegetation_type (*character 16*) - this represents the NVC coding (e.g. CG2d, H8c, MG5a) for the polygon;

bap_habitat (*character 64*) - the corresponding BAP priority habitat, where applicable

If the vegetation type consists of a mosaic then the proportion of each community should be represented as a percentage in brackets. The communities of a mosaic should be separated by a '+' e.g. MG5a (40%) + MG5b (60%).

Where it is determined that stands consist of intermediate communities, these should be indicated in the vegetation codes by a '/' e.g. MG5/MG4.

Where the same vegetation type occurs at more than one location on a site, these should be digitised as a multi-part polygon or region with a single *polygon_ID*.

The exact wording, including upper and lower case, must follow the standard NVC codes as outlined in the English Nature Field Survey Standards for Phase II Habitat Surveys.

The following table summarises the approach:

Site_code	Poly_ID	Vegetation_type
31WHJ	1	M19
31WHJ	2	H20
31WHJ	3	U21/U22
32WHJ	4	CG2d (30%) + H8c (20%) + MG5a (50%)

1.1.2 Quadrat data

Quadrat locations should be represented as a single GIS layer of point data.

All points should be digitised according to the standards in section 4.2.

Each record will have the following attributes (the data type for each attribute is shown in brackets):

site_code (*character 16*) - each point feature should be attributed with the agreed site code given to the site surveyed; the site codes will be provided by the project officer;



quadrat_ID (character 16) - each point feature within a site should be given a unique sequential numeric value;

The corresponding quadrat data should be supplied as spreadsheet files. A pro forma spreadsheet is included with these standards. Data for all fields required by the associated contract specification should be included in these spreadsheets.

1.1.3 Target Note data

Target Note locations should be represented by a single GIS layer of point data.

All points should be digitised according to the standards in section 4.2.

Each record should have the following attributes (the data type for each attribute is shown in brackets):

site_code (character 16) - each point feature should be attributed with the agreed site code given to the site surveyed; the site codes will be provided by the project officer;

target_ID (character 16) - each point feature within a site should be given a unique sequential numeric value;

target_note (character 254) - the target note given for each location should be entered as typed text such that it matches any target notes placed on the paper maps. Note that MapInfo tables will only accept up to 254 characters, therefore the length of the target note must be within this limit.

1.1.4 Photographs

Site photographs provide a valuable record of the habitat structure and physical status of the site, quadrat etc. All photos should be provided with a unique file name.

Photograph locations should be stored as a single GIS layer of point data.

All points should be digitised according to the standards in section 4.2.

site_code (character 16) - each point feature should be attributed with the agreed site code given to the site surveyed; the site codes will be provided by the project officer;

polygon_ID (character 16) - will match the *polygon_ID* in which the photograph is taken;

photo (character 16) - each photograph feature should be attributed with the filename (excluding path) of the appropriate digital photograph.



photo_DEG (numeric) - each photograph orientation should be recorded based on compass bearing;

target_note (character 254) - the target note given for each photograph should be entered to briefly describe the photographed subject. Note that MapInfo tables will only accept up to 254 characters, therefore the length of the target note must be within this limit.

Digital recording of photographs is required based either on digital origination or scanning of 35 mm slides. Resolution for digital origination should be at least 1024 x 768 24 bit images. Higher resolutions should be used where conditions dictate or local detail is required.

2 Material Supply

This section outlines how geographic data will be supplied to external contractors. Internal staff can access this data through the MapData Drive.

2.1 Geographic Data Supplied through the English Nature Website

English Nature's Designated Site Boundaries, Natural Areas, Character Areas and Ancient Woodlands boundaries are available to download from the English Nature Website, www.english-nature.org.uk. External contractors are expected to download these datasets as required.

2.2 Other Geographic Data

English Nature's GIS Unit will supply the following data to external contractors undertaking works described in these standards. The project officer will request this data and it will be supplied, to the contractors, within four weeks of request.

Dataset	Formats Available
OS MasterMap Data	MapInfo Native (*.tab, *.dat, *.map, *.id) MapInfo Interchange (MID/MIF) NTF DXF ¹ ESRI Shape ¹
UK Perspectives Maps Aerial Photography	ECW with either a MapInfo Tab or ERS file.

¹ These formats can be provided however they may take longer to supply to allow data formatting to take place.

External contractors will be expected to sign-up-to agents licences for both Ordnance Survey Data and UK Perspectives Aerial Photography before data is supplied.



3 Contract Product

3.1 Quality Assurance

English Nature expects external contractors to have adequate Quality Assurance procedures in place.

English Nature will check data and may ask for corrections to be made before the completion of any contract. The accuracy of all attributes when transferred from survey outputs to GIS layers expected to be 100%.

3.2 Products

All GIS data products should be supplied in MapInfo (native) format (i.e. *.tab, *.map, *.id, *.dat) one set for each GIS layer, for use in Version 6 using the following naming convention:

SurveyName_TableName

Table Names:

Vegetation Data Vegetation
 Mosaic Data VegMosaic
 Quadrat Data Quadrats
 Target Note Data TargetNotes
 Photograph Data Photos

For Example:

Herefordshire2002_Vegetation
 Herefordshire2002_VegMosaic
 Herefordshire2002_Quadrats
 Herefordshire2002_TargetNotes
 Herefordshire2002_Photos

Data may be provided in MapInfo Interchange Format (*.mif, *.mid) if the project officer is agreeable.

The projection must be: British National Grid.

The units used for attribute and quadrat data must be as follows:

Units:	Coordinate Units:	Metres
	Distance Units:	Metres
	Area Units:	Hectares

Vegetation data is supplied as a single GIS polygon layer and quadrat, target note and photograph data as individual point layers.

Photographs of survey sites should be supplied as TIFF images. Digital images should be at 1024 x 768 24-bit resolution. Images may be accepted in another format if the project officer agrees.



Metadata should be supplied as specified above, either as a document, spreadsheet or database file (compatible with Microsoft Office).

Quadrat records will be presented in the form of constancy tables in Excel spreadsheet files.

All data (as described above) should be provided on CD-ROM. Two copies of the data should be supplied.

English Nature will own the data produced by the contract and this data and all data obtained from English Nature must be returned to English Nature on completion of the contract.

4 Digitising Standards

English Nature expects that the following standards and rules be applied when digitising data from field survey into GIS.

It should be noted that these rules only cover technical aspects of the digitisation process and not the interpretational aspects. It is expected that the people undertaking the digitisation will have sufficient experience to be able to properly interpret field survey data.

4.1 Polygon Data

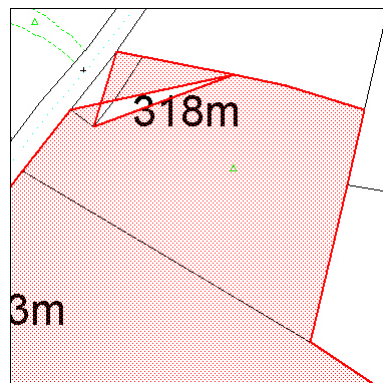
1. All polygons should be digitised to Ordnance Surveys MasterMap data (as supplied).
2. Where a boundary follows an OS MasterMap Feature the OS MasterMap feature should be copied so that the digitised boundary and OS MasterMap feature share the same geometry.
3. Where a boundary follows part of an OS MasterMap Feature the digital boundary should be snapped along the OS MasterMap feature so that the digitised boundary and MasterMap feature both share the same geometry where appropriate.
4. Where a boundary does not follow an OS MasterMap Feature the digitised boundary should be captured with sufficient nodes that the digitised feature takes on the shape of the feature on the source material at a scale of 1:2500.
5. Where a boundary is shared between two (or more) polygons the boundaries should all share the same geometry. Thus there should be no slithers or gaps between polygons with like boundaries.
6. Where a boundary follows a feature on a aerial photograph, scanned and geo-rectified map (maybe field or historical) or other raster image that is not shown on the OS MasterMap Data; the digitised boundary should be captured with sufficient nodes that the digitised feature takes on the shape of the feature on the raster material at a scale of 1:2500.



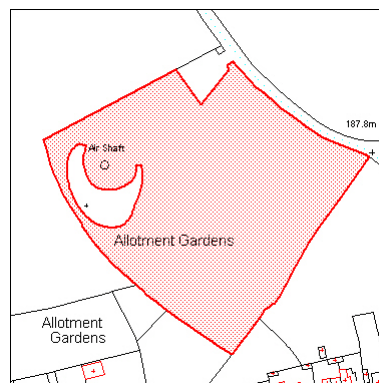
7. Features should not be "stream" digitised. Stream digitising is the process of manual digitising, of lines or regions, where nodes are automatically placed at preset intervals based upon distance or time.
8. Polygons should not contain inappropriate "spikes". In the figure below the digitised field has an inappropriate spike.



9. Polygons must not contain "bowties". Polygons must not intersect or cross themselves. In the figure below the digitised field has a bowtie caused by a polygon crossing itself.



10. Holes in polygons should be appropriately "punched". Where there is a hole in a polygon this should be digitised as a hole as shown below.



4.2 Point Data

1. Point data must be accurate to 10 metre.



2. Point data should be collected in the field using GPS, wherever possible. In areas such as woodland where leaf cover prevents accurate reading, locations may be taken from Ordnance Survey Maps. This should be reflected in the Metadata.
3. Grid References collected in the field should be to at least 8 figures, for example SE83204132.