The Malvern Hills Conservators

An NVC Survey of the Malvern Hills Conservators' Holding 2013

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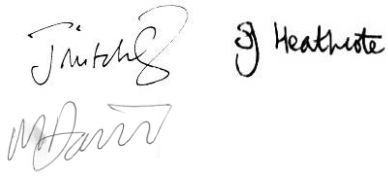
Authors	Dr Jonathan Mitchley/ Dr Steven Heathcote/ Matthew Davies	**Technical reviewer**	Dr Richard Carter
Signature		Signature	
Date:	11th November 2013	Date:	11th November 2013
Project manager	Louise Denning	**Quality reviewer**	Dr Richard Carter
Signature		Signature	
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1. This report presents the results of a detailed National Vegetation Classification (NVC) survey of the land holdings of the Malvern Hills Conservators. The surveys were carried out in June and July 2013. This document draws on the report of a previous vegetation survey of the Malvern Hills carried out by Carter Ecological Ltd in 2006; 2007.

2. The aim of this survey is to create an updated vegetation dataset that will provide a clear picture of the flora and vegetation in the Malvern Hills Conservators' land holding.

3. This will allow an understanding of recent vegetation changes since the last survey in 2006 and will provide baseline information to feed into the next site management plan.

4. The objectives are:
    - To map the vegetation communities and sub-communities of the entire holding of the Malvern Hills Conservators using the NVC methodology.
    - To identify those areas of open vegetation that have recently been colonised by scrub/ young woodland as distinct from 'woodland'.
    - To identify, quantify and discuss key areas of habitat changes since the 2006 NVC survey.
    - To identify and define those non-SSSI habitats that meet SSSI selection guidelines (based on the JNCC criteria).
    - To record the presence / absence, abundance and condition of rare and scarce species as noted in the original SSSI notification.

5. The land holdings of the Malvern Hills Conservators were surveyed using standard NVC methods by botanists from RSK Group between the 17th June and 17th July 2013.

6. Maps of amalgamated vegetation types are presented using RSK's colour coding system.

7. Scrub and woodland constitutes the largest area of the vegetation on the Malvern Hills. The woodlands (distinct from scrub) predominate on the lower slopes and account for 30.7% of the total land surveyed.

8. A number of different scrub types were mapped and together they cover 105.91ha of the Malvern Hills (about 9% of the land area); they are potentially indicative of low intensity management or lack of management.

9. The upland grassland and other communities are most abundant on the main ridge of the hills, and the most common communities are the *Pteridium aquilinum* (Bracken) dominated types (**U20** and **W25**) together covering 175.45 ha (15.3%).

10. Among the plant communities recorded, those of the most ecological and conservation value are the upland grasslands (**U1**, **U2** and **U4**), which together extend over 102.21 ha (8.9%).

The upland calcicolous grassland community **CG10** is a grassland of especially high conservation value but limited in extent (2.87 ha).

11. The most widespread mesotrophic grassland community is **MG6** grassland, covering 141 ha. There are a number species-rich examples, especially **MG6c the *Trisetum flavescens* sub-community**, which is worthy of further study.
12. There was a total of 14.54 ha of **MG5** grassland at several locations in the lowland commons.
13. There was a significant amount of **MG1** grassland, indicative of unmanaged grassland areas, covering 66.73 ha.
14. Improved grassland, **MG7**, and related open vegetation types (**OV21** and **OV23**) cover 51.97 ha predominantly along road verges and in recreation areas.
15. A total of 10.07 ha of the often species-rich *Juncus* mire community, **M23**, were mapped, predominantly on Castlemorton Common and Malvern Common, but also in small patches in wet flushes elsewhere.
16. Temporal development from open vegetation towards scrub and *Pteridium aquilinum* (Bracken) communities between [2006-2013] was analysed using the GIS system and the two methods described below.
17. In the first method we compared scrub and *Pteridium aquilinum* (Bracken) communities between the survey dates in 2006 and 2013. This map output identifies areas of new scrub since 2006 and shows that there has been an increase in scrub of 7.6 ha. The largest scrub increase was of the **U20 *Pteridium aquilinum-Galium saxatile* community** (3.38 ha).

18. In an extension of this first method we used a similar analysis to identify areas of grassland new since 2006. This analysis shows an increase of 7.51 ha of new grassland communities. Of this new grassland 28.6% is **MG1**, and 23.4% is priority acid grassland communities (**U1**, **U2** and **U4**).

19. In the second method we grouped woodland, scrub, *Pteridium aquilinum* (Bracken) and priority grassland categories as mapped in 2013. The output is a series of maps which show the juxtaposition of primary and secondary scrub with priority grasslands. In total this defines 22.9 ha of priority scrub clearance areas which might be converted to open habitat.

20. We also evaluated vegetation changes by comparing the vegetation maps from 2006 with the vegetation in the field during our 2013 survey. A number of areas are identified showing different types of vegetation change, e,g. some areas have shown increasing *Betula pubescens* (Downy Birch).

21. We have identified some areas where there have been grassland gains from scrub but also a number of areas where there have been losses of grassland extent or quality. Management changes such as increasing frequency of mowing might help revert some of these areas of lower value grassland to more species-rich types.

22. We evaluated a number of areas falling outside the current SSSI network to identify any non-SSSI habitats that might meet SSSI selection guidelines on botanical grounds (based on JNCC criteria).

23. We assessed the data against the botanical criteria for selection of SSSI for grasslands and woodlands. There were two areas of species-rich woodland, Park Wood and Hollybush Roughs, but overall, we do not think these merit individual SSSI designation although they might merit inclusion in adjacent woodland SSSI areas.

24. A number of grassland areas were considered including Hollybed Common and the area of Castlemorton Common currently outside the existing SSSI. We could not justify the incorporation of these additional areas into the existing SSSI, although they undoubtedly have value for wildlife and conservation.

25. We also evaluated five areas of species-rich, neutral lowland meadow (referable to the NVC type **MG5 *Cynosurus cristatus* - *Centaurea nigra* grassland**) at Newland (1.69 ha), Great Malvern along Albert Road North (1.57 ha), Malvern Common (8.81 ha), Hall Green (1.09 ha) and Rydd Green (1.32 ha). Overall four of these areas were not considered to qualify as potential SSSI although we would encourage further evaluation of the conservation value of these lowland meadows.

26. The largest of these areas, Malvern Common, was considered to qualify for SSSI status according to the criteria. It comprises areas of species-rich **MG5 *Cynosurus cristatus* - *Centaurea nigra* grassland** and **M23 *Juncus effususlacutiflorus-Galium palustre* rush-pasture** mire. A full analysis is provided together with a map showing the boundary of the proposed Malvern Common SSSI.

27. We did not systematically search all previously recorded locations for rare plant species on the Hills. Surveyors were, however, aware of the plants on the list and the vegetation types in which they are likely to occur, and rare plants were incidentally recorded. A total of 25 of the species on the Notable Flora list were recorded during our surveys and details for each are presented.

2 INTRODUCTION

2.1 Purpose of the Report

This report presents the results of a detailed National Vegetation Classification (NVC) botanical survey of the land holdings of the Malvern Hills Conservators. The surveys were carried out in June and July 2013. This document draws on the report of a previous vegetation survey of the Malvern Hills carried out by Carter Ecological Ltd[1] in 2006 (Carter Ecological Ltd 2006).

2.2 Project Brief

The aim of this NVC survey is to create an updated vegetation dataset that will provide a clear picture of the flora and vegetation in the Malvern Hills Conservators' land holding. This will allow an understanding of recent vegetation changes since the last survey in 2006 and provide baseline information to feed into the next site management plan.

The objectives were:

- Using the NVC methodology, to map the vegetation communities and sub-communities of the entire holding of the Malvern Hills Conservators (as shown in *Appendix A* – Figure 1).
- To identify those areas of open vegetation that have recently been colonised by scrub/ young woodland as distinct from 'woodland'.
- To identify, quantify and discuss key areas of habitat changes since the relevant previous NVC survey.
- To identify and define those non-SSSI habitats that meet SSSI selection guidelines (based on the JNCC criteria).
- To record the presence / absence, abundance and condition of rare and scarce species as noted in the original SSSI notification.

2.3 Ecological Background

The previous survey report (Carter Ecological Ltd 2006; 2007) included details of the ecological background to the Malverns Hills area including a discussion of other previous surveys; Countryside Consultancy (2003) and Davies (1994).

The 2013 survey includes some additional parcels of land of significant size not included in the previous survey. There is a large area of common land around Castlemorton Common (including the Castlemorton Common SSSI) and Hollybed Common, Malvern Link Common and a field adjacent to Albert Road North. These

[1] Now part of the RSK Group

commons are all located on the east side of the hills, and were historically maintained probably by grazing and/or mowing. They all remain as landscapes with trees, although grazing continues only on Castlemorton and Hollybed Commons. The land at Old Hills (Ordnance Survey Grid Reference SO 82660 48804) is an additional new area for the 2013 survey. The Old Hills are an area of mixed grassland, scrub and woodland. The hills are on mudstone and siltstone bedrock, close to the River Severn.

2.4 Structure of the Report

The remainder of the report is structured as follows:

- Section 3 gives details of the methods;
- Section 4 discusses the NVC communities;
- Section 5 discusses the non-SSSI areas;
- Section 6 discusses the notable plants; and
- Section 7 lists the references.

The remaining sections of the report provide the appendices.

- Appendix A Figures.
- Appendix B Quadrat Data (electronic copy only)
- Appendix C Species lists (electronic copy only).
- Appendix D Photographs.

3 METHODS

3.1 General

The land holdings of the Malvern Hills Conservators were surveyed in their entirety as mapped on the 1st June 2013. Recording was led by Dr Richard Carter and Louise Denning. Dr Richard Carter has over 25 years consultancy experience and is a full member of CIEEM and a Chartered Environmentalist. Louise Denning has 12 years consultancy experience and is also a full member of CIEEM and a Chartered Environmentalist. Six other botanical specialists from RSK carried out parts of the survey; Charles Campbell, Matthew Davies, Richard Finch, Dr Steven Heathcote, Dr Jonathan Mitchley and Corin Simmonds. Surveys took place between the 17th June and 17th July 2013.

3.2 Changes to Survey Methods from the 2006 Survey

The field survey and NVC diagnosis and GIS mapping methods used for the NVC survey on the Malvern Hills in 2013 follow those set out in the report of the botanical survey of the Malvern Hills in 2006/2007 (Carter Ecological Ltd 2006).

As in the earlier survey, many vegetation types were recorded in the 2013 survey, including transitions and mosaics, and 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 following the same procedure as in earlier reports into 26 categories to which simple colour codes could be assigned. The groupings are shown in *Table 3.1*. Transitions and mosaics were mapped as the first NVC code appearing in the GIS database, so **U1b-U2a** is mapped as **U1b**, and **U4b** + **OV27b** is mapped as **U4b**. In the maps 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 remains searchable in the GIS product.

Table 3-1 Grouping of vegetation types for hard-copy mapping, with notes where communities have been grouped. Abbreviations follow the standard NVC codes except for 'SCu' which refers to unclassified scrub, 'Wu' unclassified woodland and elsewhere the suffix 'u' refers to unclassified NVC types, i.e. not conforming to any particular sub-community.

Amalgamated NVC Communities	Notes
Hardstanding / No Access / Open Water / Arable	Areas where no NVC type is assigned
Aquatic and related communities	
A7 A8 Au MG11 OV28 OV35 S12 S19 S22 S23	Communities with permanent to near-permanent inundation

Amalgamated NVC Communities	Notes
Mesotrophic grasslands and mires	
MG1	*Arrhenatherum* grassland
MG1e	Ditto species-rich
MG5	Hay meadow
MG6	*Lolium-Cynosurus* pasture
MG6c	Ditto species-rich
MG7 OV21 OV23	Communities of highly improved habitats
MG9	*Deschampsia* pasture
MG10	*Juncus* pasture
M23	*Juncus* Mire
Upland grasslands and bracken	
U20 W25	Communities dominated by Bracken
U1	*Festuca-Agrostis-Rumex* grassland
U1b lichen var.	Ditto lichen-rich
U2	*Deschampsia flexuosa* grassland
U4	*Festuca-Agrostis-Galium* grassland
CG10	Upland calcicolous grassland
VM	*Vaccinium myrtillus*
Scrub and woodland and open vegetation	
W2 W6	Wet Woodlands
W8	Ash woods on base rich soils
W10 W16	Oak woodlands on base-poor soils
Wu W12	Secondary woodland types
SCu W21 W22	Mature scrub vegetation
W23	Gorse scrub
W24	Bramble scrub
OV24 OV25 OV26 OV27	Tall herb vegetation, typically species-poor

3.3 Site of Special Scientific Interest (SSSI) Assessment Criteria

The biological SSSI selection criteria are divided by habitats (Nature Conservancy Council 1989). The assessment of habitats is based on the floristics, primarily using the NVC classification (Rodwell 2006). We assessed grassland and woodland sites not currently part of the Malvern Hills SSSI, against the SSSI selection criteria and against Natural England's condition assessment methodology (English Nature 2007) to determine if they were of sufficient quality to be put forwards for inclusion in the SSSI network for the Malvern Hills area. In this evaluation we addressed only habitat and floristic criteria for the selection of SSSIs.

3.4 Constraints and Site Coverage

We were able to survey 96% of land within the Conservators' holdings. There were a number of quarries and steep rock faces not fully accessible, and these were assessed from a safe location. Consequently some details of mapping in these areas are

approximations. The same was true for some woodland on steeper slopes. Aquatic features were assessed only from the banks.

The occurrence of rare plants was recorded on an incidental basis, and there was no deliberate attempt to search for these plants in known or potential new locations.

Surveys were undertaken during June and July, which is an optimal time of year for recording vascular plants in grasslands and most other habitats. In woods, vernal herbs such as *Adoxa moschatellina* (Moschatel), *Anemone nemorosa* (Wood Anemone) and *Hyacinthoides non-scripta* (Bluebell) are likely to have been under-recorded, making sub-community determinations especially difficult. The same is also true of many of the spring ephemerals in the grassland, several of which are rare plants in the Malvern Hills, e.g. *Moenchia erecta* (Upright Chickweed) and *Scleranthus annuus* (Annual Knawel).

3.5 Plant Nomenclature

Plant nomenclature follows Stace (2010) for vascular plants and Hill et al. (2008) for bryophytes. Plant species were identified carefully, but at any time of year some species will be indeterminable because they are not in flower, or because only scrappy plants are available. Doubtful identifications are preceded in this report by ‘cf.’ where the plant is very probably the species indicated, but it is impossible to distinguish it from similar members of the genus with certainty.

4 NVC TYPES

4.1 General

The Malvern Hills area includes a very diverse array of vegetation types including a range of acid grasslands, and *Pteridium aquilinum* (Bracken) and *Rubus fruticosus* agg. (Bramble) and other scrub on the higher hills. On the lower-lying commons and road verges there is a range of mesotrophic grasslands, rush pastures, mires, *Ulex europaeus* (Gorse) scrub, *Ulex gallii* (Western Gorse) scrub, and other scrub and woodland types. In addition there are areas of open vegetation and some small areas of aquatic vegetation.

The report of the 2006 survey (Carter Ecological Ltd 2006) details the approach to determining NVC communities in the field and from quadrat data. The 2006 report, and especially the 2007 report, explains our approach to dealing with issues of vegetation ecology such as vegetation transitions and mosaics. The 2013 survey covered the area surveyed from 2006 but in addition includes the remaining extensive areas of vegetation in the commons, scrub and woodland. The maps showing the grouped NVC communities are given in Figure 2 Map 1 to 12.

4.2 Synopsis of Previously Recorded NVC types

Here we list the NVC type mapped in the 2006 survey (further details are included in Carter Ecological Ltd 2006) followed by details of the additional NVC types which were either minor constituents in the previous reports and only briefly described or which were mapped for the first time in 2013 survey, and for these communities we provide more detailed information.

4.2.1 Calcicolous Grassland Communities

Only one calcicolous grassland type was mapped in 2006:

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

The following rare or scarce plant species was recorded from this vegetation type in 2013 (*Section 6.1*): *Calluna vulgaris* (Heather) and *Helianthemum nummularium* (Common Rock-rose).

4.2.2 Calcifugous Grassland Communities

The following calcifugous grassland types were mapped in 2006:

- **U1 *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland, lichen variant;**

- **U1b *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland, typical sub-community;**
- **U1b *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland, typical sub-community, open variant;**
- **U1 *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland,** undifferentiated, a standard NVC type;
- **U2a *Deschampsia flexuosa* grassland*, Festuca ovina-Agrostis capillaris* sub-community;**
- **U2a *Deschampsia flexuosa* grassland*, Festuca ovina-Agrostis capillaris* sub-community**, open variant;
- **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 now have reservations about the NVC diagnosis (see 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 in 2006:

- **U1b** and **U1**-undifferentiated on the one hand to **U2a** on the other;
- **U1**-undifferentiated to **U4**-undifferentiated;
- **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.

The following rare or scarce plant species were recorded from the acid grassland vegetation types in 2013 (*Section 6.1*): *Arenaria serpyllifolia* (Thyme-leaved Sandwort), *Calluna vulgaris* (Heather; and in transitions with **CG10**), *Cerastium semidecandrum* (Little Mouse-ear), *Filago minima* (Small Cudweed), *Moenchia erecta* (Upright Chickweed; and in transitions with **CG10**), *Ornithopus perpusillus* (Bird's-foot), *Potentilla tabernaemontani* (Spring Cinquefoil),*Scleranthus annuus* (Annual Knawel), *Stellaria pallida* (Lesser Chickweed), *Teesdalia nudicaulis* (Shepherd's Cress) and *Trifolium ornithopodioides* (Bird's-foot Clover).

4.2.3 Heath Communities

In the 2006 report the only vegetation loosely referable to heath was:

- **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.

4.2.4 Mesotrophic Grasslands

The following mesotrophic grassland types were mapped in 2006:

- **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**;
- **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.

In the previous surveys, the **MG5 *Cynosurus cristatus-Centaurea nigra* grasslands** and **MG6 *Lolium perenne-Cynosurus cristatus* grasslands** were noted as additional grassland types (RSK 2006, page 47) because they were only recorded from a few localities in 2006. These two grassland types were mapped much more widely in the extended area of the 2013 survey and so these grassland types are describe in more detail in section 4.3.

4.2.5 Tall-herb and Bracken Communities

The following tall-herb and *Pteridium aquilinum* (Bracken) communities were mapped in 2006:

- **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**).

4.2.6 Scrub and Woodland Communities

Scrub and woodland:

- **W23 *Ulex europaeus-Rubus fruticosus* scrub**, undifferentiated;
- **W24 *Rubus fruticosus-Holcus lanatus* underscrub**, undifferentiated; and
- **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 Additional NVC Types identified during the 2013 survey

4.3.1 Mesotrophic Grasslands

The following additional mesotrophic grassland types were mapped in 2013:

- **MG1e *Arrhenatherum elatius* grassland, *Centaurea nigra* sub-community**;
- **MG5 *Cynosurus cristatus-Centaurea nigra* grassland**;
- **MG5b *Cynosurus cristatus-Centaurea nigra* grassland, *Galium verum* sub-community**;
- **MG6b *Lolium perenne-Cynosurus cristatus* grassland, *Anthoxanthum odoratum* sub-community**;
- **MG6c *Lolium perenne-Cynosurus cristatus* grassland, *Trisetum flavescens* sub-community**;
- **MG7 *Lolium perenne* leys and related grasslands**;
- **MG7e *Lolium perenne* leys and related grasslands, *Lolium perenne-Plantago lanceolata* grassland**; and
- **MG9a *Holcus lanatus-Deschampsia cespitosa* grassland, *Poa trivialis* sub-community**.

Further details' regarding each of these vegetation types is given below.

4.3.1.1 MG1e Arrhenatherum elatius grassland, Centaurea nigra sub-community

In the lowland areas of the Malvern Hills **MG1 *Arrhenatherum elatius* grassland** occurs widely in roadside vegetation, managed by sporadic and irregular mowing, most notably as the **MG1a *Arrhenatherum elatius* grassland, *Festuca rubra* sub-community** and the **MG1b *Arrhenatherum elatius* grassland, *Urtica dioica* sub-community** which are typical of such situations. In 2013, in addition to the two widespread sub-communities RSK also mapped **MG1e *Arrhenatherum elatius* grassland, *Centaurea nigra* sub-community.** This sub-community is the most species-rich of the **MG1 *Arrhenatherum elatius* grasslands** and *Arrhenatherum elatius* (False Oat-grass) itself is less dominant than in the other sub-communities and there are a range of species also associated with hay-meadows such as *Centaurea* cf.

nigra (Common Knapweed), *Conopodium majus* (Pignut), *Galium verum* (Lady's Bedstraw), *Lathyrus pratensis* (Meadow Vetchling), *Lotus corniculatus* (Common Bird's-foot-trefoil), *Rhinanthus minor* (Yellow-rattle) and *Rumex acetosa* (Common Sorrel). Sometimes this vegetation can represent transitions to hay meadow vegetation (MG5 *Cynosurus cristatus-Centaurea nigra* grassland) or examples of such meadows which have become somewhat degraded due to reduced mowing frequency and increase in cover of *Arrhenatherum elatius* (False Oat-grass) at the expense of hay meadow species. This vegetation type was mapped in the road verges and commons such as Malvern Common and Newland.

The overall composition of vegetation referable to the NVC type **MG1 *Arrhenatherum elatius* grassland** is given in *Table 4-1*. No rare or scarce species were recorded from this vegetation type in 2013.

Table 4-1 Vegetation referable to the NVC type MG1 *Arrhenatherum elatius* grassland (Roman numerals in bold indicate constant species in our data).

	MG1 Constancy	**MG1** Domin
Arrhenatherum elatius	**V**	**(4-10)**
Holcus lanatus	**V**	**(2-7)**
Festuca rubra	**IV**	**(2-7)**
Dactylis glomerata	**IV**	**(2-3)**
Plantago lanceolata	**IV**	**(1-3)**
Poa trivialis	III	(4-6)
Agrostis stolonifera	III	(2-6)
Cirsium arvense	III	(1-2)
Ranunculus repens	II	(1-5)
Agrostis capillaris	II	(4)
Alopecurus pratensis	II	(3-4)
Anthoxanthum odoratum	II	(2)
Rumex acetosa	II	(2)
Stellaria graminea	II	(2)
Vicia sativa	II	(2)
Conopodium majus	II	(1-2)
Heracleum sphondylium	II	(1-2)
Lathyrus pratensis	II	(1-2)
Ranunculus acris	II	(1-2)
Rhinanthus minor	II	(1-2)
Phleum pratense	II	(1)
Anthriscus sylvestris	I	(8)
Centaurea cf. nigra	I	(4)
Elytrigia repens	I	(4)
Lotus corniculatus	I	(4)
Galium aparine	I	(3)

	MG1 Constancy	MG1 Domin
Achillea millefolium	I	(2)
Allium vineale	I	(2)
Convolvulus arvensis	I	(2)
Galium verum	I	(2)
Vicia tetrasperma	I	(2)
Cerastium fontanum	I	(1)
Cynosurus cristatus	I	(1)
Geum urbanum	I	(1)
Lathyrus nissolia	I	(1)
Taraxacum sect. Ruderalia	I	(1)
Veronica chamaedrys	I	(1)
Number of species per quadrat	12-17	
Number of quadrats	5	

4.3.1.2 MG5 Cynosurus cristatus-Centaurea nigra grassland

The earlier surveys (2006) focused in the hills and just a few commons so **MG5 *Cynosurus cristatus-Centaurea nigra* grassland**, which is the central lowland hay meadow vegetation type of Britain, was recorded as an additional grassland type. However, in 2013 the survey included more lowland commons and other areas with meadow vegetation that is clearly referable to the NVC type **MG5 *Cynosurus cristatus-Centaurea nigra* grassland**. This vegetation is characteristic of those commons managed by regular annual mowing for hay, sometimes with follow-up grazing of the aftermath growth. The vegetation is rich in herbs and can present a very colourful appearance in the summer months before mowing. The main grasses are *Agrostis capillaris* (Common Bent), *Anthoxanthum odoratum* (Sweet Vernal-grass), *Cynosurus cristatus* (Crested Dog's-tail), *Dactylis glomerata* (Cock's-foot), *Festuca rubra* (Red Fescue) and *Holcus lanatus* (Yorkshire-fog). A wide range of associated herbs includes *Centaurea cf. nigra* (Common Knapweed), *Lotus corniculatus* (Common Bird's-foot-trefoil), *Plantago lanceolata* (Ribwort Plantain), *Ranunculus acris* (Meadow Buttercup), *Ranunculus repens* (Creeping Buttercup), *Trifolium pratense* (Red Clover) and *Trifolium repens* (White Clover).

Our vegetation could usually be assigned to one of the sub-communities. The majority of the **MG5 *Cynosurus cristatus-Centaurea nigra* grassland** was mapped in the northern part of the study area in the Commons and along the road verges. Hay meadow vegetation of this kind is a relatively scarce vegetation type in Britain, and can be of high conservation value (Nature Conservancy Council 1989). The example at Malvern Common is especially extensive for the region as a whole and forms an interesting mosaic with other species-rich communities such as **M23 *Juncus effusus/acutiflorus-Galium palustre* rush-pasture** and is discussed as a possible new SSSI designation in *Section 5*.

The overall composition of vegetation referable to the NVC type **MG5 *Cynosurus cristatus-Centaurea nigra* grassland** is given in *Table 4-2*. The following rare or scarce species were recorded from this vegetation type in 2013 (*Section 6.1*): *Helictotrichon pubescens* (Downy Oat-grass). A number of other rare and scarce species have also been recorded from these vegetation types (Barnett & Garner 2005).

Table 4-2 Vegetation referable to the NVC type MG5 Cynosurus cristatus-Centaurea nigra grassland (Roman numerals in bold indicate constant species in our data)

	MG5 Constancy	**MG5** Domin
Agrostis capillaris	**V**	**(3-8)**
Holcus lanatus	**V**	**(1-8)**
Anthoxanthum odoratum	**V**	**(1-6)**
Lotus corniculatus	**IV**	**(1-8)**
Ranunculus repens	**IV**	**(1-7)**
Plantago lanceolata	**IV**	**(1-6)**
Ranunculus acris	**IV**	**(1-5)**
Trifolium pratense	**IV**	**(1-5)**
Potentilla erecta	III	(3-5)
Festuca rubra	III	(2-5)
Cynosurus cristatus	III	(1-5)
Rumex acetosa	III	(1-4)
Trifolium repens	III	(1-4)
Luzula campestris	III	(1-3)
Rhinanthus minor	II	(3-6)
Carex leporina	II	(1-6)
Hypochaeris radicata	II	(1-6)
Lolium perenne	II	(1-6)
Festuca ovina	II	(2-5)
Centaurea cf. nigra	II	(1-5)
Pedicularis sylvatica	II	(2-4)
Alopecurus pratensis	II	(1-4)
Lotus pedunculatus	II	(1-4)
Achillea millefolium	II	(1-3)
Cerastium fontanum	II	(1-2)
Dactylis glomerata	II	(1-2)
Achillea ptarmica	I	(4-7)
Poa trivialis	I	(1-7)
Calliergonella cuspidata	I	(3-6)
Carex flacca	I	(1-6)
Lathyrus pratensis	I	(3-5)
Leontodon saxatilis	I	(2-5)
Carex hirta	I	(1-5)

Galium verum	I	(2-4)
Danthonia decumbens	I	(1-4)
Juncus effusus/ conglomeratus	I	(1-4)
Nardus stricta	I	(1-4)
Hordeum secalinum	I	(2-3)
Leontodon hispidus	I	(2-3)
Linum catharticum	I	(1-3)
Rhytidiadelphus squarrosus	I	(1-3)
Phleum pratense	I	(1-2)
Heracleum sphondylium	I	(1-2)
Scorzoneroides autumnalis	I	(1-2)
Stellaria graminea	I	(1-2)
Silaum silaus	I	(1)
Number of species per quadrat	9-30	
Number of quadrats	20	

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

This sub-community is characterised by species indicative of slightly wetter soil conditions, and as well as the community constants includes e.g. *Lathyrus pratensis* (Meadow Vetchling), *Lotus pedunculatus* (Greater Bird's-foot-trefoil) and *Juncus* spp. This vegetation type was mapped in Malvern Link Common, Great Malvern and Newland.

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

This sub-community is characteristic of lighter, drier soils and as well as the community constants also includes a range of drier grassland species such as *Briza media* (Quaking-grass) and *Trisetum flavescens* (Yellow Oat-grass) the sedge *Carex flacca* (Glaucous Sedge) and the herb *Galium verum* (Lady's Bedstraw). This vegetation type was mapped in Malvern Common and Malvern Links.

*4.3.1.5 **MG5c Cynosurus cristatus –Centaurea nigra grassland, Danthonia decumbens sub-community***

This sub-community is characteristic of more acid soils and in addition to the community constants includes some species more indicative of calcifugous grasslands and in our samples included *Danthonia decumbens* (Heath-grass), *Potentilla erecta* (Tormentil), and *Luzula campestris* (Field Wood-rush). This grassland type was mapped as part of mosaics with other sub-communities in Malvern Links Common.

*4.3.1.6 **MG6 Lolium perenne-Cynosurus cristatus grassland***

In the previous survey (2006) which focused on the upland areas of the Malvern Hills, the lowland vegetation type **MG6 *Lolium perenne-Cynosurus cristatus* grassland** was only included as an additional type. However in the 2013 survey, which includes a number of lowland commons and road verges, **MG6 *Lolium perenne-Cynosurus cristatus* grassland** was the most abundant of the mesotrophic grassland types

characterising many of the grazed pastures on improved and semi-improved commons. **MG6 *Lolium perenne-Cynosurus cristatus* grassland** is often a grazed grassland type usually with frequent and even abundant *Cynosurus cristatus* (Crested Dog's-tail), *Lolium perenne* (Perennial Rye-grass) and *Holcus lanatus* (Yorkshire-fog).

In the more agriculturally improved locations the associated species may be limited to the species most tolerant of grazing and nutrient enrichment, such as *Bellis perennis* (Daisy), *Cerastium fontanum* (Common Mouse-ear), *Plantago lanceolata* (Ribwort Plantain), *Trifolium repens* (White Clover) and *Taraxacum* sect. *Ruderalia* (Common Dandelion). In less intensively managed situations the vegetation can be more varied and species-rich especially in **MG6c *Lolium perenne – Cynosurus cristatus* grassland, *Trisetum flavescens* sub-community**.

In other situations this vegetation can include indicators of wetter ground such as *Alopecurus geniculatus* (Marsh Foxtail) and *Deschampsia cespitosa* (Tufted Hair-grass) (the NVC defines some of these as variants of the typical sub-community) and this can be indicative of transitions to the vegetation types of wetter areas such as **MG9 *Holcus lanatus-Deschampsia cespitosa* grassland, w**ith species such as *Deschampsia cespitosa* (Tufted Hair-grass) and *Lotus pedunculatus* (Greater Bird's-foot-trefoil) and even *Pedicularis sylvatica* (Lousewort). The composition of vegetation referable to the NVC type **MG6 *Lolium perenne-Cynosurus cristatus* grassland** and the three sub-communities is given in *Table 4-3.*

The following rare or scarce species were recorded from this vegetation type (mainly the *Trisetum flavescens* (Yellow Oat-grass) sub-community) in 2013 (*Section 6.1*): *Bromopsis erecta* (Upright Brome), *Bupleurum tenuissimum* (Slender hare's-ear), *Filipendula vulgaris* (Dropwort), *Koeleria macrantha* (Crested Hair-grass), *Oenanthe pimpinelloides* (Corky-fruited Water-dropwort) and *Rumex pulcher* (Fiddle Dock). Overall, from the results of the 2013 survey, the **MG6** grasslands of the Malvern Hills area are considered especially worthy of further research.

Mosaics of such vegetation types were mapped in the lowland commons throughout the study area, specific locations are given below under the sub-community descriptions.

Table 4-3 Vegetation referable to the NVC type MG6 Lolium perenne-Cynosurus cristatus grassland and sub-communities (Roman numerals in bold indicate constant species in our data)

	MG6a	**MG6a**	**MG6b**	**MG6b**	**MG6c**	**MG6c**
	Constancy	Domin	Constancy	Domin	Constancy	Domin
Agrostis capillaris	**V**	**(3-7)**	**V**	**(1-7)**	**V**	**(1-6)**
Cynosurus cristatus	**V**	**(1-6)**	**V**	**(2-8)**	**V**	**(3-6)**
Holcus lanatus	**V**	**(1-6)**	**V**	**(2-7)**	III	(1-4)
Lolium perenne	**V**	**(1-8)**	**V**	**(1-6)**	**IV**	**(1-4)**
Trifolium repens	**IV**	**(1-6)**	**V**	**(1-8)**	**V**	**(2-6)**
Plantago lanceolata	II	(2-3)	**V**	**(1-6)**	**V**	**(1-6)**
Trifolium pratense	I	(3)	**V**	**(1-5)**	**V**	**(1-4)**
Festuca rubra	III	(2-8)	**IV**	**(1-6)**	**V**	**(1-7)**

	MG6a	**MG6a**	**MG6b**	**MG6b**	**MG6c**	**MG6c**
	Constancy	Domin	Constancy	Domin	Constancy	Domin
Lotus corniculatus	I	(3)	**IV**	**(1-7)**	**V**	**(2-6)**
Cerastium fontanum	III	(1-3)	**IV**	**(1-3)**	**V**	**(1-2)**
Anthoxanthum odoratum	**III**	(2-4)	**IV**	**(1-5)**	III	(1-3)
Trisetum flavescens			II	(2-6)	**V**	**(2-6)**
Galium verum			I	(1-3)	**V**	**(2-5)**
Achillea millefolium	I	(2)	III	(1-3)	**IV**	**(1-3)**
Festuca ovina			II	(3-5)	**IV**	**(1-6)**
Carex hirta	III	(1-5)	II	(1-4)	I	(2)
Deschampsia cespitosa	II	(2-4)	I	(1-2)		
Lotus pedunculatus	I	(3)	II	(1-6)		
Juncus conglomeratus			II	(1-7)		
Rhinanthus minor			I	(4-7)		
Pedicularis sylvatica	I	(3)	I	(1-2)		
Carex leporina			I	(1-3)		
Ranunculus acris	I	(3)	III	(1-6)	I	(3)
Rumex acetosa	I	(1)	III	(1-3)	I	(1)
Hypochaeris radicata			III	(1-5)	I	(1)
Luzula campestris			III	(1-3)	III	(1-3)
Potentilla erecta	I	(2)	II	(1-4)	I	(1-3)
Danthonia decumbens			I	(1-2)	I	(1-3)
Cirsium arvense	II	(1-5)	I	(1-2)	III	(1-4)
Linum catharticum			I	(1)	III	(1-3)
Phleum bertolonii			I	(1-2)	III	(1-3)
Leontodon hispidus			I	(1)	III	(1-4)
Scorzoneroides autumnalis			III	(1-5)	II	(1-3)
Carex flacca			II	(1-4)	II	(2-3)
Leontodon saxatilis			II	(1-3)	I	(1-2)
Ranunculus bulbosus	I	(5)	I	(1)	II	(1-2)
Carex caryophyllea			I	(1-4)	II	(1-3)
Ononis repens					II	(4-7)
Briza media					II	(1-3)
Bromopsis erecta					II	(1-3)
Cirsium acaule					II	(1-4)
Pilosella officinarum					II	(2)
Thymus polytrichus					II	(4-7)
Nr species per quadrat	11-21		15-22		19-32	
Nr quadrats	5		37		10	

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

This grass-dominated vegetation has the community constants *Cynosurus cristatus* (Crested Dog's-tail), *Festuca rubra* (Red Fescue), *Holcus lanatus* (Yorkshire-fog) and *Lolium perenne* (Perennial Rye-grass), with herbs characteristic of improved pastures such as *Cerastium fontanum* (Common Mouse-ear), *Cirsium arvense* (Creeping Thistle), *Ranunculus repens* (Creeping Buttercup), *Trifolium repens* (White Clover). This vegetation type was mapped in a number of places where heavier grazing was focused in locations accessible to roads and to farms such as Malvern Links and Castlemorton Common.

4.3.1.8 *MG6b Lolium perenne-Cynosurus cristatus grassland, Anthoxanthum odoratum sub-community*

In this more species-rich type of **MG6 *Lolium perenne – Cynosurus cristatus* grassland**, *Anthoxanthum odoratum* (Sweet Vernal-grass) is diagnostic together with *Agrostis capillaris* (Common Bent) and with species of less improved grassland such as *Ranunculus acris* (Meadow Buttercup), *Rumex acetosa* (Common Sorrel), *Hypochaeris radicata* (Cat's-ear) and *Luzula campestris* (Field Wood-rush).

In the context of the Malvern Hills this vegetation can mark out transitions to the vegetation of more calcifugous swards such as **U4 *Festuca ovina-Agrostis capillaris-Galium saxatile* grassland**, including calcifugous indicators species such as *Danthonia decumbens* (Heath-grass), *Luzula campestris* (Field Wood-rush), *Scorzoneroides autumnalis* (Autumn Hawkbit) and *Potentilla erecta* (Tormentil).

Mosaics of such vegetation types were mapped in the Old Hills and Malvern Link Common, to the north Middle Hills and Castlemorton Common to the south of the study area.

4.3.1.9 *MG6c Lolium perenne-Cynosurus cristatus grassland, Trisetum flavescens sub-community*

This is the most species-rich sub-community of the **MG6 *Lolium perenne-Cynosurus cristatus* grassland** and the diagnostic species here are *Trisetum flavescens* (Yellow Oat-grass) and *Phleum bertolonii* (Smaller Cat's-tail), but also some calcicolous species including some which do not feature in the NVC tables for MG6 *Lolium perenne – Cynosurus cristatus* grassland, such as *Briza media* (Quaking-grass), *Bromopsis erecta* (Upright Brome), *Cirsium acaule* (Dwarf Thistle), *Ononis repens* (Common Restharrow), *Pilosella officinarum* (Mouse-ear-hawkweed) and *Thymus polytrichus* (Wild Thyme).

This kind of vegetation was mapped in the Castlemorton Common area and is more species-rich than the samples given in the NVC volumes (our samples had between 19 and 32 species per quadrat compared with 11 to 20 species in the NVC tables for **MG6c *Lolium perenne-Cynosurus cristatus* grassland, *Trisetum flavescens* sub-community**). We interpret this rather interesting vegetation in the Malvern Hills as marking transitions to more calcicolous swards of **CG2 *Festuca ovina-Avenula pratensis* grassland** or **CG3 *Bromus erectus* grassland**, and although **CG2** and **CG3** *per se* were not recorded in the area, the species pool available in the locality clearly includes some of the species of these calcicolous vegetation types.

4.3.1.10 *MG7 Lolium perenne leys and related grasslands*

This is vegetation of improved agricultural pastures and of amenity and recreational swards. The swards are grass-dominated and species-poor and centred around the abundance of the main pasture grass *Lolium perenne* (Perennial Rye-grass). During the 2013 surveys we found examples of several of the sub-communities usually characterised by the presence of one or more distinctive grasses such as *Alopecurus*

pratensis (Meadow Foxtail) in **MG7c the *Lolium perenne-Alopecurus pratensis* grassland.**

In other situations *Lolium perenne* (Perennial Rye-grass) is accompanied by broad-leaved herbs such as *Plantago* species as in **MG7e *Lolium perenne-Plantago lanceolata* grassland.** This is vegetation of reseeded road verges and lawns which are regularly mown and which receive moderate trampling. In similar situations but where there is greater disturbance **MG7 *Lolium perenne* leys and related grasslands** may be replaced by **OV23 *Lolium perenne-Dactylis glomerata* community** and this community is discussed in the 2006 report (Carter Ecological 2006).

These types of vegetation were widely mapped in the lowland commons and road verges. No rare or scarce species were recorded from this vegetation type in 2013.

4.3.1.11 MG9 Holcus lanatus-Deschampsia cespitosa grassland

This vegetation is characteristic of wetter soils in pastures and occurred quite extensively on the lowland commons usually in mosaics and transitions with **MG6 *Lolium perenne-Cynosurus cristatus* grassland** and also **M23 *Juncus effususlacutiflorus-Galium palustre* rush-pasture.**

Deschampsia cespitosa (Tufted Hair-grass) is the characteristic species which helps define this vegetation, but in our samples it was never dominant, but instead co-dominant or co-occurring with a range of mesotrophic grassland species such as *Holcus lanatus* (Yorkshire-fog), *Agrostis* spp. (Bents), *Carex leporina* (Oval Sedge), *Festuca rubra* (Red Fescue), *Poa trivialis* (Rough Meadow-grass), *Dactylis glomerata* (Cock's-foot) and *Cynosurus cristatus* (Crested Dog's-tail). In addition, marking areas with wetter soils were some accompanying poor-fen species such as *Juncus conglomeratus* (Compact Rush), *Juncus effusus* (Soft-rush) and *Lotus pedunculatus* (Greater Bird's-foot-trefoil) and also *Ranunculus flammula* (Lesser Spearwort) and *Pedicularis sylvatica* (Lousewort).

This vegetation type was quite characteristic of many of the lowland commons and was mapped in transitions and mosaics with **MG6 *Lolium perenne-Cynosurus cristatus* grassland** and the vegetation of wetter soils with **M23 *Juncus effususlacutiflorus-Galium palustre* rush-**pasture and mapped for example in Castlemorton Common. The composition of vegetation referable to the NVC type **MG9a *Holcus lanatus-Deschampsia cespitosa* grassland, *Poa trivialis* sub-community** is presented in *Table 4-4.* The following rare or scarce species were recorded from this vegetation type in 2013 (*Section 6.1*) *Lythrum portula* (Water-purslane).

Table 4-4 Vegetation referable to the NVC type MG9a Holcus lanatus-Deschampsia cespitosa grassland, Poa trivialis sub-community. (Roman numerals in bold indicate constant species in our data).

	MG9a Constancy	**MG9a** Domin
Juncus effusus	**V**	**(4-9)**
Holcus lanatus	**V**	**(2-5)**
Ranunculus acris	**V**	**(2-5)**
Cynosurus cristatus	**V**	**(1-5)**
Deschampsia cespitosa	**V**	**(1-5)**
Lotus pedunculatus	**V**	**(1-5)**
Agrostis stolonifera	**V**	**(3-4)**
Juncus conglomeratus	**IV**	**(1-6)**
Agrostis capillaris	**IV**	**(1-5)**
Agrostis canina	**IV**	**(1-4)**
Anthoxanthum odoratum	**IV**	**(1-4)**
Carex leporina	**IV**	**(1-3)**
Ranunculus repens	**IV**	**(1-3)**
Trifolium repens	III	(1-4)
Potentilla erecta	III	(1-3)
Festuca rubra	II	(3-4)
Pedicularis sylvatica	II	(1)
Carex hirta	I	(4)
Carex nigra	I	(2)
Plantago lanceolata	I	(2)
Poa trivialis	I	(2)
Ranunculus flammula	I	(2)
Carex flacca	I	(1)
Cirsium palustre	I	(1)
Lotus corniculatus	I	(1)
Rhinanthus minor	I	(1)
Salix cinerea	I	(1)
Trifolium pratense	I	(1)
Number of species per quadrat	11-26	
Number of quadrats	7	

4.3.2 Mire Communities

The following mire community was mapped in 2013:

- **M23a *Juncus effusus/acutiflorus-Galium palustre* rush-pasture, *Juncus acutiflorus* sub-community.**

This vegetation is characteristic of poorly drained and relatively unimproved pasture and formed mosaics and transitions with **MG6 *Lolium perenne-Cynosurus cristatus* grassland** and **MG9 *Holcus lanatus-Deschampsia cespitosa* grassland**. The key species defining this community are the *Juncus* species (Rushes), the grass *Holcus*

lanatus (Yorkshire-fog) and dicotyledonous herbs*alium palustre* (Common Marsh-bedstraw) and *Lotus pedunculatus* (Greater Bird's-foot-trefoil). Quite a wide range of associated species were recorded in our samples including the grasses *Alopecurus pratensis* (Meadow Foxtail), *Anthoxanthum odoratum* (Sweet Vernal-grass), *Bromus commutatus* (Meadow Brome), *Cynosurus cristatus* (Crested Dog's-tail), *Deschampsia cespitosa* (Tufted Hair-grass), *Poa trivialis* (Rough Meadow-grass), the sedges *Carex demissa* (Common Yellow-sedge), *Carex flacca* (Glaucous Sedge), *Carex hirta* (Hairy Sedge), *Carex leporina* (Oval Sedge) and *Carex pulicaris* (Flea Sedge), and the dicot herbs *Cardamine pratensis* (Cuckooflower), *Cirsium palustre* (Marsh Thistle), *Dactylorhiza fuchsii* (Common Spotted-orchid), *Mentha aquatica* (Water Mint), *Oenanthe lachenalii* (Parsley Water-dropwort), *Pedicularis sylvatica* (Lousewort), *Potentilla erecta* (Tormentil), *Ranunculus flammula* (Lesser Spearwort), and *Silene flos-cuculi* (Ragged-Robin).

The composition of vegetation referable to the NVC type **M23a *Juncus effusus/acutiflorus-Galium palustre rush-pasture, Juncus acutiflorus sub-community*** is given in *Table 4-5.* The following rare or scarce plant species were recorded from this vegetation type in 2013 (*Section 6.1*): *Carex echinata* (Star Sedge), *Carex hostiana* (Tawny Sedge), *Dactylorhiza praetermissa* (Southern Marsh-orchid) and *Oenanthe lachenalii* (Parsley Water-dropwort).

This vegetation was mapped as individual stands and also in transitions, for example with **MG9 *Holcus lanatus-Deschampsia cespitosa* grassland**, in a number of locations including Castlemorton Common and Malvern Common.

Table 4-5 Vegetation referable to the NVC type M23a Juncus effusus/acutiflorus-Galium palustre rush-pasture, Juncus acutiflorus sub-community. (Roman numerals in bold indicate constant species in our data).

	M23a Constancy	**M23a** Domin
Holcus lanatus	**V**	**(1-6)**
Lotus pedunculatus	**V**	**(1-6)**
Anthoxanthum odoratum	**V**	**(1-5)**
Carex flacca	**IV**	**(2-6)**
Ranunculus repens	**IV**	**(1-5)**
Cirsium palustre	**IV**	**(1-4)**
Galium palustre	**IV**	**(1-4)**
Ranunculus acris	**IV**	**(1-4)**
Cynosurus cristatus	**IV**	**(1-3)**
Juncus conglomeratus	III	(2-9)
Juncus inflexus	III	(4-8)
Juncus acutiflorus	III	(1-8)
Juncus effusus	III	(2-7)
Agrostis canina	III	(4-6)
Carex leporina	III	(1-5)

	M23a Constancy	**M23a** Domin
Festuca rubra	III	(1-5)
Pulicaria dysenterica	III	(1-5)
Oenanthe lachenalii	III	(2-4)
Calliergonella cuspidata	III	(1-4)
Carex hirta	III	(1-4)
Mentha aquatica	III	(1-4)
Dactylorhiza fuchsii	III	(1-3)
Plantago lanceolata	III	(1-3)
Poa trivialis	III	(1-3)
Silene flos-cuculi	III	(1-3)
Stellaria graminea	III	(1-3)
Bromus commutatus	III	(1-2)
Cirsium arvense	III	(1-2)
Rumex acetosa	III	(1-2)
Ranunculus flammula	II	(2-6)
Potentilla erecta	II	(1-4)
Potentilla reptans	II	(1-4)
Potentilla anserina	II	(1-3)
Hydrocotyle vulgaris	I	(6-7)
Filipendula ulmaria	I	(1-6)
Festuca ovina	I	(3-4)
Agrostis stolonifera	I	(1-4)
Nardus stricta	I	(1-4)
Rumex conglomeratus	I	(1-4)
Carex demissa	I	(2-3)
Luzula campestris	I	(1-3)
Carex nigra	I	(1-2)
Deschampsia cespitosa	I	(1-2)
Juncus articulatus	I	(1-2)
Number of species per quadrat	16-29	
Number of quadrats	17	

4.3.3 Aquatic communities

Aquatic vegetation and areas of open water such as ponds are relatively scarce in the study area but some ponds were recorded as well as some areas with aquatic / wetland vegetation including: **A2 *Lemna minor* community**, **A7 *Nymphaea alba* community**, **A8 *Nuphar lutea* community**, **A16 *Callitriche stagnalis* community**, **MG11 *Festuca rubra-Agrostis stolonifera-Potentilla anserina* grassland**, **OV28 *Agrostis stolonifera-Ranunculus repens* community**, **OV35 *Lythrum portula-Ranunculus flammula* community**, **S12 *Typha latifolia* swamp**, **S19 *Eleocharis palustris* swamp**, **S22 *Glyceria fluitans* water-margin vegetation** and **S23 Other water margin vegetation**. The following rare or scarce plant species were recorded from the aquatic vegetation types in 2013 (*Section 6.1*): *Ranunculus trichophyllus* (Thread-leaved Water-crowfoot) and *Lythrum portula* (Water-purslane).

4.3.4 Scrub and Woodland Types

Much of the woodland surveyed was difficult to assign to an NVC type unambiguously. This is probably due to the relatively young nature of woodlands in the Malvern Hills which have likely developed through the colonisation of abandoned pastures, meadows and common land by shrubs and trees as a result of relaxation of grazing in the early to mid 20th century. The following additional scrub and woodland communities were mapped in 2013:

- **W2 *Salix cinerea-Betula pubescens-Phragmites australis* woodland**;
- **W6a *Alnus glutinosa-Urtica dioica* woodland, typical sub-community**;
- **W8 *Fraxinus excelsior-Acer campestre-Mercurialis perennis* woodland**;
- **W8d *Fraxinus excelsior-Acer campestre-Mercurialis perennis* woodland, *Hedera helix* sub-community**;
- **W10 *Quercus robur-Pteridium aquilinum-Rubus fruticosus* woodland**;
- **W21 *Crataegus monogyna-Hedera helix* scrub**;
- In addition a category of mixed deciduous secondary woodland, referred to as Wu, was recorded which does not conform to any published NVC type.

The following rare or scarce plant species were recorded from some of the woodland vegetation types in 2013 (*Section 6.1*): *Cardamine impatiens* (Narrow-leaved Bitter-cress), *Ceratocapnos claviculata* (Climbing Corydalis), *Sorbus torminalis* (Wild Service-tree) and *Torilis nodosa* (Knotted Hedge-parsley).

4.3.4.1 W2 Salix cinerea-Betula pubescens-Phragmites australis woodland

Small areas of Willow woodland have been mapped associated with wetter soils for example along the streams which crosses Castlemorton Common. *Salix cinerea* (Grey Willow) is dominant with frequent *Rubus fruticosus* agg. (Bramble) and locally frequent *Fraxinus excelsior* (Ash). The field-layer includes frequent *Brachypodium sylvaticum* (False Brome) and *Pteridium aquilinum* (Bracken).

4.3.4.2 W6a Alnus glutinosa-Urtica dioica woodland, typical sub-community

Small areas of Alder woodland have been mapped associated with wetter soils. *Alnus glutinosa* (Alder) is dominant with some *Fraxinus excelsior* (Ash) and in the shrub-layer *Corylus avellana* (Hazel) and *Salix cinerea* (Grey Willow). The field-layer including disturbance indicators such as *Urtica dioica* (Common Nettle).

4.3.4.3 W8 Fraxinus excelsior-Acer campestre-Mercurialis perennis woodland

Some stands could be assigned at least tentatively to **W8 *Fraxinus excelsior-Acer campestre-Mercurialis perennis* woodland**. These were often the more mature woodlands on the upper slopes of the hills. The canopy has *Fraxinus excelsior* (Ash), sometimes including *Quercus robur* (Pedunculate Oak) and *Castanea sativa* (Sweet Chestnut), the shrub-layer has *Acer campestre* (Field Maple), *Corylus avellana* (Hazel) and *Sambucus nigra* (Elder), and the field-layer has varying amounts of *Mercurialis*

perennis (Dog's Mercury), *Allium ursinum* (Ramsons) and *Circaea lutetiana* (Enchanter's-nightshade).

The best example of **W8 *Fraxinus excelsior-Acer campestre-Mercurialis perennis* woodland** is Park Wood, an area known to be ancient semi-natural woodland. The woodland consisted of blocks of high-canopy *Fraxinus excelsior* (Ash) woodland, with sparse understory. During our survey we found 21 ancient woodland indicator species (based on the list for Worcestershire as described in Kirby & Goldberg (2004)) which were *Anemone nemorosa* (Wood Anemone), *Allium ursinum* (Ramsons), *Carex pendula* (Pendulous Sedge), *Carex remota* (Remote Sedge), *Carex sylvatica* (Wood-sedge), *Chrysosplenium oppositifolium* (Opposite-leaved Golden-saxifrage), *Euphorbia amygdaloides* (Wood Spurge), *Galium odoratum* (Woodruff), *Hyacinthoides non-scripta* (Bluebell), *Lamiastrum galeobdolon* (Yellow Archangel), *Lysimachia vulgaris* (Yellow Loosestrife), *Melica uniflora* (Wood Melick), *Mercurialis perennis* (Dog's Mercury), *Milium effusum* (Wood Millet), *Polystichum setiferum* (Soft Shield-fern), *Primula vulgaris* (Primrose), *Prunus avium* (Wild Cherry), *Quercus petraea* (Sessile Oak), *Ulmus glabra* (Wych Elm), *Veronica montana* (Wood Speedwell) and *Viola* cf. *riviniana* (Common Dog-violet). There are several other ancient woodland indicator species and notable species reported from this wood including *Epipactis helleborine* (Broad-leaved Helleborine) and *Paris quadrifolia* (Herb-Paris) (Bennet & Garner 2005, MHC 2006). This was part of a mosaic with recently-coppiced woodland blocks with re-growth of *Acer campestre* (Field Maple) and *Corylus avellana* (Hazel) stools, and a more dense ground layer of eutrophic species including *Galium aparine* (Cleavers) and *Rubus fruticosus* agg. (Bramble). The management plan notes that this woodland is one of the few in the Malvern Hills on limestone bedrock (MHC 2006) which gives the woodland a more distinct flora.

*4.3.4.4 **W10 Quercus robur-Pteridium aquilinum-Rubus fruticosus woodland / W16 Quercus spp.-Betula spp.-Deschampsia flexuosa woodland**.*

Some woodland stands could be assigned at least tentatively to W10 *Quercus robur-Pteridium aquilinum-Rubus fruticosus* or to the related but generally more upland type **W16 *Quercus* spp.-*Betula* spp.-*Deschampsia flexuosa* woodland**. These were often the more mature woodlands on the lower slopes of the hills. The canopy has *Quercus robur* (Pedunculate Oak) and/or *Quercus petraea* (Sessile Oak) (and hybrids are very likely Stace 2010 page 290) and the shrub-layer *Betula pubescens* (Downy Birch) and *Ilex aquifolium* (Holly) with *Lonicera periclymenum* (Honeysuckle).

The woodland on the east-facing slope at Hollybush Roughs is ancient semi-natural woodland. This woodland is referable to **W10 *Quercus robur-Pteridium aquilinum-Rubus fruticosus* woodland**. We found a total of 13 ancient woodland indictor species for Worcestershire present in Hollybed Roughs. These include the woody species *Malus sylvestris* (Crab Apple) and the herbs *Anemone nemorosa* (Wood Anemone), *Athyrium filix-femina* (Lady-fern), *Dryopteris affinis* (Golden-scaled Male-fern), *Hyacinthoides non-scripta* (Bluebell), *Luzula forsteri* (Southern Wood-rush),

Mercurialis perennis (Dog's Mercury), *Oxalis acetosella* (Wood-sorrel), *Poa nemoralis* (Wood Meadow-grass), *Polystichum setiferum* (Soft Shield-fern), *Schedonorus giganteus* (Giant Fescue), *Veronica montana* (Wood Speedwell) and *Viola riviniana* (Common Dog-violet). This wood is adjacent to secondary Ash woodland, and it is likely that these ancient woodland species will have been able to colonise the secondary woodland, thus blurring the boundaries.

4.3.4.5 ***W14 Fagus sylvatica-Rubus fruticosus woodland***

Some areas with abundant *Fagus sylvatica* (Beech) could be at least tentatively assigned to **W14 *Fagus sylvatica-Rubus fruticosus* woodland**. The vegetation is rather species-poor, the canopy is dominated by *Fagus sylvatica* (Beech), with *Acer pseudoplatanus* (Sycamore), *Carpinus betulus* (Hornbeam) and *Fraxinus excelsior* (Ash) the shrub-layer is poorly developed and the field-layer is dominated by *Hyacinthoides non-scripta* (Bluebell).

4.3.4.6 ***W21 Crataegus monogyna-Hedera helix scrub***

Crataegus monogyna (Hawthorn) is a frequent tree in the lowland commons of the Malvern Hills and the vegetation can be referred to **W21 *Crataegus monogyna-Hedera helix* scrub** where there is abundant *Crataegus monogyna* (Hawthorn). The shrub-layer is dominated by *Crataegus monogyna* (Hawthorn) with some *Fraxinus excelsior* (Ash) and a range of shrubs including *Betula pendula* (Silver Birch), *Corylus avellana* (Hazel), *Sambucus nigra* (Elder) and the field-layer is dominated by *Geum urbanum* (Wood Avens).

4.3.4.7 Mixed Broad-leaved Deciduous Secondary Woodland

Much of the woodland stands sampled could not unambiguously be assigned to an NVC woodland type (including some we have included in **W8 *Fraxinus excelsior-Acer campestre-Mercurialis perennis* woodland** and **W10 *Quercus robur-Pteridium aquilinum-Rubus fruticosus* woodland** above), and so were grouped under this heading. *Acer pseudoplatanus* (Sycamore) is a prominent canopy tree together with key tree species from both **W8 *Fraxinus excelsior-Acer campestre-Mercurialis perennis* woodlan**d and **W10 *Quercus robur-Pteridium aquilinum-Rubus fruticosus* woodland**, namely *Fraxinus excelsior* (Ash) and *Quercus robur* (Pedunculate Oak) sometimes with *Sorbus aucuparia* (Rowan) and *Castanea sativa* (Sweet Chestnut) and shrub-layer with *Acer campestre* (Field Maple), *Corylus avellana* (Hazel), *Crataegus monogyna* (Hawthorn), *Betula pendula* (Silver Birch) and *Sambucus nigra* (Elder). The field-layer includes varying amounts of typical woodland species such as *Rubus fruticosus* agg. (Bramble), *Hyacinthoides non-scripta* (Bluebell), *Mercurialis perennis* (Dog's Mercury), *Circaea lutetiana* (Enchanter's-nightshade), *Dryopteris* spp. (Male and Buckler ferns) and *Geum urbanum* (Wood Avens) as well as more ruderal species.

4.4 Areas of NVC types

Many NVC communities and sub-communities as well as transitions and mosaics between one or more vegetation types were identified and mapped during the 2013 survey. Although our GIS database contains all of this information for search and retrieval purposes, there are simply too many categories to map effectively on to hard copy maps. In order to provide a clear and meaningful picture of the main vegetation cover in the Malvern Hills, we have amalgamated related community types as in *Table 3-1* and these amalgamated communities have been used to determine the extent of each type from the GIS analysis (*Table 4-6*). The NVC vegetation maps are presented in *Figure 2.*

Table 4-6 Extent of major amalgamated NVC community types in the Malvern Hills arranged by main vegetation category and extent (ha).

Amalgamated NVC Communities	Area (ha)	% of total area
Hardstanding / No Access / Open Water / Arable	48.02	4.2
Aquatic and related communities		
A7 A8 A16 Au MG11 OV28 OV35 S12 S19 S22 S23	0.8	0.1
Mesotrophic grasslands and mires		
MG6	141.06	12.3
MG1	66.73	5.8
MG7 OV21 OV23	51.97	4.5
MG9	44.7	3.9
MG5	14.54	1.3
M23	10.07	0.9
MG6c	7.21	0.6
MG10	1.67	0.1
MG1e	0.22	0.0
Upland grasslands		
U20 W25	175.45	15.3
U2	59.9	5.2
U1	33.05	2.9
U4	9.26	0.8
CG10	2.87	0.3
U1b lichen var.	2.07	0.2
VM	1.0	0.1
Woodland and scrub and open vegetation		
W8	144.43	12.6
W10 W16	106.11	9.3
Wu W12	98.65	8.6
SCu W21 W22	59.28	5.2
W23	26.02	2.3
OV24 OV25 OV26 OV27	17.09	1.5

W24	20.61	1.8
W2 W6	2.86	0.2
Total	**1145.6**	**100%**

Scrub and woodland accounts for the largest area of the vegetation on the Malvern Hills. The woodlands (distinct from scrub) predominate on the lower slopes and account for 30.7% of the total land surveyed. Between woodland types there is a roughly even division between Ash woodland (**W8**), Oak and Birch woodland (**W10/W16**) (although only very broadly referable to these woodland NVC types see Section 4.3.4) and unclassified secondary woodland (**Wu** – with a very small amount of Beech woodland - **W12**, and wet Willow and Alder woodland **W2** and **W6**).

A number of different scrub types were mapped and together these cover 105.9 ha of the Malvern Hills (about 9% of the land area) and are indicative of low intensity management or lack of management. Section 4.5 discusses changes in scrub area as identified from a comparison of the 2006 and 2013 surveys.

Among the plant communities recorded, those of the most ecological and conservation value are the upland grasslands (U1, U2 and U4), which together extend over 102.2 ha (8.9%). The upland calcicolous grassland community CG10 is a grassland of especially high conservation value but limited in extent (2.87 ha).

The most widespread mesotrophic grassland community is **MG6** grassland, covering 141.1 ha. This grassland covers large areas of the lowland commons and pastures and the different sub-communities are indicative of mild and sometimes more extreme agricultural improvement, but with sufficient management to prevent encroachment of coarse grasses. The 2013 survey has mapped a number species-rich examples, especially **MG6c the *Trisetum flavescens* sub-community**, which we mapped as a separate type and which covered over 7.21 ha. In general terms the **MG6** grasslands of the Malvern Hills area are extensive and considered worthy of further study.

There was 14.5 ha of **MG5** grassland mapped, a nationally important BAP habitat type, and this was mapped at several locations in the lowland commons. Species-rich examples and mosaics with other vegetation types, e.g. in Malvern Common, are discussed in Section 5 in terms of potential new SSSI designations.

There was a significant amount of MG1 grassland, indicative of unmanaged marginal grassland areas, covering 66.7 ha, the best examples being **MG1e *Arrhenatherum elatius* grassland, *Centaurea nigra* sub-community** which we have mapped as a separate type in the hard copy maps, but which covers just 0.22 ha in total.

Improved grassland, **MG7**, and related open vegetation types (**OV21** and **OV23**) cover 52.0 ha predominantly along road verges and in recreation areas.

A total of 10.07 ha of the often species-rich *Juncus* mire community, **M23**, were mapped, predominantly on Castlemorton Common and Malvern Common, but also small patches in wet flushes elsewhere.

4.5 Changes in NVC types

4.5.1 Introduction

The objective was to compare the vegetation mapping in 2006 with that in 2013 to identify those areas that have changed significantly in terms of vegetation between the two survey periods 2006-2013. We used a combination of automated methods using the GIS system and field observations based on comparing vegetation maps from 2006 with actual vegetation observed in the field in 2013.

There are some constraints relevant to the interpretation of vegetation change. Any field mapping exercise will be subject to field errors due to poor or ambiguous sight lines in the field, difficulties in interpreting the vegetation cover and extent on areas of uneven terrain such as steep slopes, and other practical problems associated with surveying large and heterogeneous areas. There will also be some errors associated with defining vegetation boundaries and differences between surveyor opinions.

As a result, some "changes" will reflect these differences of interpretation and opinion, e.g. defining apparent change which does not reflect a real change but which is due for example, to differences in accessibility and clarification of vegetation in different surveys. An example here is on slopes where enhanced access can more clearly reveal the extent of areas of slope vegetation such as *Pteridium aquilinum* (Bracken) etc more clearly in one survey than another. This is not change of interest to this project.

Other apparent changes might reflect real but unimportant change. Examples here include shifts between related sub-communities of similar vegetation types, e.g. **MG1a *Arrhenatherum elatius* grassland, *Festuca rubra* sub-community** to **MG1b *Arrhenatherum elatius* grassland, *Urtica dioica* sub-community**; generally this is not change of interest to this project.

However, shifts between contrasting sub-communities might be significant e.g. between **MG1e *Arrhenatherum elatius* grassland, *Centaurea nigra* sub-community** and **MG1b *Arrhenatherum elatius* grassland, *Urtica dioica* sub-community** which in this case would reflect a shift from a more species-rich to a less species-rich vegetation type.

Finally, other identified changes might reflect real and significant vegetation change, e.g. change from one community to another, e.g. change from **MG5 *Cynosurus cristatus-Centaurea nigra* grassland** to **MG1 *Arrhenatherum elatius* grassland** which could reflect changes in mowing frequency or timing or other management changes.

We have attempted to focus on this final category - the real and significant change – by checking the GIS map outputs with our own knowledge and experience of the area and other evidence such as our field notes. However, inevitably the analysis of change is

not entirely an objective process and this needs to be borne in mind when reading this section and interpreting the graphical output.

4.5.2 Changes in scrub and *Pteridium aquilinum* (Bracken) vegetation: automated approaches

4.5.2.1 Introduction

The objective is to compare the vegetation mapping in 2006 with that in 2013 focusing on increases in scrub and bracken cover to identify those areas of open vegetation that have recently been colonised by scrub/ young woodland as distinct from 'woodland'.

Due to the large extent of the area surveyed our approach was to use the 2006 and 2013 habitat mapping to calculate habitat change automatically using the GIS system. We outline two approaches to evaluating changes in scrub vegetation below but for both approaches the areas mapped only in the 2013 survey (and outside the 2006 survey area) were removed. Any areas from the 2006 survey which were not revisited were also removed, resulting in two legitimately comparable areas of 793.83 ha. All parcels of the same community were then merged together. Finally, using the GIS, we automatically calculated the areas of each unique NVC community.

We have taken two automated approaches to identifying and mapping the change in scrub and bracken vegetation between 2006 and 2013. These can be viewed as first steps towards a strategic approach to scrub and bracken management in the Malvern Hills, we would emphasise that these are first steps as a degree of ground-truthing is required to make best use of these outputs.

4.5.2.2 Method 1: Identifying new areas of scrub and bracken (2006-2013)

In the first method we prepared a set of GIS maps for each of the survey dates 2006 and 2013 in which we identified areas mapped as woodland i.e. any of **Wu**, **W2**, **W6**, **W8**, **W10**, **W16**. In addition we also identified areas mapped as scrub or bracken but here we defined two categories: primary scrub and secondary scrub as follows. Primary scrub was defined as any parcels mapped as discreet scrub communities, i.e. any of **SCu**, **U20**, **W21**, **W23**, **W24**, **W25**. Secondary scrub was defined as any parcels mapped as mosaics or transitions between any scrub type with other vegetation types e.g. **MG1**+**U20**.

In this way we were able to produce two sets of maps showing the distribution of woodland, established scrub (primary) and scrub mosaics (secondary) for 2006 and 2013. The next step was to "clip" the 2013 scrub layer with the 2006 scrub layer resulting in the locations of "new" scrub since 2006 (*Figure 3*). This map output provides an overview of areas that might be targeted for scrub and/or bracken clearance.

Overall this analysis indicates that there has been an increase in scrub and bracken of 7.6 ha. The largest increase was of the U20 *Pteridium aquilinum-Galium saxatile* community (3.38 ha).

4.5.2.3 Areas of new grassland (2006-2013)

Having identified area of new scrub we looked for the reverse case, i.e. areas mapped as scrub in 2006 which were mapped as grassland in 2013. To identify and calculate areas of new grassland since 2006 we took the prepared data sets used the in new scrub calculations and clipped any 2013 parcels outside of 2006 areas classified scrub (woodland, primary scrub or secondary scrub). Any woodland, primary scrub or secondary scrub left within the clipped 2013 dataset was then removed leaving only new grassland community areas. These results are presented as maps of new grassland since 2006 in *Figure 5*. The analysis shows 7.25 ha of grassland mapped in 2013 which were mapped as scrub in 2006. We can consider these as new grassland areas and 29.66% is MG1, and of 24.41% are acid grassland communities (U1, U2 and U4).

4.5.2.4 Method 2: Prioritising scrub associated with priority grasslands (2013)

The first method provides a broad overview of areas of new scrub identified from the mapping comparing 2006 and 2013. An additional output would be to prioritise existing scrub areas (2013 mapping) in terms of potential conservation benefits of management. For example, scrub associated with valuable grassland habitats could be a greater priority for scrub control action than scrub associated with lower grade grasslands.

This approach (the second method) involved grouping woodland, scrub and grassland categories as follows:

- Woodland includes **Wu**, **W2**, **W6**, **W8**, **W10**, **W16**;
- Primary scrub includes **SCu**, **U20**, **W21**, **W23**, **W24**, **W25**;
- Secondary scrub includes where primary scrub is part of a mosaic or transition but not dominant e.g. **MG1**+**U20**;
- Primary scrub and priority grassland includes a transition between the two but scrub is dominant e.g. **W23**+**U1**;
- Priority grassland and primary scrub includes a transition between the two but priority grassland is dominant e.g. **U1**+**W23**;
- Secondary priority grassland includes where priority grassland is part of a mosaic or transition but not dominant e.g. **MG1**+**U1**; and
- Priority grassland includes **U1**, **U1b lichen var**., **U2**, **U4**.

The output is a series of maps (*Figure 4*) which show the juxtaposition of primary and secondary scrub with priority grasslands. This provides a step towards a strategic tool for prioritising scrub management. In theory, the priority scrub clearance areas are

those areas of transitions between primary scrub (the dominant type) and priority grassland (red areas in Figure 6 maps 1 to 8) or priority grassland (the dominant type) and primary scrub (orange areas in *Figure 4* maps 1 to 8).

The results show that primary scrub and priority grassland covers 14.77 ha and that priority grassland and primary scrub covers 8.16 ha. In total this defines 22.93 ha of priority scrub clearance areas which might be converted to open habitat (*Figure 4* maps 1 to 8).

4.5.3 Some field observations on vegetation change

4.5.3.1 Introduction

During our the 2013 mapping work for the survey area repeated from 2006 we were able to refer to the 2006 maps at the same time as carrying out the 2013 survey. In this way we were able to consider areas of habitat change on a case by case basis and below we outline some of these observations based on target notes the locations of which are given in *Figure 8*.

Target note 1: The northernmost grassland areas on the hills were mostly mapped as **U2a** but they are quite mesotrophic and remapped as **MG1a** or **U2** transitional to **MG1**. This area looks only lightly managed and appears to be an area where real change has occurred. Bracken areas here are rolled and this appears to have opened out the vegetation (**W25** + **MG1a** in 2006, and **MG1a** transitional to **U20a** in 2013)

Target note 2: An area of grassland and rush pasture at Birches farm which was mapped as a mosaic of **MG6** and **MG10** in 2006 but included more extensive areas of **M23** in the 2013 mapping suggesting that the area has increased in wetness since 2006.

Target note 3: Area mapped as **W25** in 2006, and mapped as **U20/MG1** in 2013 and representing an area of grassland gain, see also *Figure 5*.

Target note 4: An area of grassland on a north-west slope mapped with frequent *Vaccinium* in 2006 and re-mapped as **U2b** (*Vaccinium myrtillus* sub-community) from **U2a** *(Festuca ovina-Agrostis capillaris* sub-community) in 2013. This could have been overlooked originally, but in conversation with the Natural England officer who did the very first NVC survey, her opinion was that *Vaccinium* vegetation has expanded on the hills since then, so this could be real change.

Target note 5: The soils here are relatively thin and the scrub/bracken downslope fairly light, so this is an area where there could be relatively easy grassland gains by clearing the edges. Also, west of this, a small area mapped as **U2a** in 2006 looks to have scrubbed up to **MG1**/**W23** in the 2013 mapping.

Target note 6: This bracken area was mapped as **W25** in 2006, however in 2013 it looked to have been rolled and the vegetation has opened out to **U20a** with elements of **MG1a**/**U4**. East of this area, bracken recorded as **W25** in 2006 is closer to **U20c** in 2013. This could relate to survey inaccuracies in difficult terrain, but there are grassy areas and livestock paths through it, so it could be opening out. It could be that this whole area is relatively recent bracken encroachment on **U4**, and with further rolling and grazing this could be another relatively easy grassland gain.

Target note 7: An area recorded as *Vaccinium* in 2006 and mapped as **U2b** in 2013 reflecting opening out of some area of *Vaccinium* and colonisation by fine grasses.

Target note 8: An area mapped as **MG1** in 2006 and as **W23/U20** in 2013 and representing one of the areas of new scrub in 2013, see also *Figure 3*.

Target note 9: An example of an area where there has been *Betula pendula* (Silver Birch) colonisation.

Target note 10: Area of roadside grassland mapped as **MG5** in 2006 and as **MG1e** in 2013 possibly indicating vegetation change caused by the impact of reduced frequency of mowing.

Target note 11: Area mapped as **U4** in 2006 and as **MG1** 2013 and an indication of change from acid grassland to less interesting mesotrophic grassland.

Target note 12: Area mapped as **U4** in 2006 and as **U20** in 2013 and an example of loss of acid grassland to *Pteridium aquilinum* (Bracken) encroachment.

Target note 13: Area mapped as **MG6** in 20o6 and as **U20** in 2013 and an example of loss of mesotrophic grassland to Bracken encroachment.

Target note 14: Area mapped as **MG5** in 2006 and as **MG1** in 2013 and an example of loss of species-rich meadow to rank *Arrhenatherum* grassland. This area is included in the boundary of the proposed Malvern Common SSSI (see Section 5) and would benefit from increased mowing frequency with removal of cuttings to enhance botanical diversity.

Target note 15: Area mapped as **MG6** in 2006 and as **MG1** in 2013, another example of a shift to taller rank grassland, possibly reflecting a decrease in frequency of management by mowing or grazing management.

Target note 16: An area mapped as **U20** in 2006 but where there has been *Betula pendula* (Silver Birch) colonisation.

Target note 17: An area mapped as **U20** in 2006 but where there has been *Betula pendula* (Silver Birch) colonisation.

Target note 18: Areas mapped as **W25** in 2006 and as **MG1** in 2013, representing grassland gain from scrub (see also *Figure 5*).

Target note 19: Area mapped as **U1b** in 2006 and as **U20/W25** in 2013 and representing areas of loss of acid grassland to scrub (see also Figure 3).

5 NON-SSSI AREAS

5.1 Introduction

Some of the new areas included in the 2013 survey area fall outside of the designated SSSIs and the one of the objectives of the 2013 survey was to determine whether any of these currently non-SSSI areas do actually reach the criteria for SSSI designation. This section discusses those parts of the survey area that we consider to be of sufficient botanical quality to qualify for SSSI status, but which are not currently included in the SSSI boundary. We evaluated the botanical data against the criteria for selection of SSSI for grasslands and woodlands (the two main vegetation types encountered during the survey).

5.2 Woodland areas

Figure 6 shows the SSSI boundaries within the Malvern Hills area and the existing Ancient Semi-natural Woodland and Plantation Ancient Woodland.

The best example of **W8 *Fraxinus excelsior-Acer campestre-Mercurialis perennis* woodland** is Park Wood, an area designated as ancient semi-natural woodland. The woodland consisted of blocks of high-canopy *Fraxinus excelsior* (Ash) woodland, with sparse understory. During our survey we found 21 ancient woodland indicator species (based on the list for Worcestershire as described in Kirby & Goldberg (2004)) which were *Anemone nemorosa* (Wood Anemone), *Allium ursinum* (Ramsons), *Carex pendula* (Pendulous Sedge), *Carex remota* (Remote Sedge), *Carex sylvatica* (Wood-sedge), *Chrysosplenium oppositifolium* (Opposite-leaved Golden-saxifrage), *Euphorbia amygdaloides* (Wood Spurge), *Galium odoratum* (Woodruff), *Hyacinthoides non-scripta* (Bluebell), *Lamiastrum galeobdolon* (Yellow Archangel), *Lysimachia vulgaris* (Yellow Loosestrife), *Melica uniflora* (Wood Melick), *Mercurialis perennis* (Dog's Mercury), *Milium effusum* (Wood Millet), *Polystichum setiferum* (Soft Shield-fern), *Primula vulgaris* (Primrose), *Prunus avium* (Wild Cherry), *Quercus petraea* (Sessile Oak), *Ulmus glabra* (Wych Elm), *Veronica montana* (Wood Speedwell) and *Viola* cf. *riviniana* (Common Dog-violet). There are several other ancient woodland indicator species and notable species reported from this wood including *Epipactis helleborine* (Broad-leaved Helleborine) and *Paris quadrifolia* (Herb-Paris) (Bennet & Garner 2005, MHC 2006). This was part of a mosaic with recently-coppiced woodland blocks with re-growth of *Acer campestre* (Field Maple) and *Corylus avellana* (Hazel) stools, and a more dense ground layer of eutrophic species including *Galium aparine* (Cleavers) and *Rubus fruticosus* agg. (Bramble). The management plan notes that this woodland is one of the few in the Malvern Hills on limestone bedrock (MHC 2006) which gives the woodland a more distinct flora.

An additional area on the east-facing slope at Hollybush Roughs is ancient semi-natural woodland. This woodland is referable to **W10 *Quercus robur-Pteridium aquilinum-Rubus fruticosus* woodland**. We found a total of 13 ancient woodland indictor species for Worcestershire present in Hollybed Roughs. These include the woody species *Malus sylvestris* (Crab Apple) and the herbs *Anemone nemorosa* (Wood Anemone), *Athyrium filix-femina* (Lady-fern), *Dryopteris affinis* (Golden-scaled Male-fern), *Hyacinthoides non-scripta* (Bluebell), *Luzula forsteri* (Southern Wood-rush), *Mercurialis perennis* (Dog's Mercury), *Oxalis acetosella* (Wood-sorrel), *Poa nemoralis* (Wood Meadow-grass), *Polystichum setiferum* (Soft Shield-fern), *Schedonorus giganteus* (Giant Fescue), *Veronica montana* (Wood Speedwell) and *Viola riviniana* (Common Dog-violet). This wood is adjacent to secondary Ash woodland, and it is likely that these ancient woodland species will have been able to colonise the secondary woodland, thus blurring the boundaries.

Overall, we do not think these merit individual SSSI designation although they might merit inclusion in adjacent woodland SSSI areas, see Figure 6. Apart from these two areas, much of the woodland on the hills is included within the existing SSSI boundary. There were no outstanding examples of woodland outside of the SSSI boundary that would warrant inclusion as part of the SSSI for their botanical merit. Most of the woodland is secondary mixed broadleaved woodland of little distinct botanical interest.

5.3 Grassland areas

Areas of grassland which we considered included Hollybed Common which is not currently a statutory designated site for Nature Conservation. Hollybed Common is a large area of semi-natural grassland, which has been managed by grazing as common land for a long time. The common consists primarily of **MG6 *Lolium perenne* – *Cynosurus cristatus* grassland**, **MG9 *Holcus lanatus-Deschampsia cespitosa* grassland** and U1/W25. The areas of **U1 *Festuca ovina-Agrostis capillaris-Rumex acetosella* grassland** are of higher conservation significance, particularly as the examples on Hollybed Common are of a more typical lowland meadow character, different to the acid grassland communities found on the hills. However the total extent of U1 is only 1.01 ha (2.65%). There are 19 notable plant species reported from Hollybed common (Bennett & Garner (2005); 5 found during the RSK survey). There are also 8 Waxcap fungi present on Hollybed Common (Spence & Spence 2008). It is felt that under the assessment criteria it is difficult to justify the inclusion of Hollybed Common into a SSSI, due to the large proportion of **MG6b *Lolium perenne-Cynosurus cristatus* grassland, *Anthoxanthum odoratum* sub-community** grassland despite parts of it being of higher conservation and ecological value. Further consideration by Natural England may be required at the landscape scale due to its proximity adjacent to Castlemorton Common SSSI and the Malvern Hills SSSI.

Another area which we considered was Castlemorton Common and currently a total area of 158 ha is included in the Castlemorton Common SSSI. This area includes a full

range of mesotrophic and mire communities along with areas of scrub. The areas of Castlemorton Common outside the SSSI boundary consist of 46.9 ha **MG6 *Lolium perenne – Cynosurus cristatus* grassland** and 22.7% MG9 grassland. Other habitats cover 30.0% of the area (approximately 22% is scrub communities, 4% is M23 mire, 3% is the roads and the remaining ~8% consists of miscellaneous grassland communities). On these grounds it is difficult to justify the inclusion of these additional areas into the existing SSSI, although they undoubtedly have a high value for wildlife and conservation.

We also considered a number of areas of grassland outside of the current SSSI boundary that were of high botanical value. For example, five areas of species-rich, neutral lowland meadow (referable to the NVC type **MG5 *Cynosurus cristatus - Centaurea nigra* grassland**) were mapped at Newland (1.69 ha), Great Malvern along Albert Road North (1.57 ha), Malvern Common (8.81 ha), Hall Green (1.09 ha) and Rydd Green (1.32 ha).

The SSSI selection guidelines (English Nature 1989, para 3.5) states that any single community of MG grassland of 5 ha or more should be considered for selection. Four of these areas are between 1.09 and 1.69 ha and so we do not consider them further here, however, bearing in mind the national importance of **MG5** grassland we would encourage further evaluation of the conservation value of these lowland meadows. For this report we focus on the largest area at Malvern Common for further evaluation. The following section provides a description of this grassland and the botanical features and their location and fit with the SSSI selection guidelines. *Figure 7* shows the boundary of the Malvern Common proposed SSSI according to our analysis below.

5.4 Malvern Common

5.4.1 General Description and Location

Part of Malvern Common is covered in species-rich, neutral lowland meadow (referable to the NVC type **MG5 *Cynosurus cristatus - Centaurea nigra* grassland**). This occurs in mosaic and transition with a mire community (referable to the NVC type **M23 *Juncus effusus/acutiflorus-Galium palustre* rush-pasture)** on wetter soils around the edges, and with rank grassland on road verges and in unmanaged areas. The vegetation was sampled in a series of eight quadrats, which included the variation in vegetation across the common including the mire vegetation and the neutral lowland meadow.

5.4.2 Floristic Composition and Area

The table below (*Table 5-1*) presents the data from quadrats recorded in the species-rich, neutral lowland meadow on the common. In this table, Quadrat 2 matched most closely with **MG5b *Cynosurus cristatus-Centaurea nigra* grassland, *Galium verum* sub-community**, and Quadrat 3 with **MG5 *Cynosurus cristatus - Centaurea nigra* grassland undifferentiated**, with matching coefficients of over 50. Species highlighted

in **bold** in the table are the constant species from the NVC account. This vegetation type covers an area of 8.81 ha, covering nearly 50% of the proposed area.

Table 5-1: Selected quadrats recorded from Malvern Common

Species	Q2	Q3	Constancy	Cover
Plantago lanceolata	**5**	**6**	2	(5-6)
Festuca rubra	**5**	**6**	2	(5-6)
Rhinanthus minor	3	6	2	(3-6)
Lotus corniculatus	**5**	**4**	2	(4-5)
Agrostis capillaris	**4**	**4**	2	(4)
Anthoxanthum odoratum	**4**	**4**	2	(4)
Centaurea cf. nigra	**3**	**4**	2	(3-4)
Cynosurus cristatus	**4**	**3**	2	(3-4)
Holcus lanatus	**4**	**4**	2	(4)
Dactylorhiza fuchsii	1	1	2	(1)
Trifolium pratense	**5**	**5**	2	(5)
Potentilla reptans	5	-	1	(5)
Galium verum	4	-	1	(4)
Ranunculus acris	-	4	1	(4)
Trifolium repens	**4**	**-**	1	(4)
Trisetum flavescens	4	-	1	(4)
Carex flacca	3	-	1	(3)
Hypochaeris radicata	-	3	1	(3)
Leontodon hispidus	3	-	1	(3)
Dactylis glomerata	**2**	**-**	1	(2)
Hordeum secalinum	2	-	1	(2)
Phleum pratense	-	2	1	(2)
Rumex acetosa	-	2	1	(2)
Schedonorus pratensis	2	-	1	(2)
Stellaria graminea	2	-	1	(2)
Scorzoneroides autumnalis	1	2	2	(1-2)
Tragopogon pratensis	1	1	2	(1)

In wetter parts of the common, to the north of the MG5 grassland, the vegetation develops into a species-rich mire community. The two vegetation types are separated on the ground by a very shallow watercourse, which is presumably wet in winter and dry in summer.

The mire vegetation is marked by the dominance of *Juncus acutiflorus* (Sharp-flowered Rush) amongst many of the species found in the adjacent grassland, including a high abundance of *Centaurea cf. nigra* (Common Knapweed). Other species that mark this vegetation out from the adjacent grassland include *Carex hostiana* (Tawny Sedge), *Dactylorhiza fuchsii* (Common Spotted-orchid), *Dactylorhiza praetermissa* (Southern Marsh-orchid) and *Lotus pedunculatus* (Greater Bird's-foot-trefoil). One quadrat was recorded from this vegetation type (*Table 5-2*). This vegetation produced a low match coefficient (23%) for **M23a *Juncus effusus/acutiflorus-Galium palustre* rush-pasture, *Juncus acutiflorus* sub-community**. The low coefficient is probably as

much to do with the small sample size as the atypical nature of the vegetation in relation to the NVC account for this community. The full species list for this site is given in Appendix C.

Table 5-2: Quadrat data from mire vegetation on Malvern Common

Species	Q1
Juncus acutiflorus	7
Centaurea cf. nigra	6
Agrostis stolonifera	4
Holcus lanatus	4
Lotus pedunculatus	4
Ranunculus acris	4
Anthoxanthum odoratum	3
Carex flacca	3
Cynosurus cristatus	3
Festuca rubra	3
Carex hostiana	2
Dactylorhiza fuchsii	2
Phleum pratense	2
Bromus commutatus	1
Dactylorhiza praetermissa	1
Hordeum secalinum	1
Schedonorus pratensis	1

5.4.3 Assessment against SSSI Criteria

The SSSI selection criteria for lowland grasslands broadly aim to select the best examples of uncommon lowland grassland types, as well as particularly large examples of these types. The criteria for site evaluation continue to be those defined by Ratcliffe (1977) in A Nature Conservation Review. The primary criteria are: size, diversity, naturalness, rarity, fragility and typicalness. Secondary criteria are recorded history, position in an ecological/ geographical unit, potential value and intrinsic appeal. Below we evaluate Malvern Common against these criteria.

Primary criteria:

Size: Significantly larger than the 5 ha threshold in the SSSI guidelines.

Diversity: A range of species-rich vegetation types exist in a mosaic including notably **MG5 *Cynosurus cristatus-Centaurea nigra* grassland** and **M23 *Juncus effusus/acutiflorus - Galium palustre* rush-pasture.**

Naturalness: As a traditionally managed lowland common Malvern Common is natural in the sense that it represents a semi-natural vegetation mosaic.

Rarity: **MG5 *Cynosurus cristatus - Centaurea nigra* grassland** is a rare and declining vegetation type in Britain (reference). In addition within Malvern Common a number of

rare and scarce plants were recorded in our 2013 survey and a number of others are listed by Barnett & Garner (2005; these would need to be confirmed by independent survey) *Carex binervis* (Green-ribbed Sedge), *Carex distans* (Distant Sedge), *Carex hostiana* (Tawny Sedge), *Dactylorhiza praetermissa* (Southern Marsh-orchid), *Dactylorhiza x transiens, Filipendula vulgaris* (Dropwort), *Galeopsis speciosa* (Large-flowered Hemp-nettle), *Helictotrichon pratensis* (Meadow Oat-grass), *Marrubium vulgare* (White Horehound), *Anacamptis morio* (Green-winged Orchid) and *Rosa agrestis* (Small-leaved Sweet-briar).

Fragility: **MG5 *Cynosurus cristatus* - *Centaurea nigra* grassland** is sensitive to agricultural improvements such as inputs of mineral fertilisers and also to inappropriate management (e.g. intensive grazing, early mowing for silage) or neglect of management both of which can result in conversion to less diverse and less interesting types of grassland and scrub which are difficult to restore to the original type.

Typicalness: The lowland meadow on Malvern Common is a good fit for **MG5 *Cynosurus cristatus* - *Centaurea nigra* grassland** and it has a good abundance of the constant species found in this community.

Secondary criteria:
Recorded history: Unknown but worthy of further investigation into local historical and documentary sources.

Position in an ecological/ geographical unit: The Malvern Hills sit at the crossroads of eastern and western and southern and more northern areas of Britain and as such represent a potentially interesting biogeographical gradient.

Potential value: Management planning and action has the potential to maintain and enhance the botanical and zoological diversity of this site.

Intrinsic appeal: Malvern Common is located within a residential community and there is uninterrupted access to the common which is a key green and wildlife space providing significant intrinsic and amenity appeal.

5.4.4 Setting the Common Standards Monitoring targets

All SSSIs are assessed on a regular basis against a set of criteria derived to provide a consistent assessment across SSSIs (JNCC 2004). The Common Standards Monitoring for Lowland Meadows, which includes **MG5 *Cynosurus cristatus* - *Centaurea nigra* grassland**, was used to set targets for the drier grasslands on the proposed SSSI. Details of the targets are given in *Table 5-3*. Targets for the wetter areas of **M23 *Juncus effusus/acutiflorus-Galium palustre* rush-pasture** were set against the Common Standard Monitoring guidance of Lowland Purple Moor Grass and Rush Pasture habitats (*Table 5-4*).

Table 5-3. Common Standard Monitoring targets for MG5 grassland in the proposed Malvern Common SSSI

Attributes	Guidance on Targets	Targets with Explanation
Extent	No significant loss of feature.	The total area for MG5 within the proposed SSSI is 8.8 ha out of a site total of 18.24 ha (48.3%). Monitoring should ensure this area is maintained.
Sward composition: grass:herb ratio	Target should be set to register a low or decreasing herb cover as unfavourable. As a generic standard, the grass:herb ratio normally should fall within the range 40-90% herb cover. Within this range, local targets can be set to register a decrease in herb cover by 20% or more as unfavourable.	The current percent composition of herbs is 70-75% of the sward.
Sward composition: frequency of positive indicators	Targets should be set to register a low or declining frequency of key indicators as unfavourable. As a generic standard, the frequencies of positive indicators should, at the very least, confirm the presence of the target community. Local targets could also be set for site-specific positive indicator species, to register a decrease in frequency of 20% or more as unfavourable.	The following species are selected as key indicators for the area of proposed SSSI, with constancy and abundance in brackets: *Centaurea cf. nigra* (IV, 3-6) *Galium verum* (II, 2-4) *Leontodon hispidus* (I, 3) *Lotus corniculatus* (III, 4-5)
Sward composition: frequency of negative indicators - agricultural weeds	Target should be set to register high or increasing frequency/cover as unfavourable. As a generic standard, no species should be more than occasional throughout the sward or together more than 5% cover. Occasionally, local targets for S. jacobaea and A. sylvestris may be set to accept swards with either species frequent as favourable. More stringent local frequency targets can be set, if appropriate, to register increase in frequency of 10% or more as unfavourable.	The agricultural weeds were absent from the quadrats of MG5 Cynosurus cristatus - Centaurea nigra grassland and not significantly frequent or abundant in the wider area surveyed.
Sward composition: cover of negative indicators - agriculturally favoured species	Target should be set to register high or increasing cover as unfavourable. As a generic standard, no species should be individually at more than 10% cover, or collectively at more than 20% cover. More stringent local cover targets can be set, if appropriate, to register an increase of cover of 5% individually or 10% collectively as unfavourable.	The following agriculturally favoured species *Lolium perenne, Phleum pratense, Bromus hordeaceus, Holcus lanatus* and *Trifolium repens* currently comprise up to 15% of the sward, with no single species more than 10% overall.

Attributes	Guidance on Targets	Targets with Explanation
Sward composition: cover of negative indicators - rank grasses and sedges	Targets should be set to register high or increasing cover as unfavourable. As a generic standard, *Arrhenatherum* and *Dactylis* together should cover less than 10% of the sward. Bulky wetland species collectively should cover less than 20% or the sward. It is probably unlikely that lower local thresholds would need to be set. Occasionally, thresholds may need to be raised, according to wider conservation objectives.	Currently *Arrhenatherum elatius* is infrequent in the MG5 grassland (but is present in the MG1 grassland which occupies 5.96 has which is 32.7% of the site area), and *Dactylis glomerata* does not achieve cover (<4%) in any quadrat.
Sward composition: cover of negative indicators – scrub and tree species, and bracken	Targets should be set to register high or increasing cover as unfavourable. As a generic standard, woody species and bracken together should be at no more than 5% cover. It is probably impractical to set local targets at below 5% cover, but see comments. Very occasionally a higher cover may be acceptable.	Scrub and small trees cover approximately 0.3 ha which is 1.7% of the site area. There is no *Pteridium aquilinum* (Bracken).
Indicators of local distinctiveness	Targets should be set to register low or declining population size/extent (species) or loss of cover (transitions) as unfavourable. Additional targets may be set for other attributes as appropriate. There are no generic targets for this attribute. Local targets should be set to ensure: - existing populations of rare/scarce species are maintained at least at current levels and often local distribution characteristics - community and habitat transitions are maintained at current levels and in current locations - other locally distinctive attributes are maintained.	Two notable plants for the Malvern Hills were recorded in the M23 part of the Common, *Carex hostiana* and *Dactylorhiza praetermissa*. These species are both locally rare, and populations are comprised of a small number of individuals.
Sward structure: average height	Targets should be set to register both over- and under-grazed conditions as unfavourable. As a generic standard, pastures should usually be within the range 5-20 cm. In hay meadows, the lower limit is 5 cm, with no upper level. Locally it may be appropriate to reduce the upper threshold or increase the lower one, depending upon conservation objectives. It is probably unlikely that the generic range would need to be broadened.	The MG5 hay meadow vegetation showed a typical structure at time of survey above the lower limit of 5 cm.
Sward structure: litter	Target should be set to register high or increasing cover as unfavourable. As a generic standard, total extent should be no more than 25% cover of the sward. More stringent local targets can be set, if appropriate, to register increase in litter cover of 10% or more as unfavourable. It is probably unlikely that the threshold would need to be raised.	Litter was not especially evident at the time of survey and was well below the threshold of 25% cover of the sward.
Sward structure: extent of bare ground (not rock)	Target should be set to register high or increasing cover as unfavourable. As a generic standard, total extent should be no more than 5% of the sward. Locally it may be appropriate to increase the threshold if there are specific conservation objectives requiring bare ground. Targets of less than 5% are not recommended and would be hard to assess.	Bare ground was very limited at time of survey and was no more than the threshold value of 5% of the sward.

Table 5-4. Common Standards Monitoring guidance on the M23 community found on Malvern Common based on the guidance for "Lowland Rush Pastures"

Attributes	Guidance on Targets	Targets with Explanation
Extent	No significant loss of feature	The current extent of M23 within the proposed SSSI area is 2.26 ha.
Sward composition: frequency of positive indicators	Targets should be set to register a low or declining frequency of key indicators (Table 5a) as unfavourable. As a generic standard, the frequencies of positive indicators should at the very least, confirm the presence of the target community. Local targets could also be set for site-specific positive indicator species, to register a decrease in frequency of 20% or more as unfavourable.	The following five positive indicators for M23 are present on Malvern Common: *Dactylorhiza fuchsii* *Dactylorhiza praetermissa* *Galium palustre* *Lotus pedunculatus* *Mentha aquatica*
Sward composition: frequency and cover of *Molinia caerulea* and bulky *Juncus* spp	Target should be set to register both high and low cover as unfavourable. As a generic standard, the cover of all species combined should be within the range 25-80%. Within this range, it may occasionally be appropriate to set local targets to register an increase in cover by 20% or more as unfavourable. Smaller increases or decreases within the generic range may not necessarily be unfavourable.	*Juncus acutiflorus* (Sharp-flowered Rush) had cover of 33-50% at the time of survey.
Sward composition: frequency of negative indicators - agricultural weeds	Target should be set to register high or increasing frequency/cover as unfavourable. As a generic standard, no species should be more than occasional throughout the sward or together more than 5% cover. More stringent local frequency targets can be set, if appropriate, to register an increase in frequency of 10% or more as unfavourable.	No agricultural weeds were present in the quadrat and those present were only listed as rare in the species lists.
#Sward composition: cover of negative indicators - agriculturally favoured species	Target should be set to register high or increasing cover as unfavourable. As a generic standard, no species should be individually at more than 10% cover, or collectively at more than 20% cover. More stringent local cover targets can be set, if appropriate, to register an increase of cover of 5% individually or 10% collectively as unfavourable.	Agriculturally favoured species are all individually less than 10% of the sward and less than 20% combined
Sward composition: cover of negative indicators - rank grasses and sedges	Targets should be set to register high or increasing cover as unfavourable. As a generic standard, *Arrhenatherum* and *Deschampsia* together should cover less than 10% of the sward. Bulky wetland species collectively should cover less than 20% or the sward.	These grasses are rare in the sward and have less than 5% cover

Attributes	Guidance on Targets	Targets with Explanation
	It is probably unlikely that lower local thresholds would need to be set. Occasionally, thresholds may need to be raised, according to wider conservation objectives	
Sward composition: cover of negative indicators – scrub and tree species, and bracken	Targets should be set to register high or increasing cover as unfavourable. As a generic standard, woody species and bracken together should be at no more than 5% cover. It is probably impractical to set local targets at below 5% cover, but see comments. Occasionally a higher cover may be acceptable, particularly for *Myrica gale* and *Ulex gallii*.	There is currently no invasion of scrub or *Pteridium aquilinum* (Bracken) into the wet areas of Malvern Common
#Indicators of local distinctiveness	Targets should be set to register low or declining population size/extent (species) or loss of cover (transitions) as unfavourable. Additional targets may be set for other attributes as appropriate. There are no generic targets for this attribute. Local targets should be set to ensure: - existing populations of rare/scarce species are maintained at least at current levels and often local distribution characteristics - community and habitat transitions are maintained at current levels and in current locations - other locally distinctive attributes are maintained.	Two notable plants for the Malvern Hills were recorded in the M23 part of the Common, *Carex hostiana* and *Dactylorhiza praetermissa*. These species are both locally rare, and populations are comprised of a small number of individuals.
*Sward structure: average height	Targets should be set to register both over- and under-grazed conditions as unfavourable. As a generic standard, swards should usually be within the range 5-80 cm. Locally it may be appropriate to reduce the upper threshold or increase the lower one, depending upon conservation objectives. Very occasionally the lower limit could be reduced.	Sward heights of up to 80 cm are appropriate for M23, and the examples on Malvern Common were all between 5-80cm

6 NOTABLE PLANT SPECIES

A document describing the Notable Flora on the Malvern Hills Conservators Land was published by Barnett & Garner (2005). This work includes plants that are scarce or rare in the UK or Worcestershire, or in a few cases, where they are rare or scarce on the Conservator's land. The publication also gives details of the locations where these plants are found. The publication includes a total of 79 species, subspecies, varieties or interspecific hybrids.

The botanical survey in 2013 did not include a systematic search all possible locations for rare plant species on the Hills. However, the surveyors were aware of the plants on the list and the vegetation types in which they were likely to occur, and looked for them whenever such vegetation types were encountered. All records were incidental, and they do not represent a thorough survey of the current status of any of the species. It is likely that a number of ephemeral species would not have been visible above ground at the time of survey.

A total of 25 of the species on the Notable Flora list were recorded during our surveys. The details for each plant are presented in *Table 6-1*.

Table 6-1 Details of rare and notable plant species recorded during the 2013 survey (Grid References are not given where a plant was found at multiple localities).

Species	Locations listed in Barnett & Garner	Locations recorded in 2013	NVC communities	Grid Reference(s)	Notes
Arenaria serpyllifolia (Thyme-leaved Sandwort)	Listed as very scarce in Worcestershire	Worcestershire Beacon	U1b		Spring annual found around Worcestershire Beacon
Bromopsis erecta (Upright Brome)	*not listed*	Castlemorton Common	**MG6c**-**CG2c**	SO 777 382 (Map 50)	Calcicolous grass, found in a single location
Bupleurum tenuissimum (Slender hare's-ear)	Castlemorton Common, Hollybed Common; Link Common	Castlemorton Common	**MG6c**-**CG2c**	SO 775 383 (Map 50)	Annual; Nationally scarce
Calluna vulgaris (Heather)	British Camp; Worcestershire Beacon	British Camp	**U2a**, **U2b**, **U4a**-**CG10**	-	Perennial shrub; Several populations are present around British Camp where the species is grazed to form small mounds
Cardamine impatiens (Narrow-leaved Bitter-cress)	5 locations including North Hill	North Hill	**Wu**	SO 774 464	Annual or biennial; Nationally Scarce. A small population of 4 individuals was found in the woodland understory on the east side of the hills.

Species	Locations listed in Barnett & Garner	Locations recorded in 2013	NVC communities	Grid Reference(s)	Notes
Carex echinata (Star Sedge)	4 commons	Flush on British Camp slopes	**M23a**	SO 764 394	A small number of individuals were found in an M23 flush occurring on the south-east slope of British Camp.
Carex hostiana (Tawny Sedge)	Castlemorton Common	Castlemorton Common; Malvern Common	**M23a**	SO 777 393	Small populations of this species were found on two commons.
Cerastium semidecandrum (Little Mouse-ear)	Listed as scarce in Worcestershire	British Camp; Black Hill	U1		Spring annual, small populations found around British Camp and on the edge of a woodland strip on Black Hill
Ceratocapnos claviculata (Climbing Corydalis)	Several woodlands	Many woodlands (at least 16)	**W16**, **Wu**, felled woodland	-	Annual; *Ceratocapnos claviculata* was a common species in areas of woodland and scrub. The plant was particularly abundant in areas of recently felled woodland, but common in more open wooded areas throughout.
Dactylorhiza praetermissa (Southern Marsh-orchid)	Castlemorton Common, Malvern Common	Castlemorton Common, Malvern Common	**M23a**	-	Perennial; *Dactylorhiza praetermissa* was found in the sward of lowland meadows at Castlemorton and Malvern Commons. The plants were found amongst the more common *D. maculata*.
Filago minima (Small Cudweed)	Castlemorton Common, Quarries	Worcestershire Beacon; Swinyard Hill	**U1b**	SO 769 445 SO 765 389	Annual found in the open areas of grassland with rocky outcrops near the summit of the two hills. The areas are heavily trampled parts of the hill. This habitat was shared with several other small annuals.

Species	Locations listed in Barnett & Garner	Locations recorded in 2013	NVC communities	Grid Reference(s)	Notes
Filipendula vulgaris (Dropwort)	Malvern Common	Old Hills	**MG6b**	SO 826 489	Perennial species, occasional in the grazed grasslands on the Old Hills
Helianthemum nummularium (Common Rock-rose)	Hangman's Hill	British Camp; Clutter's Cave	**CG10a**	-	Sub-shrub present in grassland around the summit of British Camp and the hilltop grassland extending to the south past Clutter's Cave.
Helictotrichon pubescens (Downy Oat-grass)	Hollybed Common	Common off Albert Road North	**MG5a**	SO 781 462	Perennial grass.
Juncus compressus (Round-fruited Rush)	**Not listed**	Hollybed North		SO7728137876	[species list on map 59] IUCN near threatened
Koeleria macrantha (Crested Hair-grass)	Castlemorton Common	Map 50 77703 38300	**MG6c**-**CG2c**	SO 775 383	Perennial grass
Lythrum portula (Water-purslane)	Castlemorton & Hollybed Commons	Castlemorton & Hollybed Commons	**OV35**; **MG9**	SO 786 394 SO 777 373	*Lythrum portula* was found growing on exposed mud on temporary, poached pools along the road at the north of Castlemorton Common, and in a trampled, dry ditch on Hollybed Common

Species	Locations listed in Barnett & Garner	Locations recorded in 2013	NVC communities	Grid Reference(s)	Notes
Moenchia erecta (Upright Chickweed)	Listed as rare in Worcestershire	British Camp and Clutter's Cave	**U1**	SO 765 395 SO 762 393	Annual of short turf.
Oenanthe lachenalii (Parsley Water-dropwort)	Castlemorton & Hollybed Commons	Castlemorton Common	**M23a**	-	Perennial species of inundated soils found in the wetter areas of Castlemorton Common
Oenanthe pimpinelloides (Corky-fruited Water-dropwort)	Hollybed Common; Old Hills;	Castlemorton & Hollybed Commons	**MG6b**	-	Perennial species of grazed pasture
Ornithopus perpusillus (Bird's-foot)	Listed as scare in Worcestershire	Worcestershire Beacon	U1b		Listed as locally uncommon in the SSSI citation; a few individuals were found in the open, rocky ground along the ridge approaching the Worcestershire Beacon.
Potentilla tabernaemontani (Spring Cinquefoil)	Hangmans Hill	Hangmans Hill to British Camp	**U1b**	SO 762 393	Perennial species found growing in the hilltop grasslands to the south of British Camp on the west-facing slopes
Ranunculus trichophyllus (Thread-leaved Water-crowfoot)	Castlemorton Common	Castlemorton Common	Aquatic habitats	-	Aquatic annual or perennial found in a single pond on Castlemorton Common.

Species	Locations listed in Barnett & Garner	Locations recorded in 2013	NVC communities	Grid Reference(s)	Notes
Rumex pulcher (Fiddle Dock)	Castlemorton & Hollybed Commons	Hollybed Common	**MG6c**	SO 779 373	A single individual was found growing in a grazed area of grassland on the eastern edge Hollybed Common
Scleranthus annuus (Annual Knawel)	Swinyards & Hangmans Hills	Pinnacle Hill	**U1b**	SO 768 416	Over 100 individuals of this small annual found growing in the short-sward, rocky areas of trampled grassland along the trail at the peak of the middle hills
Sorbus torminalis (Wild Service-tree)	**Not listed**	Along North End Land and Mayfield	Hedgerow tree	SO 79212 46944 and SO 79376 46847	UK BAP priority species and listed in the SSSI citation as a "less common in the Malverns"
Stellaria pallida (Lesser Chickweed)	Castlemorton Common; Hangmans & Ragged Stone Hills	Worcestershire Beacon	**U1**	SO 760 400	A few plants of this annual were found on the stone steps on the ascent between the British Camp Car Park and the hill top in May.
Teesdalia nudicaulis (Shepherd's Cress)	Worcestershire Beacon	Worcestershire Beacon	**U1**	SO 769 442	50 plants of this winter-annual were found in the short-swards of turf near the top of the Worcestershire Beacon
Torilis nodosa (Knotted Hedge-parsley)	Castlemorton & Hollybed Commons	Hollybed North	Open vegetation in hedge bank	-	Annual, a small population of this species were present on a dry, open sandy bank between a road and a hedgerow

Species	Locations listed in Barnett & Garner	Locations recorded in 2013	NVC communities	Grid Reference(s)	Notes
Trifolium ornithopodioides (Bird's-foot Clover)	Hollybed Common, British Camp	Worcestershire Beacon	**U1**	SO 769 445	*Trifolium ornithopodioides* was found in the open rocky ground close to the summit of the Worcestershire Beacon

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