Botanical Survey of Human and Canine Impacts on Heathland at Cannock Chase

Flint Fields, looking towards the south.

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Botanical Survey of Human and Canine Impacts on Heathland at Cannock Chase, Staffordshire.

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Report Status: Final
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Summary

Cannock Chase SAC Partnership commissioned *Arvensis Ecology* to undertake a botanical survey of areas of Cannock Chase. This report details the results of that survey undertaken August 2024.

The purpose of this survey was to provide evidence of the impact humans, associated pedestrian vehicles and dogs are having on areas including and surrounding car parks. Cannock Chase national landscape area has 9200 people living within the boundary.

The dominant habitats identified during the current survey belonged to grasslands, heathlands and woodlands. In many cases the sites surveyed showed a neat gradient of habitats from coarse mesotrophic grassland, through acid grassland and then heathland. The latter two are of a greater ecological value. An NVC survey identified eight main communities, ranging from three types of mesotrophic grassland (MG1, MG6 and MG7), to acid grassland (U4, U20), lowland heathland (H9) and woodland (W10, W16 and W25). The most species rich of these habitats was the MG1 mesotrophic grassland, although many of these species were 'weedy'. By contrast the acid grassland and heathland had fewer species present but they were of higher ecological value. In contrast was the Bracken underscrub (W25) in which Bracken often formed a monoculture.

NVC surveys identified ten communities within five broad habitats: heathland (H9), mesotrophic grassland (MG1, MG6 and MG7), open vegetation (OV25), acid grassland (U4, U20) and woodland (W10, W16 and W25). Ecologically the most important are H9, U4, W10, W16; of lesser importance is MG1. Of very low ecological importance are MG6, MG7 and OV25.

Large stands of good quality heathland (H9) were identified, but when crossed by a track, they are typically bordered by communities indicating some improvement (MG1, MG6, MG7 OV25). By the car park, and areas with high trampling and dog fouling, MG6 and MG7 grasslands predominate.

Various thoughts have been given on how these communities interact with associated management/nutrients. Key is the amount of nutrients from a mixture of sources which are in places transitioning desirable habitats to less desirable habitats.

Ellenberg Indicator Values showed clearly that areas had differing nutrient status, not derived from the surrounding soil. A trend of lower EIVs for nutrients in the heathland compared to mesotrophic grasslands was visible.

Using CSR traits, a clear distinction between mesotrophic grasslands, acid grasslands and heathland plots are shown. As expected, more Stress and Competitor tolerant plants were found within the heathland communities, with very low ruderal values (suggesting low disturbance). Mesotrophic grassland was closer to the Ruderal values with less Stress tolerant values. Acid grasslands were intermediate between heathlands and mesotrophic grasslands as expected.

The data collected will be of use when compared to any future surveys.

The areas with the highest incidence of dog fouling could be found in Mesotrophic grassland (particularly the MG6/7 communities), with heathlands typically lower (absent from 9 of 13 plots). Acid grassland, (which is of a lower sward height and lacking the woody subshrubs) had higher amounts of dog fouling than much of the heathland (3 plots with a low score, 1 each of medium and

high scores). Woodlands were typically fairly clear of dog fouling, perhaps as they are further off the main paths.

Trampling across plots was reviewed, this was similar to the amount of dog fouling with the highest being present in mesotrophic grassland (moderate 6, high 3), one acid grassland plot was also considered highly trampled. Heathlands were mixed, with 10 plots undisturbed (moderate 2, high 1). Woodlands were again relatively undisturbed.

Bike tracks and heavy trampling as expected were more evident nearer to car parks, then the pressures radiated out along footpaths and tracks, generally reducing further away from car parks (although bottle necks did cause some excessive trampling elsewhere).

Bare ground (sometimes natural, but mostly caused by excessive wear from pedestrians and cyclists), was highest in woodland (likely natural), open vegetation (2% - likely shading from coarse 'weedy' vegetation due to excessive nutrients), heathland (0-50% - but much of this was either natural or caused by recent heather management), mesotrophic grassland (0-25% - typically caused by scuffing – otherwise a naturally tight sward).

Partly due to the design of the study, those habitats which were of more ecological importance generally had fewer impacts from humans and associated animals. But this also reflected the distance away from car parks and footpaths and intentional/accidental impacts.

It is clear that humans and their dogs are having a negative impact on vegetation at Cannock Chase.

Higher amounts of disturbance from pedestrians and bikes are present near to car parks, spreading out along tracks. Typically, it would seem that humans are remaining on most of the paths, although some desire lines are present where they cut corners.

It was clear that those habitats identified as Mesotrophic Grassland (MG6/7) had the most dog fouling, trampling and other disturbance.

It is of concern that the presence and proportions of dog faeces (and in turn dog urine), which in some areas, particularly car parks and adjacent areas can be excessive. Evidence of past faeces/urine events can be seen in good quality habitats where dogs have been allowed to roam freely. Preventing dogs from roaming freely off leads would assist both with ground nesting birds and in preventing further local eutrophication and lowering of the ecological value of heathland and other habitats.

Introduction

Cannock Chase SAC commissioned *Arvensis Ecology* to undertake a baseline botanical survey of areas of Cannock Chase. This report details the results of that survey undertaken during August 2024.

The purpose of this survey was to provide evidence of the impact humans, canines and associated activities, are having on areas including and surrounding car parks.

Cannock Chase National Landscape area has a population of 9,200 people within its boundaries; further out, 2 million people live within 30 kilometres of this boundary (Cannock Chase National Landscape 2024b). Within the British Isles there are currently 12-13 million dogs, with 31% of all households having one or more dog (PFMA 2022; Anderson et al. 2023). Treatments to control ectoparasites on dogs can be harmful to the environment (including neonicotinoids), whether through direct contact such as dogs entering waterbodies as well as concerns that chemicals may excreted out in dogs urine and faeces. 86% of dog owners applied ectoparasite treatment in the preceding 12 months (Perkins and Goulson 2023).

Some of the study areas are currently in use as public car parks, and it is proposed that some of these may be closed in the future, whilst others will continue in use. Currently there are over 120 areas used for parking, both formal and informal car parks. Alongside surveying these sites, adjacent habitats will be surveyed to ascertain what the predominant habitat would be in this area if these sites were left to recolonise and without the associated impacts of the parking areas. The data collected is to be used to compare any potential changes in the flora in the future.

Some of the current concerns associated with the car parks and adjacent land is pressure from walkers and cyclists (trampling and litter), as well as dog fouling[1] (one cause of eutrophication, alongside aerial nitrogen deposition). This study should be able to provide evidence of eutrophication and/or impacts of trampling.

Predominantly Cannock Chase is a heathland (H9 *Calluna vulgaris-Deschampsia flexuosa* Heather-Wavy Hairgrass heath), with examples of semi-natural and plantation woodlands in areas. It was expected that the majority of the car parks will have no to very little ground flora present in the main areas, with coarser vegetation around the perimeter transitioning to heathland habitats further away from the parking areas. Surveying was to take place on these perimeter vegetation areas working outwards towards habitats of conservation importance.

Several methods were used to assess and quantify impacts including National Vegetation Classification survey, and walk over surveys to assess presence/absence of the following: litter, canine faeces, bicycle and other pedestrian/vehicle tracks.

No attempt was made to survey or record any non-botanical species.

[1] The term is used here to include both urination and defecation, both play a role in increasing the nutrient status of soils (alongside the introduction of pesticides from tick/flea treatments).

Location and Description of Cannock Chase

Cannock Chase or 'The Chase' is in the north of the West Midlands, surrounded by many cities, towns and villages including Stafford, Rugeley and Cannock (Figures 1 and 2).

Cannock Chase includes land within Stafford Borough Council, South Staffordshire District Council, Lichfield District Council and Cannock Chase District Council. The site sits within the vice-county of Staffordshire (VC 39).

The Chase is a large unenclosed landscape predominantly of semi-natural vegetation, with a range of habitats present, but dominated by heathlands, woodlands including broadleaved, coniferous and mixed, as well as standing and running water. It has a long history of use by man, including more recent usage as a training ground for the military, and forestry plantations.

The whole area of Cannock Chase is part of the Cannock Chase and Cank Wood National Character Area (NCA 67), which extends south from Cannock Chase to include much of the Black Country (NE 2024a). This also fits within the Cannock Chase Area of Outstanding National Beauty (AONB).

Conservation designations for the Chase including it being a Special Area of Conservation (SAC) and Site of Special Scientific Interest (SSSI) (DEFRA 2024).

The SAC is designated primarily for the large area of European Dry Heath which at Cannock is intermediate between the upland or northern heaths of England and Wales and those of southern England. These habitats are of importance to populations of butterflies, beetles, reptiles and several species of bats and to the European Nightjar (JNCC 2024).

The SSSI is designated for the vegetation assemblages with dry oak-birch woodlands including Sessile Oak *Quercus petraea* and Silver Birch *Betula pendula* woodland at Brocton Coppice, which is an eastern outlier for this westerly community. The matrix of dry heathland, acid grassland and wet flushes comprise a mixture of Ericoids, grasses, sedges and rushes. Further interest is for the invertebrate and vertebrate fauna (JNCC 2024, NE 2024b).

There are several botanical species of interest including Cowberry *Vaccinium vitis-idaea*, here growing at its eastern boundary, as well as the Hybrid Bilberry (or Cannock Berry) *V. x intermedium.* This is a natural cross between Cowberry and Bilberry *Vaccinium myrtillus*, first discovered in the British Isles in 1886 in Staffordshire by William Whitwell (for an undisclosed area). The first record for Cannock Chase was in 1888 by George Nicholson (BSBI 2024).

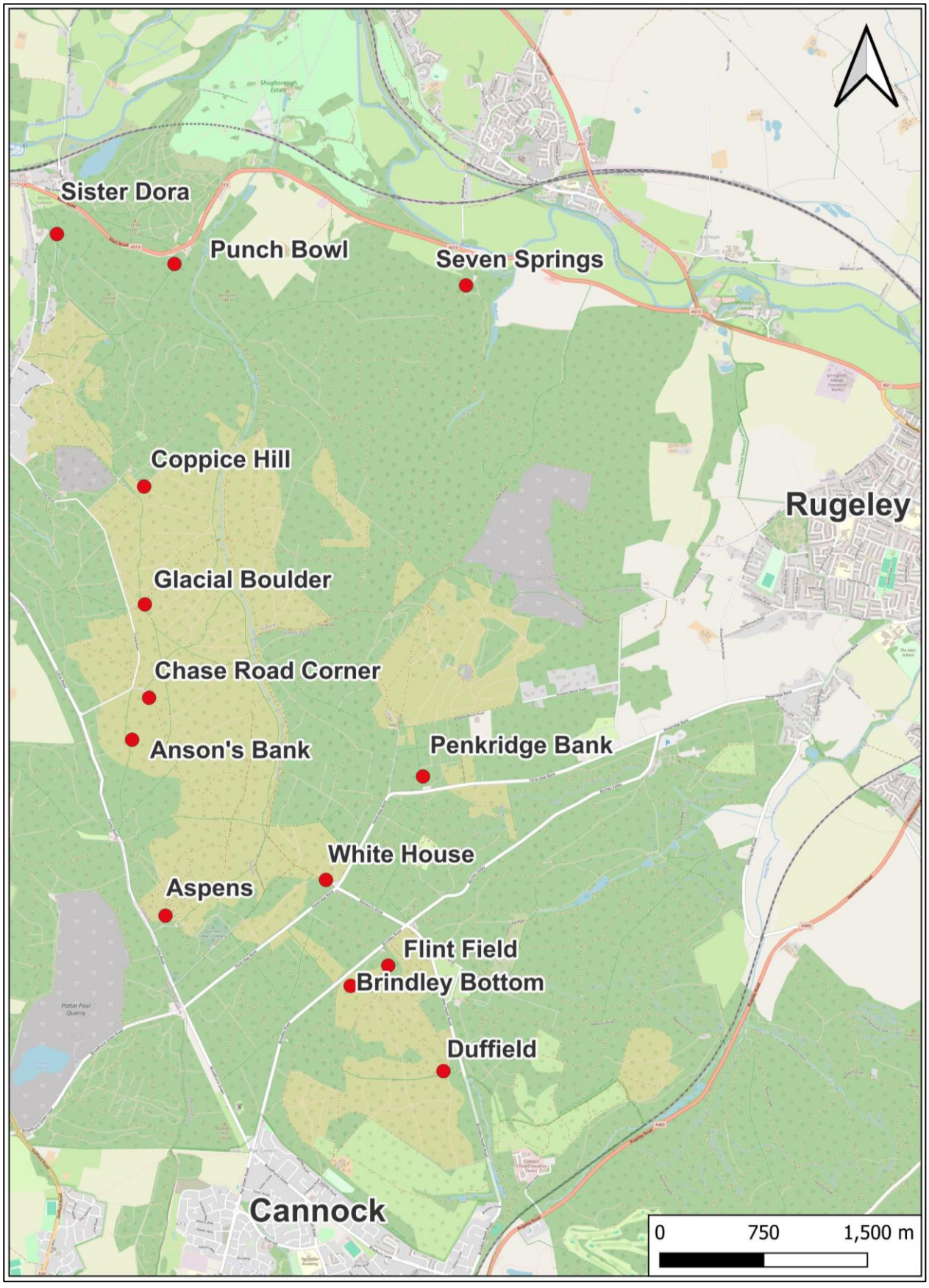

Figure 1: Location of Cannock Chase, within the West Midland conurbation, with Cannock to the south and Rugeley to the east. Sites visited during current survey annotated.

Source: Contains map data from OpenStreetMap 2024.

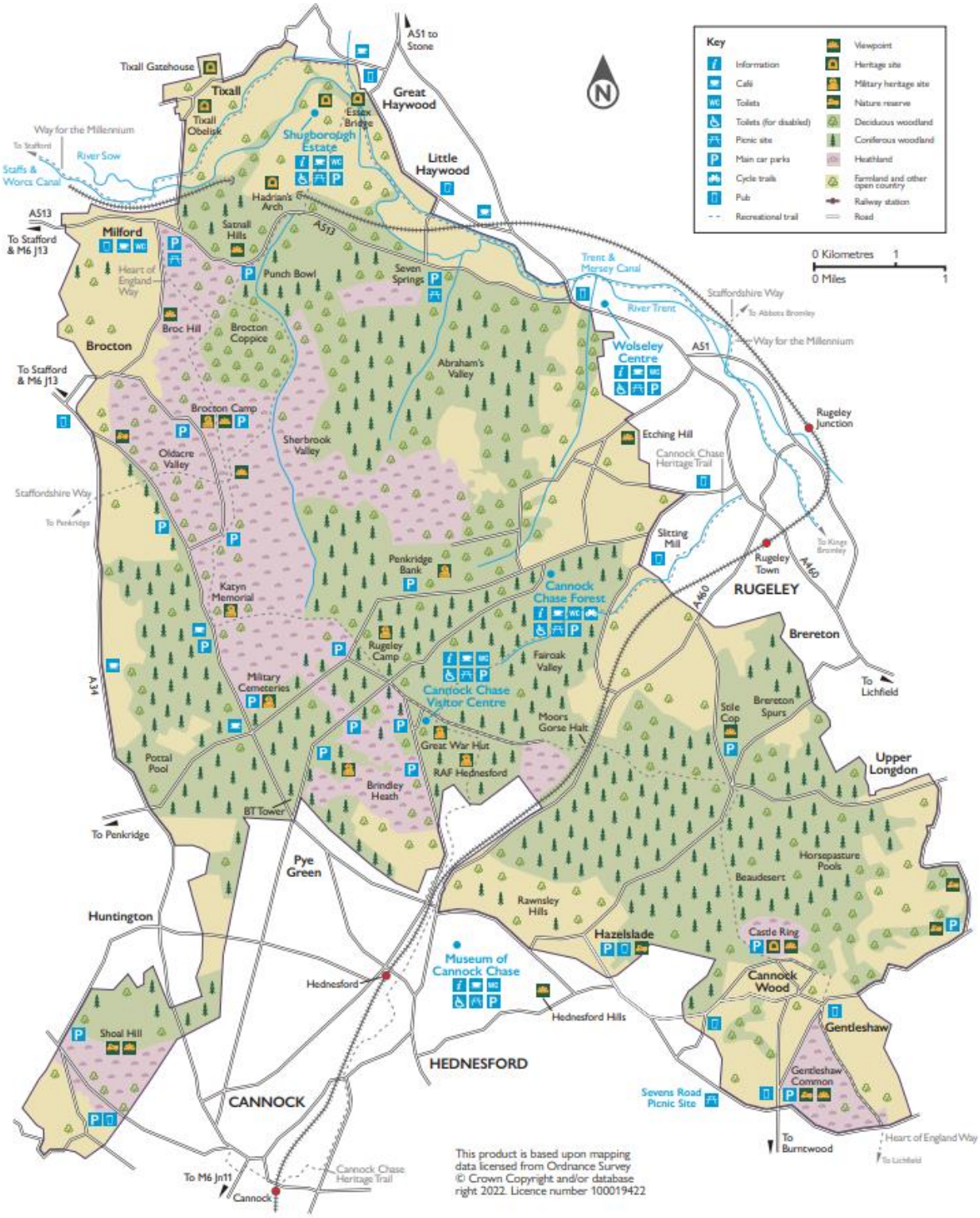

Figure 2: Map of Cannock Chase AONB, with main car parking areas indicated (P). From Cannock Chase National Landscape (2024a).

Expertise of surveyors

Mark Duffell MSc (MD) of *Arvensis Ecology* undertook the survey as an expert botanical surveyor. All botanical identification was undertaken by MD. Field surveyors employed by *Arvensis Ecology* are all professional botanists with many years of field experience, with relevant degrees and regular CPD.

Accurate identification skills are paramount to *Arvensis Ecology*, and all surveyors have a recognised qualification in identification (*Botanical Society of Britain and Ireland* Field Identification Skills Certificate (FISC). Level 4 or higher). MD has a FISC 5, and *Arvensis Ecology* now run FISCs during which they act as the 'gold standard' botanical surveyor against which candidates are assessed. MD is up to date with current taxonomy and recording techniques and has undertaken numerous surveys requiring accurate mapping and recording of vegetation. MD runs training courses for a range of government and non-government organisations in botanical identification and surveying, as well as teaching on a leading MSc in biological survey techniques and species identification[2].

Survey Constraints and limitations

The survey work was undertaken in August, which was chosen as an acceptable time to survey heathland and grassland habitats.

This timeframe means that later flowering species could be picked out readily but might cause some vernal species to have been missed or under-recorded (e.g., there may be some vernal species which had died back prior to the survey).

No attempt was made to survey or record any non-botanical species or to quantify the site for its potential for fauna, although the surrounding area is known for its rich herpetological and lepidoptera interest as well as other organisms, these include several legally protected species. There is no reason to believe that some or all are not making use of the surveyed area. Any actions on the site that could be damaging to these organisms would require further surveys to establish the location and extent of populations there.

In a couple of cases identifications were only made to an aggregate level:

- No attempt was made to identify Dandelion *Taraxacum officinale agg.* and *Rubus fruticosus* agg. beyond an aggregate level.

In the case of sites nearest to car parks with the heaviest amounts of dog faeces, a fingertip search within the quadrats was not undertaken. Instead, the surveyor identified species present from a standing position and used a stick or other tool to reveal any partially hidden species. In these areas it was not felt that this technique compromised recording. Outside of these areas hand searches were undertaken where it was considered hygienic.

[2] Manchester Metropolitan University MSc in 'Biological Recording and Ecological Monitoring'

Timing of survey: Heathlands and in particular H9 heathland can be surveyed between July-September (JNCC 2009), other habitats likely to be found on site will also fit this timeframe. Ideally any of the areas comprising semi-natural broadleaved woodland (and potential ancient woodland) would need visiting earlier in the year to pick up the vernal ground flora, but adequate information can be gained from surveying in August to identify the broad NVC habitat. Only two sites had dominant broadleaved tree cover – Sister Dora and Seven Springs. It was felt that whilst some vernal species may have been under-recorded this has not dramatically affected any results.

Otherwise, time of year, weather and surveyor skills did not impose any other constraints to the survey being carried out successfully.

All thirteen sites, and their associated Feno markers previously installed in March 2024 were re-found during the botanical survey.

Dogs and other visitors to heathland

Cannock Chase National Landscape area has a population of 9,200 people within its boundaries; further out, 2 million people live within 30 kilometres of this boundary (Cannock Chase National Landscape 2024b). Within the British Isles there are currently 12-13 million dogs, with 31% of all households having one or more dog (PFMA 2022; Anderson et al. 2023).

There are serious concerns about the impact of ectoparasite (fleas, ticks etc.) treatments (containing neonicotinoids and other compounds) on dogs can be extremely harmful to the environment. This may be through direct contact of dogs swimming in water bodies, indirectly by dog bedding being washed and the treatment making its way into the water system. Another potential source is by excretion in dog urine and faeces. Currently the impacts have been researched for aquatic invertebrates, but it is likely not to be restricted to just that group. 86% of dog owners applied ectoparasite treatment in the preceding 12 months (BVA, BSAVA and BVZS 2021; Perkins and Goulson 2023).

A study looking at visitors and their behaviour on Dorset heathlands, which has similar habitats, flora and fauna to Cannock Chase found that the overwhelming majority of visitors were dog walkers over other users (Liley et al. 2006). They found that dog walkers typically lived locally, and many of these visited the sites at least daily. Short visits were the norm (under 1.5 hours), and medium sized (collie equivalent) dogs formed nearly half the visiting canines.

70% of visitors interviewed said they visited because of the wildlife, and the open nature of the heath. Likewise, 62% visited because it was their nearest open space where they could exercise their dog(s) freely (Liley et al. 2006).

88% of dog walkers felt that not cleaning up after their dog was not acceptable, with 53% always clearing up their dog's faeces. But a third only cleaned up if their dog fouled on a main path. A view was held by some walkers that because dogs were off leads and running free from paths, they did not need to pick up the dog's waste. Liley et al. (2006) also reported that the majority of visitors kept to paths, and that the major disturbance was from dogs running free away from paths, rather than human activity. Over 80% of people kept to the main tracks, but roughly half of all dogs wandered off the main tracks (Clarke et al. 2005). The problem of multiple dogs off-lead was also raised, with more likelihood of more freedom allowed by dog walkers with multiple dogs. Only 8% of the study participants kept their dogs on leads all of the time (Clarke et al. 2005; Liley et al. 2006).

The report found overall that the size of the dog did not the influence the "amount of time spent walking the dog, nor the likelihood of the owner clearing up (or not) after their dog".

Survey Methods – assessment criteria

Assessing changes in plant species present and vegetation communities

Fixed quadrats can be used to show potential changes in species present over a timeframe. Within the quadrats a list is made of individual species along with their abundance (Domin value). Additional notes on leaf litter, other litter (vegetation), bare earth and rocks would allow assessment of disturbance (e.g. from scuffing, trampling etc.).

Vegetation change can be also assessed using the National Vegetation Classification system. This system is designed for semi-natural vegetation, rather than more disturbed ruderal habitats such as those nearer the car parks. It should be possible to identify the habitats present within the more mature and homogenous stands of vegetation and these can be used as a control against which the study areas can be compared both now and in the future.

Use of NVC and fixed quadrats in any dynamic landscape can be problematic, with the vegetation within that fixed area not staying constant over time. By selecting a larger plot and allowing the surveyor to choose placement of the quadrats within a homogeneous stand within these plots should mitigate some of these concerns (more details below). Changes in use of the area (e.g. reduction in pedestrian and cycling use and associated impacts) should in time be visible in the reduction in anthropomorphic habitats towards the desired NVC communities.

Other factors that can also be assessed include age (growth phase) and structure of key heathland species (*Calluna* and other ericaceous species), as well as average vegetation heights within the quadrats.

Assessing change in nutrient status

Soil testing would be the most accurate way of measuring the abiotic status of soils including pH and nutrients. Apart from the associated costs, measurement of Nitrogen[3] and other nutrients can be problematic given their mobility in soils, and seasonal changes linked to hydrology and climate can be an issue.

An alternative is to utilise Ellenberg Indicator Values (EIVs). These provide a tool for understanding the ecology of a site and have five major scales for Light (L), Moisture (F), Reaction (R), Nitrogen (N) and Salt tolerance (S). Each individual species has a value for each of these scales. Ellenberg values can be derived from current and historical data and require no abundance data to be collected at the time. A mean can be derived from lists for each area and can then be compared in future years to see if there has been any change. ElVs are an estimate and not an exact measure of the nutrient/pH status of soil but are useful in showing coarse scale differences in these statuses without the need for direct soil testing.

The use of Ellenberg Indicator Values (EIVs) will allow an assessment of the current Nitrogen status of soils and in turn indicate the amount of Eutrophication in any given area.

[3] Soil fertility rather than mineral nitrogen

Assessing negative biotic indicators

The presence of some botanical species in an area may be more desirable than others in terms of the site's ecology or conservation status. By reviewing the species found within the survey it will be possible to create a list of negative and positive indicator species.

The CSR biological traits model (Grime et al. 1996) places plants into three categories Competitor, Stress-tolerator, and Ruderal model (Figure 3). Stress (constraints on production e.g. water, nutrients), Disturbance (physical damage to vegetation) and Competition (amount of neighbouring plants competing for same resources) traits separate species into these three groups or combinations of them. A species such as Ling *Calluna vulgaris* is classed as a stress-tolerant competitor (SC), meaning it can survive low to high stress but only with low disturbance. Comparatively a 'weedy' species such as Annual Meadow-grass *Poa annua* is a ruderal species, relying on quick growth and early flowering to survive the low stress and high disturbance. It is expected that those more anthropomorphic areas nearer the car park will display plants with R traits, and the more established heathland species will be a mixture of S and SC traits.

		Intensity of Stress	
		Low	**High**
Intensity of disturbance	**Low**	**Competitors (C)**	**Stress-tolerators (S)**
	High	**Ruderals (R)**	No viable strategy

Figure 3: CSR strategies and evolutionary traits (Grime 1996)

The CSR results can be visualised using CSR Triangle (ternary) plot (made using Tri-Plot) (Figure 4). Examples of species that form a gradient along the Ruderal and Competitor axis are shown with Annual Meadowgrass *Poa annua*, through Perennial Ryegrass *Lolium perenne* and Broadleaved Dock *Rumex obtusifolius* to Heather *Calluna vulgaris* and Silver Birch *Betula pendula.* At Cannock Chase, a desirable habitat would be relatively stable (low Ruderal value), with intermediate Stress and Competition, and if plotted on the CSR triangle would be appear around the Heather and Silver Birch (Figure 4). Less desirable habitats would be around the plots for the three other species. Caution should be taken when using CSRs as not all ruderal species are undesirable, and/or may be of conservation importance etc.

Averaging results from each plot/quadrat will enable a comparison to be made between plots/quadrats and the habitats/species they contain.

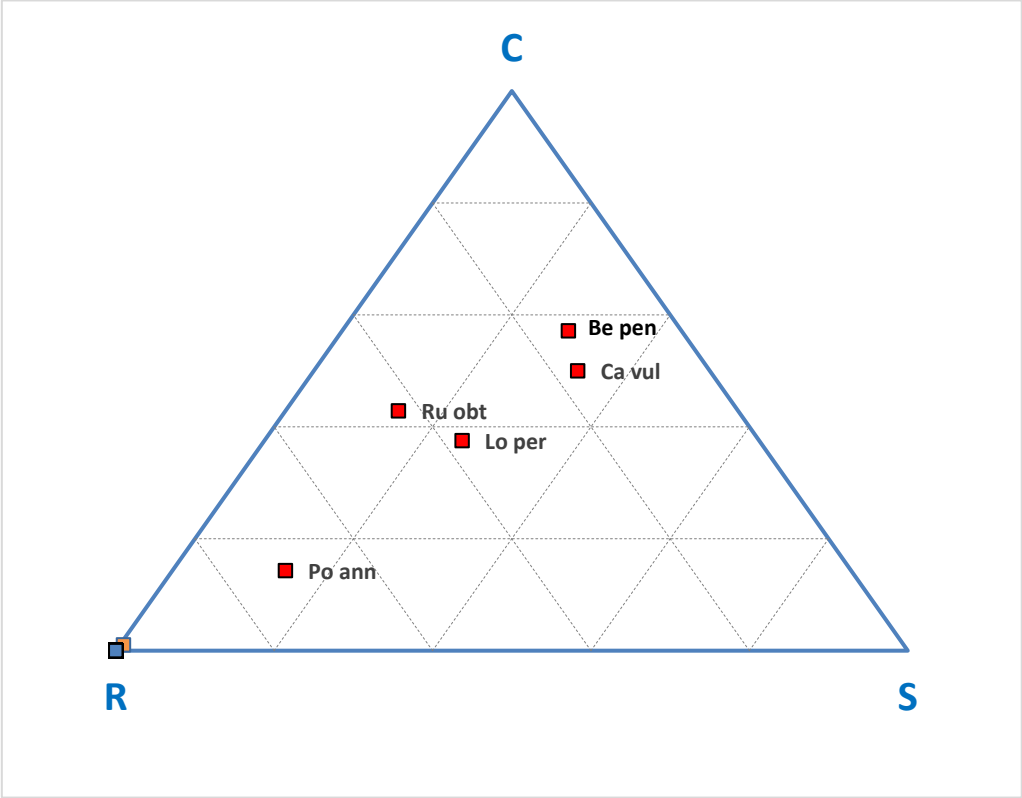

Figure 4: CSR Triangle, displaying several species. Be pen = Silver Birch *Betula pendula*, Ca vul = Heather *Calluna vulgaris*, Lo per = Perennial Ryegrass *Lolium perenne*, Po ann = Annual Meadowgrass *Poa annua,* Ru obt = Broadleaved Dock *Rumex obtusifolius.*

Employing both EIVs and Competitor, Stress-tolerator, and Ruderal status (Grime et al. 1996) will indicate these changes in the landscape. It is expected that species that tolerate more ruderal, disturbed soils and often of higher nutrient status are more likely to be found and in higher quantities nearer to the car parks. Comparably good quality heathland will have a reduced number of these disturbance species, excepting where particular management may have occurred e.g., over-grazing and/or burning. Examples of high N indicator species are given in Table 1.

Table 1: Examples of high N indicator species.

Common Name	Scientific Name	N EIV
Broad-leaved Dock	*Rumex obtusifolius*	9
Garlic Mustard	*Alliaria petiolata*	8
An Orache	*Atriplex species*	8-7
A Goosefoot	*Chenopodium sp.*	8-7
Hemlock	*Conium maculatum*	8
White Dead-nettle	*Lamium album*	8
Common Nettle	*Urtica dioica*	8
Cock's-foot	*Dactylis glomerata*	6

Analysis can compare any species found against the EIVs looking for species with a EIV Nutrient score of (6), 7, 8 or 9 (‘*Plant often found in richly fertile places*’ to ‘*Indicator of extreme rich situations*’).

Assessing disturbance, abiotic and biotic indicators

Bare ground[4] is a feature of heathlands and is essential for some species, particularly lichens, to thrive; an excess of bare ground though can allow the introduction of both native and non-native invasive species to take hold and lower the overall quality of the desired habitat(s). Bare ground can be assessed visually and recorded as a percentage of the whole area.

Bare ground can be assessed as 'Heavy Disturbance' if it has aggressive impacts occurring on the area e.g., bicycle and/or pedestrian tracks. It is classed as 'Undisturbed' if no signs of these artificial impacts are visible. Following the JNCC 2009 Common Standards Monitoring guidance for heathland between 1 and 10% of bare ground in the area is desirable to maintain a favourable condition.

An abundance of ruderal species can suggest recent/past major disturbances to the soil, allowing either a seed bed to be created or unearthing 'weed' species within the seed bed.

Negative indicators of trampling/disturbance could include:

- Species with Ruderal status.

Other less desirable species when found in quantity within a heathland landscape:

- Coarser grass species including False-oat Grass *Arrhenatherum elatius,* Yorkshire Fog *Holcus lanatus* and Cock's-foot *Dactylis glomerata.*
- Rosebay Willowherb *Chamaenerion angustifolium* (Syn. *Chamerion angustifolium*).
- Thistles *Cirsium* sp.
- Foxglove *Digitalis purpurea* (an early colonist on disturbed ground, often an indicator of disturbance after felling or other major works).
- Willowherbs *Epilobium spp.* (with exceptions)
- Ragwort *Jacobaea vulgaris* (Syn. *Senecio jacobaea*)
- Bramble *Rubus fruticosus* agg.
- Nettle *Urtica dioica*
- Tree and shrub seedlings.

Within a heathland the following species can be less desirable when found in quantity:

- Bracken *Pteridium aquilinum* Negative indicator if > 10% of the area (JNCC 2006).
- Gorse *Ulex europeaus and U. gallii.* Negative indicator if > 25% of total vegetation cover on dry heathland, to maintain stand diversity (JNCC 2006).

It may be useful to assess condition and age of Ling *Calluna vulgaris* to help with future management, in areas of disturbance typically only small seedlings are likely to be sporadically present; with reduced disturbance these plants can establish and age accordingly.

Post survey analysis can compare those species found with their CSR values (not available for all species) and highlight those species typically found in more ruderal habitats.

Additional negative indicators:

- Burning/over-grazing.
- Presence of trampling from pedestrians and/or cyclists, dog (or other animal) fouling, anti-social use e.g. barbeques, littering; other negative indicators of human presence.

[4] Soil free of vegetation cover and/or litter. Rocks and stones are not included in this category.

Within each car park a brief survey can be undertaken to assess if INNS (Schedule 9 species) are present, or any other species considered undesirable, whether native or non-native e.g. abundant Bramble *Rubus fruticosus* (and see above).

Survey Methods: Sites and plot selection, and quadrat placement

A method has been chosen that is as robust as practical, allowing future surveyors to repeat easily, whilst keeping to a sensible amount of work that is not so onerous that it will never be repeated.

Sites chosen included areas with active car parks and areas where car parking may be closed in the future (Table 2). Currently there are over 120 areas used for parking, both formal and informal car parks.

The sites chosen for surveying were made in discussion with the Cannock Chase SAC Project Officer.

Table 2: Location of Sites with site code and grid reference and altitude of main car park area.

Car park name	Site Code	Grid Reference	Altitude (m)
Anson's Bank	13	SJ 97907 17159	204
Aspens	6	SJ 98211 15855	221
Brindley Bottom	3	SJ 99478 15416	185
Chase Road Corner	12	SJ 98085 17548	187
Coppice Hill	8	SJ 97977 19141	183
Duffields Car Park	1	SK 00353 14807	167
Flint Fields	2	SJ 99801 15683	200
Glacial Boulder	7	SJ 97946 18144	192
Penkridge Bank	5	SK 00106 16838	206
Punch Bowl	10	SJ 98371 20670	112
Seven Springs	11	SK 00464 20516	83
Sister Dora	9	SJ 97438 20785	107
White House	4	SJ 99467 16155	205

At each car park area (**site**), three areas (**plots**) were identified as having three distinct vegetation types (Figures 5 and 6), from less diverse trampled vegetation in the areas closer to the car parks, through medium quality habitats to better-quality homogeneous stands in the heathland/woodland areas. These plots were chosen to have similar topography, hydrology, geology, soil conditions to the disturbed areas so potentially any beneficial changes in the poorer areas after succession will translate into these communities/habitats.

To allow re-location for future surveys, each plot was marked with a Feno marker (yellow plastic block approximately 100mm^3, held in place by a metal rod driven into the ground). On installation a grid reference was taken using a high accuracy GPS (Spectra SP20 handheld GNSS receiver), allowing sub 10cm accuracy (the locations are available in Appendix 2). To further aid relocation a sketch map of the locations with bearings and distances to significant features in the landscape was also made at the time and updated during the botanical survey with any additional features. Photographs from the Feno marker were also taken looking away, as well as some towards the marker from an adjacent landmark.

The Feno markers were installed either in areas adjacent to or within the survey area. In the case of poorer quality vegetation with heavy trampling and other activities the Feno marker was put to one side to avoid accidental/intentional damage, and/or prevent a tripping hazard.

In terms of site numbering, each quadrat was given a unique code, based on Site Name (1-13), plot number (a-c) and quadrat number (i-v). Thus, 11Biv is Site 11 – Seven Springs, Plot b, and quadrat four.

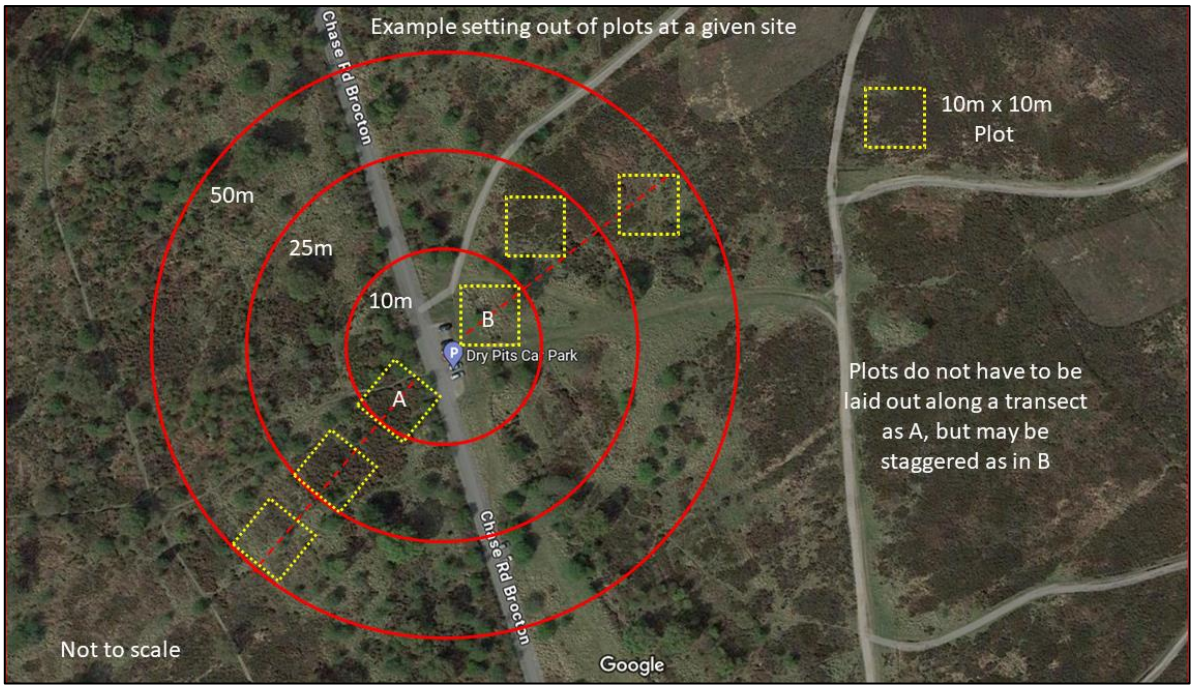

Figure 5: Example of setting out plots at a given site. Red circles are radius from centre of car park site, with each zone representing poor, medium and good habitats. A plot is placed within each zone, to allow comparison over time. Actual distances shown are examples.

Source: Imagery © 2024 Google, Imagery © 2024 Maxar Technologies, Map data © 2024 Google

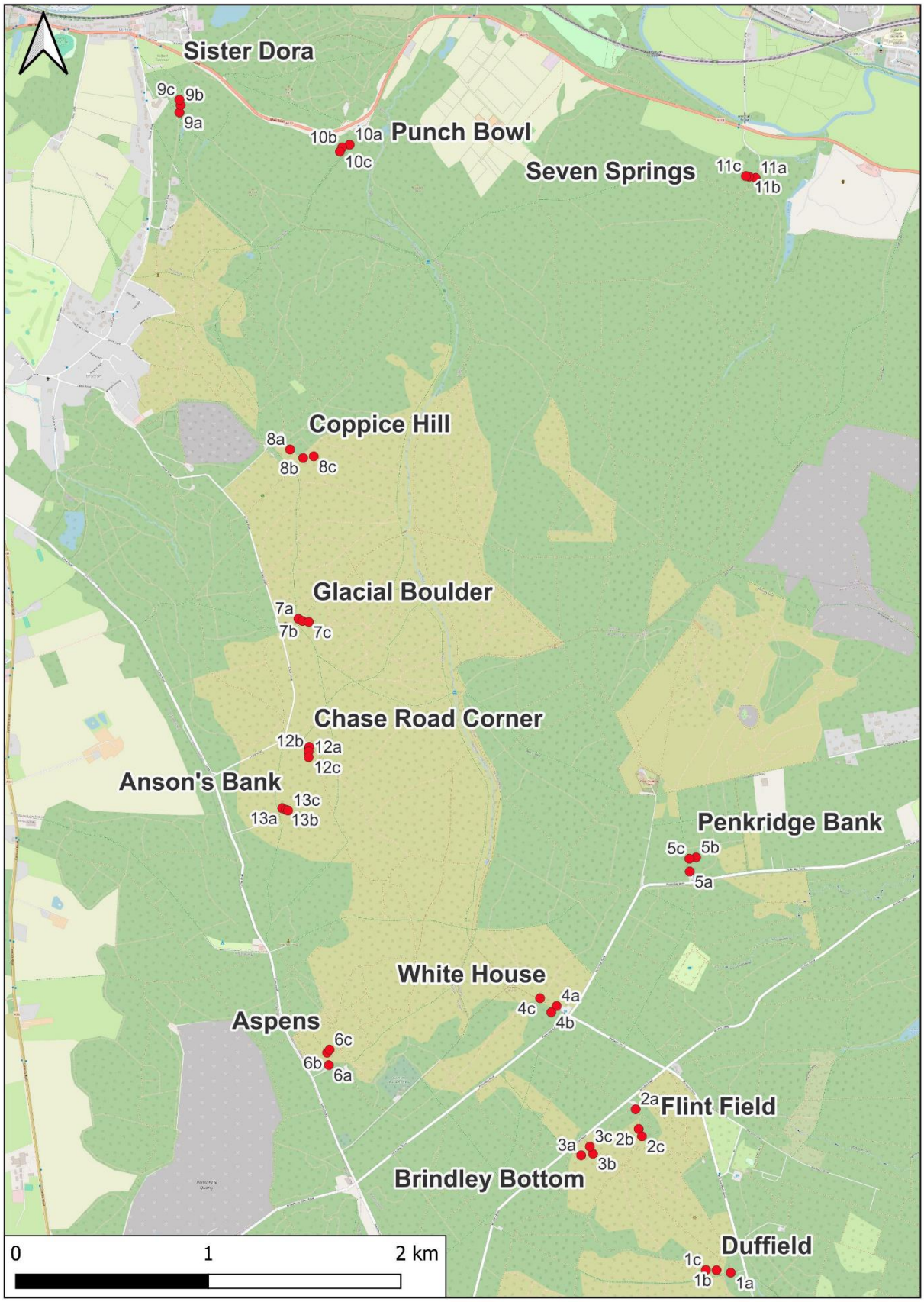

Figure 6: Location of sites with individual plots (a-c) shown.
Source: Contains map data from OpenStreetMap 2024.

Survey Methods: Botanical Survey

The botanical survey was undertaken on the following dates: 18th, 19th, 21st, 24th, 25th and 28th August 2024.

The timing of the survey was conducted according to JNCC 2009 recommendations for Heathland (July-September), with other habitats found on site fitting into that timeframe. Only one site (Seven Springs) contained semi-natural broadleaf woodland, and some vernal species may have been under-recorded but not dramatically enough to affect the results.

During the botanical survey, after the Feno marker had been relocated (utilising a grid reference, mixture of photographs, hand searches and a metal detector), the following was recorded:

- Site Code and plot number[5]
- Broad habitat: Ruderal/disturbed ground; coarse grassland; Acid grassland; Heathland; mosaic of Acid grassland and heathland; scrub; other (detailed notes).
- Presence of trampling and type of trampling (bikes and/or pedestrians), approximate area of site with this visible (% cover).
- Presence of dog fouling (visible signs, or coarser eutrophic species along path edges indicating dog urination).
- Presence of other negative human factors (litter, burning etc.)
- Presence of any bare earth within the plot (% cover).
- Any negative botanical indicators, e.g. invasive non-native species.
- Any management activities obvious (mowing, cutting, grazing animals/dunging present).
- As required a brief sketch map showing location of footpaths/cycle paths and/or other areas of disturbance across the plot can be made.
- Photos taken looking north, east, south and west from the Feno marker, plus overviews of habitat.

Once the plot marker was found a minimum of five **quadrats**[6] were positioned. The distance and bearing (from Feno marker) were recorded. These quadrats were placed within homogeneous stands of representative vegetation typical to that area. For areas with higher ecological integrity, namely the established heathland, this can be used to identify the NVC community present (and in turn the likely communities that can develop in the car park areas once that use has changed). In areas of lower ecological value, these quadrats can pick up the disturbance/eutrophication indicators, initially and potentially after the change in management and natural regeneration show development of the desired NVC communities.

Size of quadrats: Within the National Vegetation Classification system typically heathlands, particularly dry dwarf shrub heaths (as present at Cannock Chase) and short grasslands would be assessed by a 2m x 2m quadrat, for more diverse heaths, and taller herbaceous vegetation 4m x 4m quadrats are recommended (Rodwell 2006). For this study a 2m x 2m quadrat was considered sufficient to capture enough detail.

[5] In future a procedure needs to be put in place if a plot cannot be relocated and if new FENO markers should then be installed. Given the public nature of the site there is potential for markers to go 'missing'.

[6] To allow for future work and current assessment a minimum of 5 quadrats is required to make meaningful constancy tables, it may be possible from surveyor's experience to ascertain habitat in fewer quadrats, but this makes replication in the future more problematic.

Setting out the **quadrat**, followed Natural England's LTMN protocols (2016), with grid-references being taken from the southwestern corner of the quadrat and aligned north south (Figure 7). Quadrat locations are given in Appendix 2.

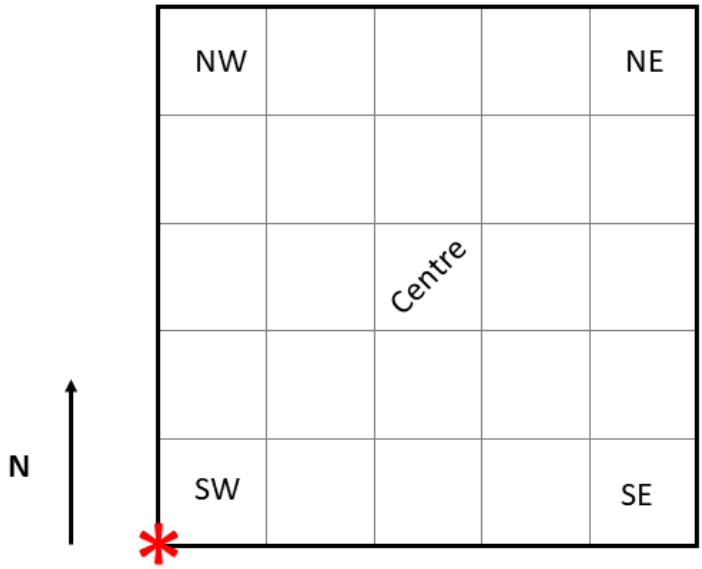

Figure 7: Quadrat placement, with permanent marker indicated by red asterisk. Grey lines indicate 400mm intervals along 2m length of quadrat poles.

Before surveying was undertaken, vegetation heights were measured using a 300mm ⌀ 200g drop disk, placed in five locations throughout the quadrat; within the centres of each 400mm interval, in the centre square plus NE, SE, SW and NW corners (see Figure 7). Heights were recorded to the nearest cm.

A list was made of all species present (including bryophytes if present) within each quadrat along with Domin cover value (Table 3: Domin values) following standard botanical recording and National Vegetation Classification techniques ((Hill, Fasham *et al.*, 2005; Rodwell 2000).

Identifications were made using Atherton *et al.* (2010), Hubbard (1992), Poland and Clement (2009, 2020), Rich and Jermy (1998) and Stace (1999, 2019). Taxonomy for Vascular plants follows Stace (2019), and for Bryophytes Atherton *et al.* (2010). Any historical records have had any taxonomical changes updated to allow analysis.

Each quadrat was photographed (facing north) and the photographs are included in this report (Appendix 8).

Table 3: Domin values

Domin	Percentage cover
10	91-100%
9	76-90%
8	51-75%
7	34-50%
6	26-33%
5	11-25%
4	4-10%
3	<4 (many individuals)
2	<4 (several individuals)
1	<4 (few individuals)

The following were be recorded for every quadrat:

- Grid reference (using a Garmin Etrex 10).
- Site code, Plot number and Quadrat number e.g. for Seven Springs. 11Aiv (11 = Seven Springs, A = plot code, iv = quadrat 4).
- Photograph taken at standing height from south of quadrat looking north.
- Date.
- Botanical and bryological species present with Domin cover values for each species.
- Note presence of and percentage cover values for litter, bare ground, rocks/stones.
- If present slope recorded using clinometer (deg.), aspect using compass (deg.)
- Broad habitat (Ruderal/disturbed ground; coarse grassland; Acid grassland; Heathland; mosaic of Acid grassland and heathland; scrub; other – detailed notes).
- NVC habitat that the surveyor identified from the field (either from experience or from NVC books).
- Describe land use here briefly (e.g. trampled with signs of dog fouling; intact heathland off paths). Note any signs of trampling, disturbed ground, litter (human), dog fouling.
- Note any undesirable botanical species present in the vicinity.
- Any additional notes required, e.g. species not found within the quadrat but within the plot.

The following were noted at each plot and in individual quadrats during the survey:

Any signs of human activity

- Tracks of bike or other vehicles.
- Trampling (foot), listed as none, minor, moderate or heavy.
- Other damage e.g. littering, burning, fire sites.

Any signs of animal activities

- Presence or absence of dog faeces (including dog poo bags). Note on amount.
- Presence of any grazing livestock (or their signs).
- Presence of any deer grazing e.g. damage or faeces.

Overview on general disturbance:

- Recorded as none, minor, moderate or heavy.

Additional notes were made as required.

A method has been chosen that is as robust as practical, allowing future surveyors to repeat easily, whilst keeping to a sensible amount of work that is not so onerous that it will never be repeated.

Utilising permanent plots with mobile quadrats will allow repeated surveying and should enable surveillance/monitoring of any changes in species/habitats present as well as several abiotic variables.

All biological records will be submitted to the relevant vice-county recorder.

Analysis

Results from each site, plots and their quadrats are summarised in:

- Appendix 1: species list from all plots
- Appendix 2: Quadrat locations, abiotic notes and vegetation heights
- Appendix 3: Human and animal impacts, overall plot disturbance
- Appendix 4: Constancy tables for each plot
- Appendix 5: Results from MAVIS analysis of NVC data
- Appendix 6a: Ellenberg Indicator values for all plots/quadrats
- Appendix 7: CSR values for all plots/quadrats

The quadrat data was compiled into constancy tables, with frequency[7] and Domin ranges (Table 3: Domin values) calculated and analysed against the NVC vegetation community keys and descriptions provided in Rodwell (2000). Data was also analysed using MAVIS (2015) for NVC analysis and Ellenberg Indicator Values (EIVs); although not all species had data available for Ellenberg values (Hill *et al.* 2004). Whilst in the field the surveyor separated plots into broad habitats, these separations were confirmed using Twinspan analysis.

Vegetation Data Outputs for each individual plot are analysed accordingly:

- NVC communities present[8] (utilising MAVIS software).
- Species list for whole plot and individually for quadrats.
- Mean Ellenberg values for plots.
- Average vegetation height for plots.
- Signs of eutrophication (EIVs), and list of species.
- Competitor, Stress-tolerator, and Ruderal proportions for each plot.

Comparisons can be made between similar plots across sites, linking disturbance factors to vegetation types.

Report containing the details above and a summary for each plot/site area.

[7] Frequency is used to describe how often a species is encountered in different quadrats/sample, regardless of how much of that individual species is present in each sample. Frequency classes are I = 1-20% (1 stand in 5) or scare, II = 21-40% or occasional, III = 41-60% or frequent, IV = 61-80% or constant, V = 81-100% or constant.

[8] Many of the plant communities present, particularly in the more modified habitats (car park, paths etc.) will not fit the National Vegetation Classification closely. The NVC surveys concentrate on natural/semi-natural environments, rather than strongly anthropogenic habitats (and are not covered in any of the volumes. For the more established habitats further away they are likely to fit Acid grasslands (U) or Heathlands (H).

Results and Discussion: Botanical Survey

A total of 1006 records were collected comprising 113 different taxa (90 species of vascular plants, 20 bryophytes and 3 lichens) (Appendix 1). None of these plants belong on Schedule 8 (protected species) or 9 (invasive non-native species).

A note on taxonomical changes

Taxonomy for Vascular plants follows Stace (2019), and for Bryophytes Atherton *et al.* (2010), this is summarised in Table 4. These changes particularly apply when comparing National Vegetation Classification descriptions to current surveys.

Table 4: Major taxonomic changes affecting species recording during current and previous surveys.

Current taxonomy	Common Name	Synonyms
Avenella flexuosa	Wavy Hair-grass	*Deschampsia flexuosa*
Chamaenerion angustifolium	Rosebay Willowherb	*Chamerion angustifolium*
Jacobaea vulgaris	Ragwort	*Senecio jacobaea*
Scorzoneroides autumnalis	Autumn Hawkbit	*Leontodon autumnalis*
Calliergonella cuspidata	Pointed Spear-moss	*Calliergon cuspidatum*
Kindbergia praelonga	Common Feather-moss	*Eurhynchium praelongum*
Pseudoscleropodium purum	Neat Feather-moss	*Scleropodium purum*

Species richness and diversity of plots and quadrats

Quadrats had between 1 and 17 species present (Table 5, Appendix 4). The quadrats with the fewest species present were in quadrats at Punch Bowl (10Biv and 10Bv; dominated by Bracken *Pteridium aquilinum*). The quadrat with the highest diversity was at Glacial Boulder (7Av; an area with a high degree of disturbance and many species of open grounds) respectively.

More species in a plot or quadrat is not necessarily better, for instance Mesotrophic Grassland (MG1) had a mean of 10.5 species per quadrat (range 5-16), although many of these are less desirable ecologically. By contrast Heathland had far fewer species, mean of 8.4 (range 4-14), but even in the most species poor quadrat the species present were of high ecological value.

Table 5: Broad habitats with range of, and means of, species present in each quadrat.

Broad Habitat	**Range**	**Mean**
Heathland (H9)	4-14	8.4
Mesotrophic Grassland (MG1)	5-16	10.5
Mesotrophic Grassland (MG6/7)	5-16	7.7
Mesotrophic Grassland (all)	5-16	8.6
Open Vegetation (OV25)	5-8	6.2
Acid Grassland (U4)	5-17	8.0
Woodland (W10)	2-9	4.6
Woodland (W16)	5-11	7.7
Woodland (W25)	1-3	2.0
Woodland (all)	1-11	4.74

* codes after each broad habitat refer to the NVC community present.

Vegetation heights

No previous data is available to assess change between survey periods. Summaries of the vegetation heights for each broad habitat are given in Table 6 (Appendix 2). If a sward height was over 100cm then it was recorded as 100+ cm. Heights of trees were not measured (as per Rodwell 1998).

Table 6: Broad habitats with range of, and means of, vegetation heights present in each quadrat.

Broad Habitat	Range (cm)	Median (cm)
Heathland (H9)	4-100+	22.8
Mesotrophic Grassland (MG1)	8-66	20.7
Mesotrophic Grassland (MG6/7)	0-62	6.8
Mesotrophic Grassland (all)	0-66	8.2
Open Vegetation (OV25)	>100	-
Acid Grassland (U4)	2-25	10.4
Woodland (W10)	2-100+	31.9
Woodland (W16)	4-69	23.0
Woodland (W25)	>100	-
Woodland (all)	2-100+	100

* codes after each broad habitat refer to the NVC community present.

Heathland had a median sward height of 22.8cm (range 4-100+ cm) which is fairly typical of lowland heathland with its ericoid subshrubs. Older stands may be higher, due to mature ericoids, and some of the stands which had Purple Moor-grass inflorescences skewed the heights upwards.

Mesotrophic grassland, MG1, which is often ungrazed and has a robust tussocky appearance, is the tallest vegetation type present. This had a wide range (8-66cm), with a median of 20.7cm.

In contrast MG6/MG7 grasslands had a significantly shorter sward height of 60.8cm (range 0-62cm), this was evident in the field where the pressure from footfall and grazing had reduced the sward height significantly. If this habitat was in an undisturbed area (lacking trampling and grazing) then it would likely attain much higher sward heights.

Acid grassland

Acid grassland typically never attains the stature of most mesotrophic grasslands, in part due to the lower nutrient availability. This is the case in this study, with a range of 0-25cm and median of 10.4cm.

Open vegetation

At Seven Springs (11a) a large stand of Nettles and Thistles was adjacent to the main footpath, this had a very high sward height, with all quadrats measuring over 100cm tall.

Woodlands

Tree heights were not measured, but woodlands would obviously be the tallest vegetation group here. In the ground flora it was at Punch Bowl (10b, 10c), that a W25 *Pteridium aquilinum-Rubus fruticosus* Bracken-Bramble underscrub community had a high vegetation height, all over 100cm, forming dense stands with little to no ground flora. A tree canopy was above these areas.

The presence of Bracken in W10 woodland (Seven Springs 11b, 11c) influenced the overall vegetation height where it was present (range 2-100+ cm, median 31.9cm), in comparison to the W16 woodland (Anson's Bank (13b, 13c) which had no Bracken present (range 4-69cm, median 23.0cm).

The data collected can form a baseline from which to identify any future changes.

Changes in Frequency and Range

If this survey is repeated in the future these changes within the same plot areas in frequency and range of individual species will be useful, especially post any management. Changes could be a reduction in more ruderal, disturbance loving species (CSR values), or an increase in species of lower nutrient levels (EIVs).

The design of this current survey should allow ready comparisons with future survey work.

NVC communities present

Quadrat data is provided in full in Appendix 4.

NVC Communities were identified by comparison of the compiled constancy tables against the NVC vegetation community keys and descriptions provided in Rodwell (2000). Data was also analysed using MAVIS software (2015) (Appendix 5).

In the field, plots and quadrats were placed based on the experience of the surveyor; it is useful to confirm these groupings using Twinspan analysis. As hoped, within these Twinspan results, several clear groups appeared, ranging from Heathland to improved/low quality grassland type[9], acid grassland, and woodland.

There are primarily five broad habitats present within the survey plots, although there are intermediates or gradients between these habitats (Table 7**Table *1***).

Table 7: Sites and Plots with the NVC community identified.

Site/Plot	A	B	C
1	MG7	U4	H9
2	MG7	U4	H9
3	MG7	U4	H9
4	MG7	H9	MG1
5	MG6	H9	MG1
6	MG6	H9	H9
7	U4	H9	H9
8	MG7	H9	H9
9	MG1	W10	H9
10	MG7	W25	W25
11	OV25	W10	W10
12	MG7	MG1	H9
13	U4	W16	W16

Heathland (H)

Within the Cannock Chase area lowland heathlands are one of the dominant habitats present. Heathland habitats were recorded from ten of thirteen sites (Duffields 1c, Flint Fields 2c, Brindley Bottom 3c, White House 4b, Penkridge Bank 5b, Aspens 6b-c, Glacial Boulder 7b-c, Coppice Hill 8b-c, Sister Dora 9c and Chase Road Corner 12c).

Keys in Rodwell (1998) suggested two main heathland communities to consider, these are H8 *Calluna vulgaris-Ulex gallii* Heather-Western Gorse heath and H9 *Calluna vulgaris-Deschampsia flexuosa* Heather-Wavy Hair-grass heath. MAVIS analysis suggested a third community H12 *Calluna vulgaris-Vaccinium myrtillus* Heather-Bilberry heath. H8 and H9 are lowland dry heaths, running from the southern Pennines down to the south coast. H12 is an upland heathland community found in upland areas of the southwest (e.g. Dartmoor), up through Wales and the Pennines north to Scotland (Rodwell 1998).

[9] Separation of the MG6 and MG7 (and to a lesser case MG1) communities was poor, but these typically share many common species.

H12 *Calluna vulgaris-Vaccinium myrtillus* heath, whilst floristically having many of the same constant species, can be ruled out as it is described for more upland areas, above 200m (Rodwell 1998). Its distribution is primarily more northerly but also present in high altitude areas to the southwest. Climatically they are in the colder, wetter sub-montane zones that are not present at Cannock Chase. Cannock Chase is an undulating site with altitudes ranging from 71m (Tixall Broad, Sow Valley) to 242m at Castle Ring, near Cannock Wood (Cannock Chase National Landscape 2024b).

The areas surveyed that contained Heathland habitats (see above) ranged from an altitude of 107m to 221m, averaging 185m.

H9 and H12 are floristically split by the differences in cover of Heather *Calluna vulgaris*, Bilberry *Vaccinium myrtillus*, and other ericoids, some of which are locally prominent in H9 (Rodwell 1998).

H8 *Calluna vulgaris-Ulex gallii* heath has as constant species Bell Heather *Erica cinerea* and Western Gorse *U. gallii.* Ecotones between H8 and H9 make it difficult to split these two communities, but whilst Bell Heather was present in some quadrats it was always at a low cover value and never constant. The only gorse recorded during the survey was Common Gorse *U. europaeus*, which was found in plots 13B and C, which were not heathland areas. Typically, whilst found on Cannock Chase *U. gallii* is a species with a more south-westerly distribution, and found in the drier soils which also encourage *E. cinerea* growth (Rodwell 1998). H8 would appear to have been recorded on Cannock Chase previously (JNCC 2024) and shares similar soil requirements to H9 (see below).

As stated, above H9 is floristically similar to H8 and H12, with an abundance of Ericoid species but at differing frequencies and cover values. Some of these Ericoids such as Crowberry *Empetrum nigrum* and Cowberry *V. vitis-idaea* can be of local importance; unusually here Hybrid Bilberry was also present within some of the plots (although not captured within the quadrats).

H9 is typical of low to moderate altitudes through the Midlands and northern England, and has been widely reported as occurring at Cannock Chase (JNCC 2024).

The soil requirements for H9 are a surface soil pH of between 3 and 4, highly oligotrophic (few nutrients) and on moderately free-draining soil, which does not tolerate compaction (Rodwell 1998).

Maintaining H8 and H9 and preventing it from succession to Oak and/or Birch woodlands requires management in the form of grazing and/or burning (Rodwell 1998). With agricultural improvements (artificial fertilisers and manuring, ploughing, re-seeding etc.) these habitats have been further reduced.

Mesotrophic Grassland (MG)

Mesotrophic or Neutral grasslands are those grasslands or meadows that lack strong calcicoles (lime loving) or calcifuges (acid loving) species. Soils typically are neutral (around pH 7). Grassland management such as hay cuts, grazing animals, addition of fertilisers and re-sowing alter the communities present. Within mesotrophic grasslands, habitats such as hay meadows can be extremely species rich; at the other end of the spectrum are the agricultural leys and pastures, which have low botanical diversity and are of scant ecological interest.

Within the Cannock Chase survey plots, excepting the acid grassland, three predominant grassland types are apparent: MG1 *Arrhenatherum elatius* False Oat-grass grassland, MG6 *Lolium perenne*-

Cynosurus cristatus Perennial Rye and Crested Dog's-tail grassland and MG7 *Lolium perenne* Perennial Rye leys and related grasslands.

The MG5 *Cynosurus cristatus-Centaurea nigra* Crested Dog's-tail and Common Knapweed grassland (not recorded during this survey), and the MG1, MG6 and MG7 grasslands all form a gradient reflecting past and current management over similar soil types (Table 8). All these communities are present in the moist and mild lowlands of the British Isles (Rodwell 1998).

Table 8: Mesotrophic grasslands in relation to treatment (based on Rodwell 1998).

NVC	MG1	MG5	MG6	MG7
Grassland type	*Arrhenatherum elatius* grassland	*Cynosurus cristatus-Centaurea nigra* grassland	*Lolium perenne-Cynosurus cristatus* grassland	*Lolium perenne* leys and related grasslands
Past/Current Management	Mown once or twice annually, ungrazed and unmanured	Mown annually for hay and, autumn- and winter-grazed, manured by livestock	Grazed, throughout year, chemically fertilised[10] and often resown	Sown swards, chemically fertilised and grazed through the year or cut for silage or amenity
Botanical diversity	Medium to high*	Medium to high*	Poor	Very low

* Dependent on subcommunity

The first three communities share several species e.g. *Holcus lanatus*, and it is the proportion and dominance of these and other species that is used to separate them. Likewise, the original community prior to any management can also influence how the current community is classified, for instance MG6 can be derived from MG5 or U4 grasslands (dependent on the underlying soil).

MG6 and MG7 are separated partly by the presence/absence of Crested Dog's-tail *Cynosurus cristatus,* both have an abundance of Perennial Rye-grass *Lolium perenne.*

The MG6 community is described as having a short, tight sward, dominated by grasses. At least some *Cynosurus* is present, along with constants of Red Fescue *Festuca rubra, Holcus lanatus, Lolium perenne* and White Clover *Trifolium repens.* Diversity of herbs is generally poor, though they may be remnants of richer diversity if the grassland was derived from MG5 or other similar grasslands. Weedy species such as Ragwort *Jacobaea vulgaris* and Creeping Thistle *Cirsium arvense* are often prominent in the sward if they take hold. Heavy trampling can shift the vegetation towards the MG7 community.

MG6 can be derived from U4 *Festuca ovina-Agrostis capillaris-Galium saxatile* Sheep's Fescue-Common Bent-Heath Bedstraw grassland transitioning from the U4b typical subcommunity, U4a to U4c and thence MG6 (with each change of community/subcommunity a reduction in botanical diversity occurs). U4a/U4b and MG6b all share *Agrostis capillaris,* Sweet Vernal-grass *Anthoxanthum odoratum* and *Festuca rubra* as constants, but the separation of the former from the latter is due to the loss or significant reduction in *F. ovina, Galium saxatile* and *Potentilla erecta.* In turn MG6 gains an abundance of *Cynosurus* (rare to scarce in U4), *Lolium perenne* (scarce in U4).

[10] Whilst no active fertilisers (either artificial or natural) are being applied to Cannock Chase survey areas, the additional nutrients added by canines and other mammals are likely the factor here.

Additionally, Meadow Buttercup *Ranunculus acris*, *Dactylis glomerata,* Dandelion *Taraxacum officinale* agg. appear at higher abundances and constancies.

Rodwell (1998) notes that "Transitions between this kind of sward [U4] and MG6 *Lolio-Cynosuretum* are very widespread where there has been some agricultural improvement towards the limit of enclosure around the upland fringes, but the eclipse of more calcifuge plants and the increased constancy of *Lolium perenne* there should help effect a separation".

MG6 grassland was recorded from two plots (Penkridge Bank 5a and Aspens 6a).

The MG7 community is a very distinctive community, with abundant and constant *Lolium perenne* and very few accompanying species, of which all are agricultural species or of low botanical importance. Primarily agricultural and intensively managed grasslands, they can also include permanent amenity grasslands, where mowing/grazing is present. This habitat is one of the least ecologically important habitats in the British Isles, yet is of high value agriculturally, hence its ubiquity. MG7 can be derived from MG6 grassland (Table 8) with changes in management, increases in nutrients, and continuous grazing/mowing.

Rodwell (1998) states that "there is a complete gradation between rich, unimproved stands of the *Centaureo-Cynosuretum* [MG5] and the very species-poor swards of the *Lolium* leys [MG6 and MG7] which have been ploughed and re-seeded, fertilised and drained… In many cases, the best that can be hoped for is to place a stand at particular points along a line of continuous variation".

MG7 grassland was recorded from seven plots (Duffields 1a, Flint Fields 2a, Brindley Bottom 3a, White House 4a, Coppice Hill 8a, Punch Bowl 10a and Chase Road Corner 12a).

MG1 grasslands can be derived from several sources, including MG5 and MG6 grasslands that have had a reduction/change in grazing/mowing regimes. Typically defined by coarser species such as *Arrhenatherum elatius* and *Dactylis glomerata.*

At one plot Chase Road Corner (12B) the underlying vegetation was derived from heathland/acid grassland, with Wavy Hair-grass *Avenella flexuosa, Festuca ovina*, Mat Grass *Nardus stricta,* Purple Moor-grass *Molinia caerulea* and two ericoids *Vaccinium myrtillus* and *V. vitis-idaea.* None of these were frequent or at a high abundance. There was an overall feel of a heathland with encroaching MG1 vegetation species in this area. This long narrow plot was an ecotone of the two neighbouring habitats, being sandwiched between the footpath with its coarse heavily trampled and species poor grassland (MG6/MG7) and further away fine stands of lowland heathland (H9). The lack of trampling and major disturbance was allowing remnants of the heathland/acid grassland to remain, but occasional disturbance and occasional local enrichment (from canine urine and faeces) was promoting coarser vegetation. The lack of grazing here has caused the proliferation of *Arrhenatherum* and *Holcus lanatus*. It would be useful to monitor the encroachment of the MG1 community into the heathland.

MG1 grassland was recorded from four sites (White House 4c, Penkridge Bank 5c, Sister Dora 9a, and Chase Road Corner 12a and 12c).

Acid Grassland (U)

Acid grassland often formed mosaics within the lowland dry heathland on site, and in many cases particularly nearer the car parks had shifted to a more mesotrophic grassland type (MG1, MG6 or

MG7). It was recorded from four plots (Duffields 1b, Brindley Bottom 3b, Glacial Boulder 7a and Anson's Bank 13a). These habitats proved to be U4 grassland, borne out by the keys in Rodwell and MAVIS analysis, although some areas could be seen as an ecotone with some of the more eutrophic sites nearby.

U4 *Festuca ovina-Agrostis capillaris-Galium saxatile* Sheep's Fescue-Common Bent-Heath Bedstraw grassland is widespread across the British Isles, distributed from the Southwest, throughout Wales and the Welsh Marches, into Staffordshire and the Peak District, north up through and into Scotland. U4 grassland is a submontane community (100-500m (exceptionally 800m)), found on acid, low nutrient soils and it is maintained by grazing (Rodwell 1998).

The constant species for the U4 community are Common Bent *Agrostis capillaris*, Sweet Vernal-grass *Anthoxanthum odoratum*, Sheep's Fescue *Festuca ovina*, Heath Bedstraw *Galium saxatile* and Tormentil *Potentilla erecta.*

Within the U4 community, it was clear that this survey had examples of several different subcommunities including U4a *Festuca ovina-Galium saxatile* typical subcommunity and U4b *Festuca ovina-Galium saxatile Holcus lanatus-Trifolium repens* subcommunity.

The U4b subcommunity is more mesotrophic than the type community, with species such as Crested Dog's-tail *Cynosurus cristatus,* Cock's-foot *Dactylis glomerata,* Yorkshire Fog *Holcus lanatus* and Smooth Meadow-grass *Poa pratensis* becoming more prominent. Sheep's Fescue is replaced by Red Fescue *F. rubra*, and other constant species are less common e.g. Heath Bedstraw and Tormentil, instead replaced by White Clover *Trifolium repens.* This subcommunity is often more common in the lowlands (100-250m), with a warmer drier climate and a more fertile soil that the other subcommunities (Rodwell 1998). Some quadrats within plots whilst still identifiable as U4 were transitional to MG6b (e.g. Duffields 1b and Brindley Bottom 3b) as discussed above.

If areas of U4 grassland are left unmanaged then Bracken *Pteridium aquilinum* can take hold and dominate the stands, this then becomes the U20 *Pteridium aquilinum-Galium saxatile* Bracken-Heath Bedstraw community. Bracken is a component of U4 but at much lower frequency, particularly in the U4e *Vaccinium myrtillus-Deschampsia flexuosa* subcommunity. U20 is definitely present at Cannock Chase and often bordered areas of U4 surveyed e.g. at Flint Fields (2b).

Vegetation heights varied across this community, with those at Glacial Boulder the lowest (mean 3.6cm) to Brindley Bottom (11.3cm).

Acid grassland often formed mosaics within the lowland dry heathland, and in many cases, particularly nearer the car parks, had shifted to a more mesotrophic grassland type (MG1, MG6 or MG7).

With agricultural improvements U4 grassland can be transitioned to a Mesotrophic Grassland MG6b *Lolium perenne-Cynosurus cristatus* Perennial Ryegrass-Crested Dog's-tail grassland. Here Sheep's Fescue is absent, replaced by Red Fescue (also present in U4a and U4b), with only scrappy cover of Tormentil and Heath Bedstraw, and other acidophiles absent (Bilberry, Wavy Hair-grass and Mat Grass). A higher abundance of Yorkshire Fog, White Clover and Mouse-ear Chickweed *Cerastium fontanum* is found. Two grasses which are constant are Perennial Ryegrass and Crested Dog's-tail.

Whilst no liming of the soils (to increase pH) is deliberately happening[11], increases in nutrient status via animals urine and faeces are widespread in many of the sites surveyed.
The increase in nutrients preferentially selects mesotrophic species (Yarrow, Mouse-ear Chickweed, Yorkshire Fog, Selfheal and White Clover) and reduces the prevalence of calcifugous, oligotrophic species (Heath Bedstraw, Bilberry and, Wavy Hair-grass).

If U4 grassland is left unmanaged either through changes in burning and/or grazing, then Bracken *Pteridium aquilinum* can take hold and form sparse to dense stands over the grassland. This appears to be the case in Flint Fields (2b).

Open Vegetation
At Seven Springs (11a), an open vegetation community was present, OV25 *Urtica dioica-Cirsium arvense* Nettle-Creeping Thistle community. This trackside stand of vegetation was dominated by Nettle and Creeping Thistle, as well as *Arrhenatherum elatius* and *Holcus lanatus.* Other species present were 'weedy' species such as Thistles *Cirsium* sp., Cleavers *Galium aparine,* Wood Avens *Geum urbanum* and Bramble *Rubus fruticosus agg.* This plot had the highest Ellenberg Indicator Value for Nitrogen (see below). The OV25 community is considered of low ecological value.

Woodlands (W)

Three distinct areas had significant tree cover at Punch Bowl (10b-c), Seven Springs (11b-c) and Anson's Bank (13b-c). Visually the different sites could be separated into distinct communities, and this was confirmed with Rodwell (1998) and MAVIS analysis. In all areas the predominant trees were a mix of Pedunculate Oak *Q. robur* and Silver and Downy Birches *Betula pendula* and *B. pubescens* respectively.

W10 *Quercus robur-Pteridium aquilinum-Rubus fruticosus* Pedunculate Oak-Bracken-Bramble woodland community was found at Sister Dora (9b) and Seven Springs (11b-c). Of the two sites, Seven Springs was the best example, with a canopy of Silver Birch and Pedunculate Oak, sub canopy of Bracken, and a moderately species rich ground flora.

W16 *Quercus spp.-Betula spp.-Deschampsia flexuosa* Oak-Birch-Wavy Hairgrass woodland community was present at Anson's Bank (13b-c). The canopy was mostly Birch *Betula* spp. with sporadic Pedunculate Oak. Here brambles dominated the understorey in much of the site, but the additional ground flora denoted an acid soil (supported by the associated EIVs).

At Punch Bowl, a very sparse woodland predominantly of Birch *Betula spp.* and Pedunculate Oak, but with rare Rowan *Sorbus aucuparia*, overtopped a very dense stand of Bracken. This formed the W25 *Pteridium aquilinum - Rubus fruticosus* Bracken-Bramble underscrub community, as is typical Bracken was the dominant species, with Bramble only present in half the quadrats.

These woodlands are classified by their canopy, ground flora and the underlying soils. W10 forms on brown earths with a low pH status, whilst W16 can be found on rankers, brown podzolic soils, typically base poor with low nutrient soils (Rodwell 1998). W25 bracken stands typically were found

[11] Although testing of the hardcore used in car parks and footpaths would be useful to determine if inert or calcareous, and thus increasing the pH levels of the surrounding soils.

transitioning into W10 woodlands, particularly along woodland rides and paths. Stands can remain isolated from previous woodland, with sparse trees (Rodwell 1998).

Unclassified habitat

One plot could not be strongly identified to a particular NVC community. At Sister Dora (9b), from an initial view it appeared to be a woodland with stands of mostly Pedunculate Oak *Quercus robur*, with some Silver Birch *Betula pendula*[12] present. The understorey was extremely poor with only six species present and considerable bare ground (40-80%). The constant species were Common Bent and Springy Turf-moss *Rhytidiadelphus squarrosus.* Otherwise, scarce and rare with very low cover were Rough-stalked Feather-moss *Brachythecium rutabulum*, Cock's-foot *Dactylis glomerata*, Heath Bedstraw and Bramble. The woodland keys in Rodwell (1998) were unsatisfactory at splitting into either W10 or W16, given the paucity of species in the quadrat. MAVIS likewise gave many unlikely communities, although it did give W10d *Holcus lanatus* Yorkshire Fog subcommunity (23.22%), but currently what is observed at the site does not fit that community description well. To the surveyor it looked like this land had previously been a mixture of heathland (H9) and acid grassland (U4), that has had tree planting taking place in the past 25-40 years. In time this woodland will develop further, but currently it has a very poor ground flora, which will take a very long time to improve florally. There is potential here to assist the ground flora with planting of suitable material (if this is done it needs flagging up to future surveyors to avoid biasing future surveys).

Summary of NVC communities present on site

Habitats of ecological importance.

Two key habitats of Cannock Chase are the Heathlands (H9) and Acid Grasslands (U4) as well as the mosaics they can create. These are botanically and ecologically desirable communities and are in part the reason for SSSI designation on parts of the Chase.

The woodland communities (W10 and W16) are both of high value for flora and fauna.

Habitats of intermediate to poor ecological importance

Potentially some of the areas identified as MG6 *Lolium perenne-Cynosurus cristatus* Perennial Rye and Crested Dog's-tail grassland could be derived from U4 grassland. With correct management and reduction in nutrients etc. they could be drawn back to a more species rich and ecologically important habitat.

Likewise, MG1 *Arrhenatherum elatius* False Oat-grass grassland (which often overtops other communities due to lack of management e.g. MG5, some heathlands) where it borders habitats of ecological importance could potentially be drawn back to a more desirable community.

The W25 Bracken underscrub is of lower value than other woodland communities recorded during this survey, but they offer buffer zones between people and the surrounding woodlands. This is of benefit for the flora and fauna in the area, in particular deer.

Habitats of very low ecological importance

Widespread near car parks and areas of high human/pet animal impact are the Mesotrophic

[12] One of the Silver Birch had an old stake adjacent to its trunk.

Grasslands (MG7 *Lolium perenne* Perennial Rye leys and related grasslands). These have very poor botanical diversity and are of poor ecological value to other animals.

Another undesirable vegetation type typical of high nutrient areas is the OV25 *Urtica dioica-Cirsium arvense* Nettle-Creeping Thistle community, as the community name suggests this is a coarse unpleasant habitat with fierce vegetation. Some ecological value for visiting pollinators can be found in the flowers and vegetation but only if contained in smaller areas and not impacting more important habitats.

NVC overview and summary

For the habitats recorded during the survey[13] it is clear that many are on an environmental abiotic and biotic gradient. Changes in management and/or input of nutrients from animals or other sources (including aerial deposition) can influence the habitats present. An attempt has been made to identify the key habitats and their environmental drivers, along with how they might transition from one community to another with the likely cause (Figure 8).

At Cannock Chase the climax community would be woodlands (either W10 or W16 depending on the underlying soils), the woodlands edges would include the W25 Bracken underscrub with a sparse tree canopy above.

Heathland (H9) and Acid grassland (U4) are plagioclimax communities, an area of land where the influences of humans have prevented the ecosystem from developing further to the climax vegetation (woodland).

Human management of the heathland and grassland ensures its continuity, although the resulting vegetation is also influenced/impacted by other inputs. Lack of grazing and an associated increase in thatch, as well as other nutrient inputs can cause the acid grassland to transition to a coarse tussocky mesotrophic grassland (MG1). With careful management it may be possible to turn back these areas to heathland/acid grassland, but the long-term effects of nutrients can be a major problem. Heavy trampling and disturbance of acid grassland alongside increase in nutrients and changes in grazing (cutting by machinery) can create a different transition to mesotrophic grasslands (MG6 and MG7). In these extreme cases of higher nutrient grasslands, it can be extremely challenging to return them to good quality acid grassland in the medium term.

[13] This survey does not comprise a complete list of all the NVC communities present on Cannock Chase.

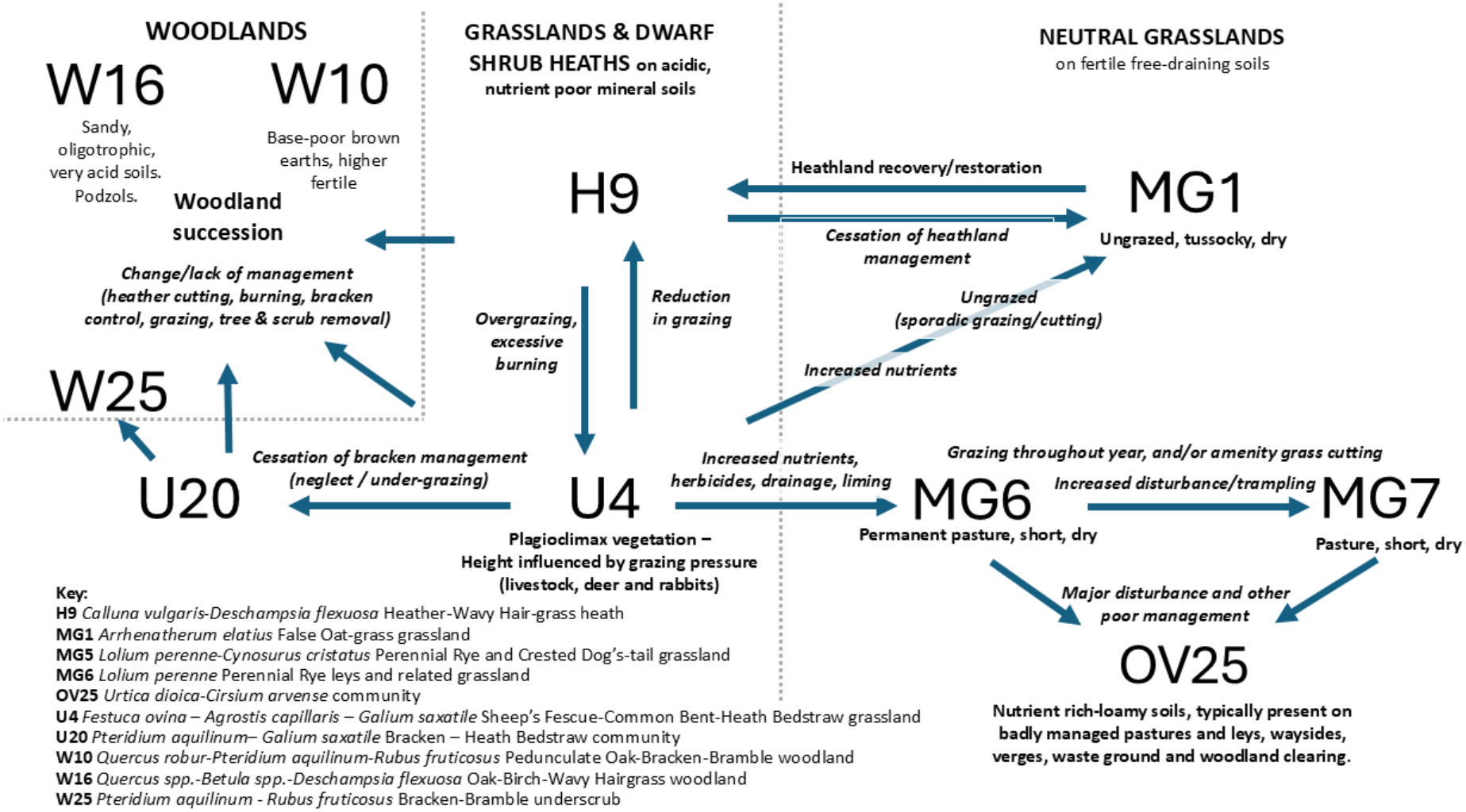

Figure 8: Interrelationships between communities recognised at Cannock Chase: influences of nutrients and management.

Ellenberg Indicator Values

Ellenberg Indicator Values (EIVs) provide an additional tool for understanding the ecology of a site and have four major scales for Light (L), Moisture (F), Reaction [linked to pH] (R), and Fertility [linked to nitrogen] (N) (Hill *et al.,* 2004). Each individual species has a value for each of these scales.

EIVs were derived from the species list contained within the individual quadrats as calculated by MAVIS (2015) (Appendix 6a). This gave a value against which all the three plots could be compared to indicate if there were any differences between them (Table 10). These values reflect the hydrology, geology and soils of the site and the influence they have on the surrounding vegetation, each EIV is dealt with separately below.

As an example (Table 9) Duffields EIVs are given below. Plot A was a mesotrophic grassland (NVC: MG7), Plot B acid grassland (U4) and Plot C heathland (H9). Only minor differences between Light and Moisture (F) values are displayed, in part due to controlling for aspect, and topography when setting out the plots. More significant are the differences between Nutrient values (range 2 to 5.5) and Reaction (range 3-6). Heathland requires a soil with both a low nutrient and reaction status, whilst acid grassland has a relatively small increase of both, and mesotrophic grassland a major increase in both compared to the heathland plot.

Table 9: Ellenberg Indicator Values for each plot within the Duffields site.

	Duffields				
Site 1	**L**	**F**	**R**	**N**	**Broad habitat**
Plot A	7	5.5	6	5.5	Mesotrophic grassland
Plot B	7	6	4	4	Acid grassland
Plot C	6	5	3	2	Heathland

Ellenberg Indicator values for Light (L) are showing the open nature of the site, with some shading present around the edges from taller vegetation[14]. The EIVs for light levels are relatively high, described as 'Plant generally in well-lit places, but also occurring in partial shade', though showing some variation (L = 6-7, mean 6.5 - Appendix 6b). As expected, those quadrats placed within the woodland areas had a lower L value (6) compared to heathland/grassland plots in the open (L = 7). A partial list of the Ellenberg Light values is contained in Appendix 6b.

Ellenberg Indicator values for Moisture (F) are showing the general uniformity of moisture values across the plots (F = 4-6.3, mean 5.4 - Appendix 6c). The site contains species that are 'Moist site indicators, mainly on fresh soils of average dampness'. The highest moisture values could be found in the heathland (F = 5.2-6.3, mean 5.8), and lowest in the mesotrophic grassland (F = 4-5.7, mean 5.2). A partial list of the Ellenberg Moisture values is contained in Appendix 6c.

Ellenberg Indicator Values for Reaction (R): The EIVs for Reaction (linked to pH value) show the range for the site to be a gradient from lowest in heathland (R = 2-3.5, mean 2.7), through acid grassland (R = 3.9-4.9, mean 4.6), and into Mesotrophic grassland (R = 5-6, mean 5.6). Woodland plots were similar in reaction value to acid grassland with medium low values (R = 3.9-4.5, mean 4.0). The area as a whole ranged from 2-6, with a mean of 4.6 (Appendix 6d).

[14] When setting out the plots attempts were made to control for differences in topography, aspect and slope, to allow only comparisons for plant communities and nutrient status to be made.

Ellenberg Fertility (N) value**:** The EIVs for fertility (linked to nitrogen) shows the biggest range across the different broad habitats, and it is these differences which are in part the reason for this study. The sites with the lowest nutrient values were the heathland plots (N = 2-3.4, mean 2.5 Appendix 6e). Acid grassland plots were then the next lowest (N = 3.3-4.4, mean 3.9). Woodland plots were intermediate between the two grasslands (N = 3.8-4.5, mean 4). Mesotrophic grassland (whether MG1, MG6 or MG7 NVC communities), were similar (N = 4.3-5.5, mean 5). One plot (Seven Springs 11a) which had an open vegetation community dominated by False Oat-grass *Arrhenatherum elatius,* Yorkshire Fog *H. lanatus* and Nettle *Urtica dioica* had the highest N value of 6.5.

If taken as a whole the range for all plots was 2-6.5, mean 4.3.

Table 10: Summary of EIVs for broad habitats recorded during current survey.

	Summary	L	F	R	N
Heathland	Range	6.3-7.0	5.2-6.3	2.0-3.5	2.0-3.4
	Average	6.6	5.8	2.7	2.5
Acid Grassland	Range	6.4-7.1	5.2-5.4	3.9-4.9	3.3-4.4
	Average	6.8	5.4	4.6	3.9
Bracken over Acid Grassland	Range	6.2	5.8	3.4	3.5
Mesotrophic Grassland MG6/7	Range	6.5-7.1	4.9-5.4	5.0-5.9	4.6-5.5
	Average	6.9	5.2	5.6	5.1
Mesotrophic Grassland MG1	Range	6.6-7.0	5.0-5.7	5.1-6.0	4.3-5.4
	Average	6.9	5.3	5.6	4.8
Mesotrophic Grassland All	Range	6.5-7.1	4.0-5.7	5.0-6.0	4.3-5.5
	Average	6.9	5.2	5.6	5.0
OV Vegetation	Range	6.7	5.7	6.6	6.5
Woodland W10	Range	6.0-6.6	5.2-5.6	3.9-4.4	3.8-4.1
	Average	6.2	5.4	4.1	3.9
Woodland W16	Range	6.0-6.2	5.4-5.6	3.9-4.5	4.0-4.5
	Average	6.1	5.5	4.2	4.25
Woodland W25	Range	6.0	5.3	3.9	3.9
	Average	6.0	5.3	3.9	3.9
Woodland All	Range	6.0-6.6	5.2-5.6	3.9-4.5	3.8-4.5
	Average	6.1	5.4	4.0	4.0

Habitat EIVs summary:

Heathland

The median values for all heathland plots show that they contain plants requiring well-lit places (e.g., with little shrub or tree cover), with soils that are moist for the majority of the year, with a pH that is acid, with low fertility.

Acid grassland

The median values for all acid grassland plots show that they contain plants requiring well-lit places (e.g., with little shrub or tree cover), with soils that are moist for the majority of the year, with a pH that is acid to moderately acid, and more or less infertile.

Mesotrophic grassland

The median values for all mesotrophic grassland plots show that the plots contain plants that require well-lit places (e.g., with little shrub or tree cover), with soils that range from moist for the majority of the year to just damp, with a pH that is moderately acid, but with intermediate fertility (and more species present that require richly fertile places).

Woodland

The median values for all woodland plots show that the plants they contain require slightly lower light levels than other plots, (semi-shade to well-lit places), with soils that are moist for the majority of the year, with a pH that is moderately acid, with low to intermediate fertility.

If this survey is repeated in the future these EIVs data from all the plots/quadrats can be compared against this previous survey to assess any changes, with a Mann-Whitney U test applied to test significance.

Using Ellenberg indicator values will allow analysis of future surveys as a broad proxy for monitoring soil nutrients, and in turn plant communities.

CSR Values

The CSR biological traits model (Grime et al. 1996) places plants into three categories Competitor, Stress-tolerator, and Ruderal (Figure 3). Stress (constraints on production e.g. water, nutrients), Disturbance (physical damage to vegetation) and Competition (amount of neighbouring plants competing for same resources) traits separate species into these three groups or combinations of them. A species such as Ling *Calluna vulgaris* is classed as a stress-tolerant competitor (SC), meaning it can survive low to high stress but only with low disturbance. Comparatively a 'weedy' species such as Annual Meadow-grass *Poa annua* is a ruderal species, relying on quick growth, early flowering to survive the low stress and high disturbance. It was expected that those more anthropomorphic areas nearer the car park will display plants with R traits, and the more established heathland species will be a mixture of S and SC traits.

The CSR values for each quadrat and the means for each plot were compiled from MAVIS (Appendix 7) and summarised in Table 11 and Figures 9 - 15.

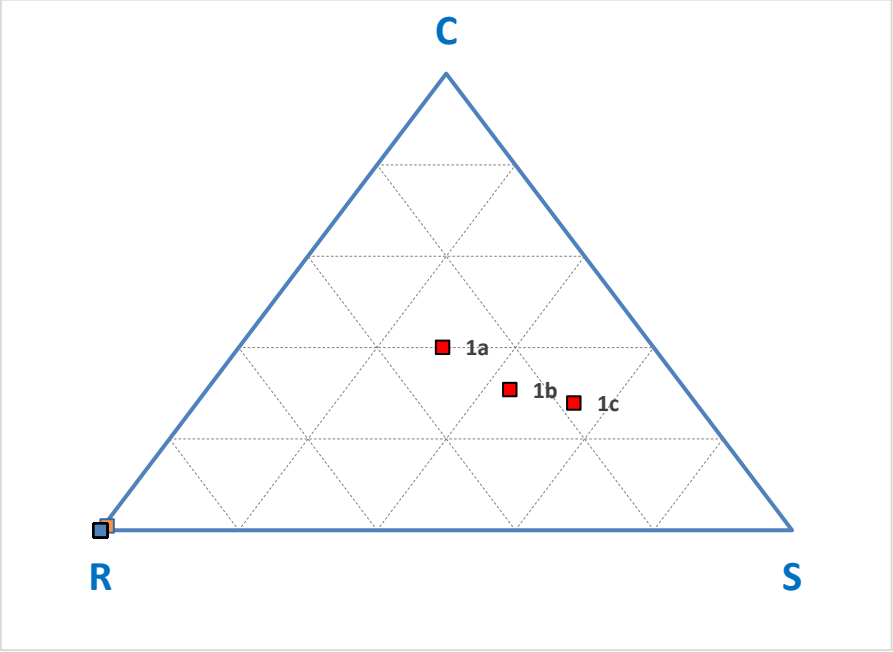

Figure 9: Example of mean CSR values from Duffields (Plots 1a, 1b and 1c).

- 1a: Mesotrophic grassland (MG7), vegetation types of moderate to high productivity (growth), with only some disturbance (R) and stress (S).
- 1b: Acid grassland (U4) with less productive vegetation (less growth), in part caused by higher stresses. Disturbance and competition lower than 1a.
- 1c: Heathland (H9) high amount of long-lived perennials (stress tolerant), but with slow growth and reproduction.

If this survey is repeated in the future these CSR data from all the plots/quadrats can be compared against this previous survey to assess any changes.

Using CSR values will allow analysis of future surveys as a broad proxy for monitoring soil nutrients, disturbance and in turn plant communities.

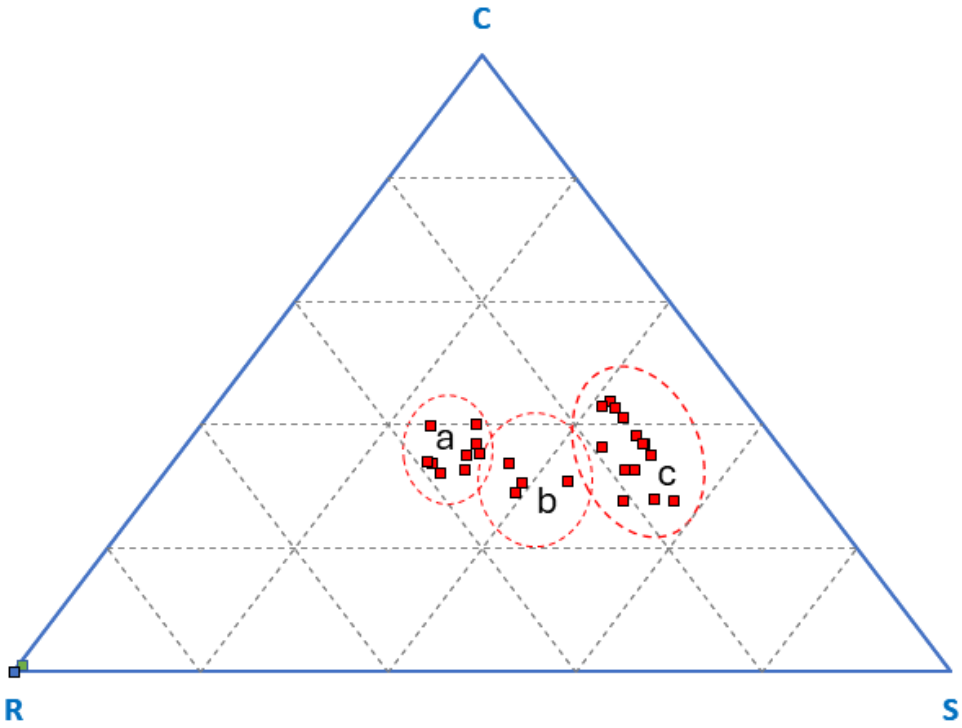

Figure 10: Mean CSR values for Mesotrophic grassland (a), Acid grassland (b) and Heathland (c) plots. Distinct zonation of CSR traits between grassland communities (a, b) and heathland (c) is apparent. This reflects the species and their CSR traits present.

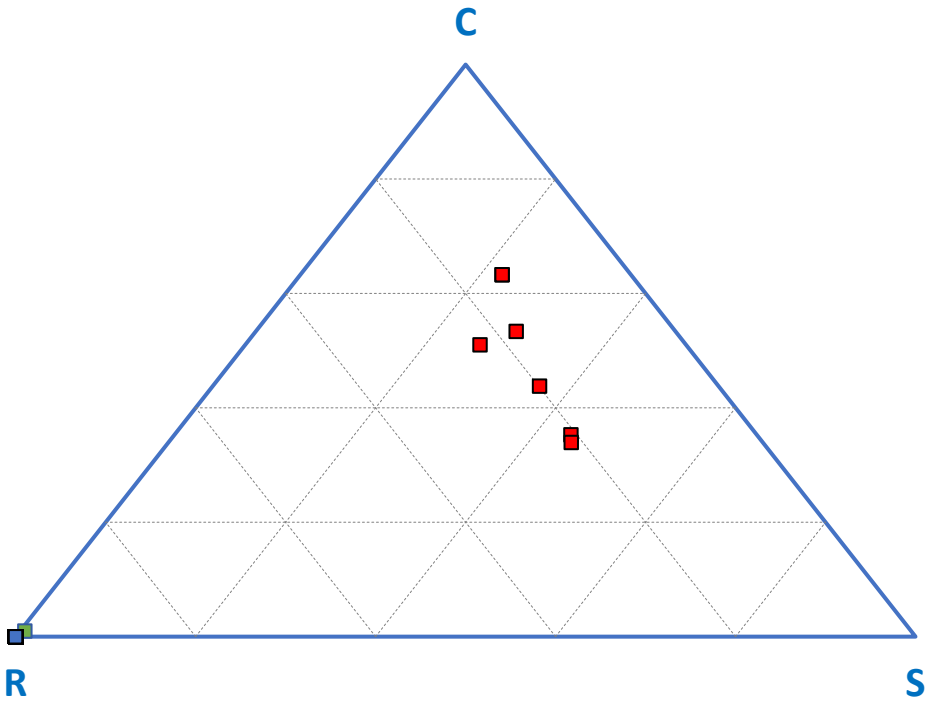

Figure 11: Woodland plots when graphed showed a distribution according to their NVC community and species composition, with the upper plot reflecting the strongly competitive nature of Bracken *Pteridium aquilinum*.

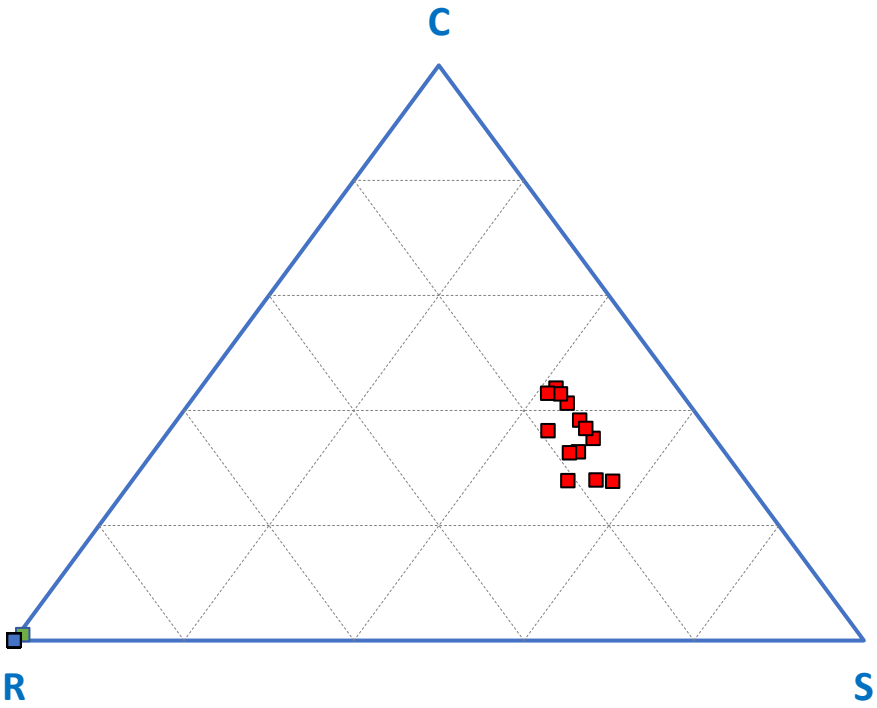

Figure 12: Heathland plots when graphed showed a gradient along the C and S axis, but with very low Ruderal values.

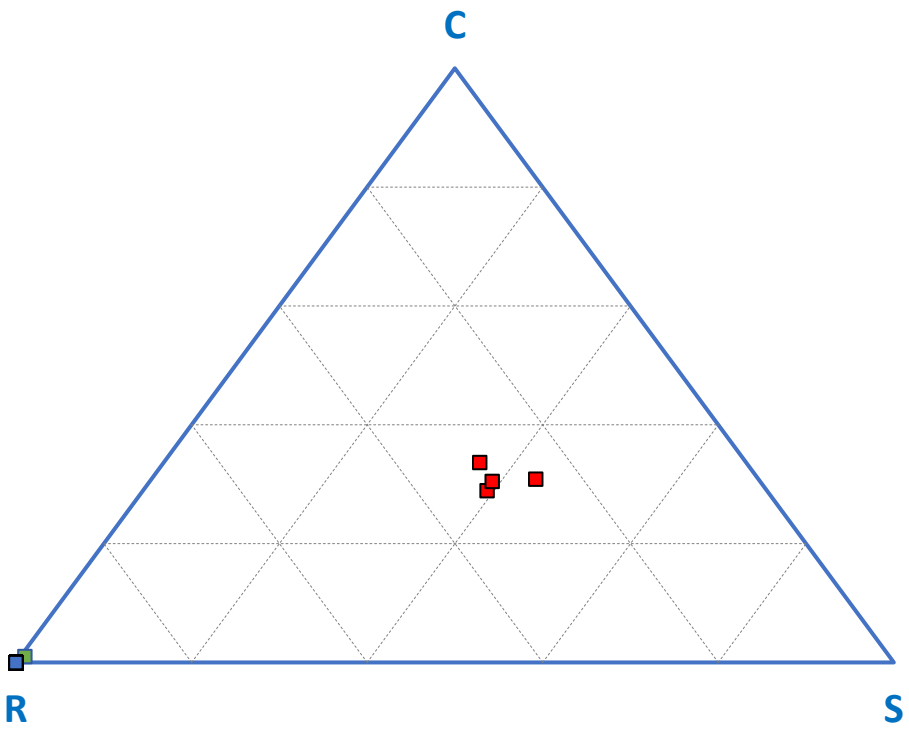

Figure 13: Acid grassland plots when graphed showed a cluster centrally, with a slight shift towards the Competitor and Stress axis.

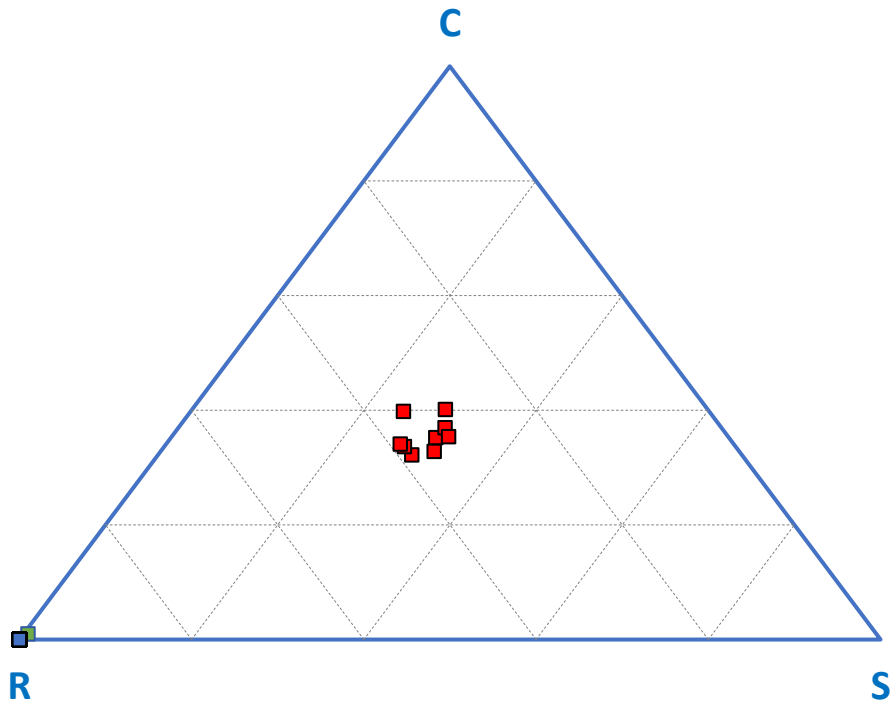

Figure 14: Mesotrophic grassland plots when graphed showed a central clustering but with a bias towards the Competitor and Ruderal axis.

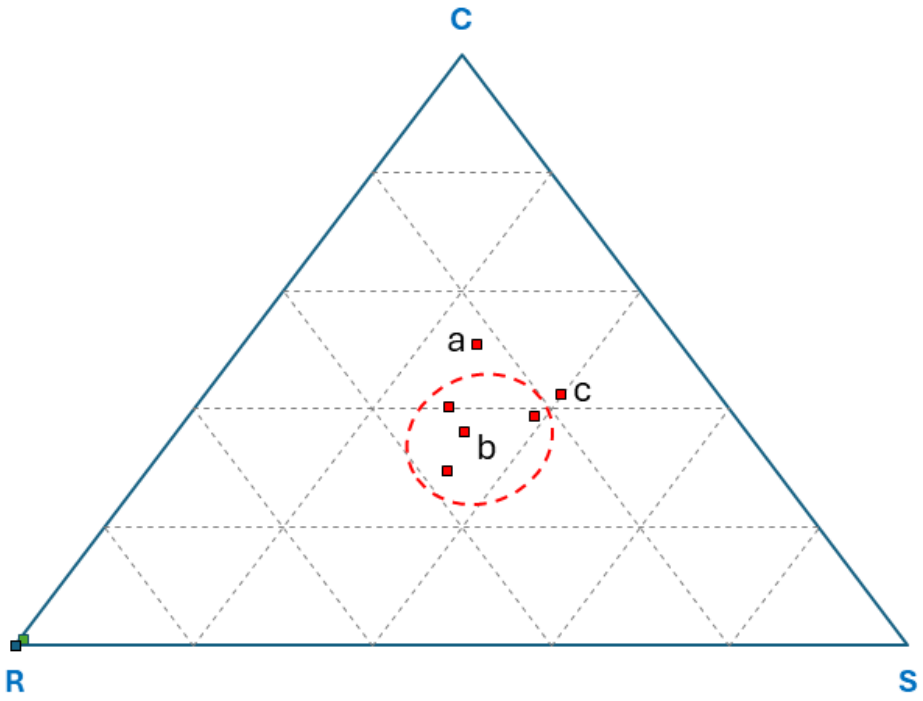

Figure 15: Remaining NVC communities:
a = the OV25 Nettle-Creeping Thistle community, a weedy plot with high Competitor values.
b = Mesotrophic grassland (MG1) with similar CSR values as Mesotrophic grassland (MG6/7).
c = Bracken-Heath Bedstraw community, firmly on the C-S axis.

Table 11: Summary of mean CSR values for each plot.

Site and Site Code	C	S	R
Duffields 1A	3.41	2.50	2.59
Duffields 1B	2.48	3.52	2.04
Duffields 1C	2.03	3.97	1.28
Flint Fields 2A	2.98	2.60	2.88
Flint Fields 2B	3.10	2.90	1.29
Flint Fields 2C	2.68	3.32	1.00
Brindley Bottom 3A	2.61	2.39	3.11
Brindley Bottom 3B	2.84	3.04	2.56
Brindley Bottom 3C	3.07	2.93	1.00
White House 4A	3.21	2.69	2.79
White House 4B	2.70	3.30	1.40
White House 4C	3.38	2.38	2.63
Penkridge Bank 5A	2.76	2.67	2.98
Penkridge Bank 5B	2.38	3.63	1.25
Penkridge Bank 5C	3.11	2.78	2.74
Aspens 6A	2.80	2.32	3.20
Aspens 6B	2.37	3.56	1.33
Aspens 6C	2.89	3.11	1.00
Glacial Boulder 7A	2.44	3.31	2.69
Glacial Boulder 7B	1.97	4.03	1.12
Glacial Boulder 7C	2.46	3.54	1.00
Coppice Hill 8A	2.97	2.70	2.73
Coppice Hill 8B	3.06	2.94	1.12
Coppice Hill 8C	3.00	3.00	1.00
Sister Dora 9A	2.40	2.73	3.00
Sister Dora 9B	2.67	3.33	1.56
Sister Dora 9C	2.11	3.89	1.59
Punch Bowl 10A	3.17	1.97	2.83
Punch Bowl 10B	4.43	1.57	1.00
Punch Bowl 10C	4.43	1.57	1.00
Seven Springs 11A	3.97	2.03	1.78
Seven Springs 11B	3.89	2.11	1.29
Seven Springs 11C	4.21	1.79	1.16
Chase Road Corner 12A	2.81	2.24	3.19
Chase Road Corner 12B	3.00	3.00	1.74
Chase Road Corner 12C	2.58	3.42	1.00
Anson's Bank 13A	2.58	3.30	2.58
Anson's Bank 13B	3.28	2.72	1.49
Anson's Bank 13C	2.59	3.41	1.62

Results and Discussion: Disturbance Survey

Various abiotic and biotic factors were assessed alongside the main vegetation survey.

Summaries of these results are given in Tables 12-15.

Colour coding (traffic lights) has been used within the following Tables (12-15) to help identify any issues, for habitats green is the most desirable, red the least and orange intermediate. For other factors green is considered best, with red at the opposite end of the spectrum.

Table 12: Amount of dog fouling within different broad habitats.

Broad Habitat	Dog fouling				No of plots
	None	Low	Moderate	High	
Heathland (H9)	9	3	1	-	13
Mesotrophic Grassland (MG1)	-	2	2	-	4
Mesotrophic Grassland (MG6/7)	-	-	4	5	9
Open Vegetation (OV25)	-	-	-	1	1
Acid Grassland (U4)	-	3	1	1	5
Woodland (W10)	2	1	-	-	3
Woodland (W16)	2	-	-	-	2
Woodland (W25)	2	-	-	-	2

It is clear from Table 12 that dog fouling is highest in the two Mesotrophic grasslands, particularly the MG7 community. Least affected are the more desirable vegetation community types: heathland, acid grassland and woodlands. Areas of acid grassland are more affected than heathlands, presumably in part as they are easier to access by dogs running free, but often (but not always) the heathlands were furthest from the car parks.

During the survey it was clear that transects of dog faeces were present along the path sides, with an initial high amount nearest the car park and then reducing the further away. After that, distribution along paths was more scattered. But it was common to find signs of localised enrichment scattered throughout the heathlands, indicative of free-roaming dogs defecating and being left in situ. The localised enrichment within the good quality heathland is of most concern, with the increase of nutrients and other disturbance (scratching after defecation) can open up areas of the heathland to invasion by negative habitat species. Once established these can further encroach into the prime heathland habitats, degrading the quality overall.

An illustration of the typical pattern of dog fouling across a given area based on the surveyor's experience of walking across these areas during the survey is given in Figure 16.

Table 13: Amount of site disturbance (and signs of deer activity) in different broad habitats.

Broad Habitat	Deer signs (no plots)	Site disturbance			No of plots
		None	Moderate	High	
Heathland (H9)	Yes (6)	10	2	1	13
Mesotrophic Grassland (MG1)	Yes (3)	3	1	-	4
Mesotrophic Grassland (MG6/7)	Yes (4)	-	6	3	9
Open Vegetation (OV25)	No	-	-	1	1
Acid Grassland (U4)	Yes (4)	-	4	1	5
Woodland (W10)	Yes (3)	2	1	-	3
Woodland (W16)	Yes (2)	2	-	-	2
Woodland (W25)	No	1	1	-	2

A general view on the disturbance of each plot was made taking into account trampling, dog fouling and types of vegetation present (Table 13). It was planned to use presence/absence of deer signs to make an assessment of how disturbed by dogs the site was, but with the amount of feeding, general habituation and large population of deer this has not been as clear as would have been liked.

Bare ground can be another indicator of disturbance, and this data was collected during the vegetation survey, sites varied from 0-90% bare ground (Table 14).

Mesotrophic grassland (MG1) by its very nature is a dense grassland with very little bare ground, in a few quadrats the open areas were due to ants' nests.

Mesotrophic grassland (MG6/7) had a variation in disturbance (0-25%, median 1%), the larger areas of disturbance are due to two quadrats at Aspens (6A) associated with site vehicles that have accessed the site here by the gateway.

U4 grassland can have small areas of disturbance (0-10%, median 0%) with a closed sward (a more open sward, dominated by small tussocks of grasses belong to the related grassland community: U1 *Festuca ovina-Agrostis capillaris-Rumex acetosella* Sheep's Fescue-Common Bent-Sheep's Sorrel grassland which are found elsewhere on site.

The areas with the highest bare ground were woodland quadrats, which is not unusual in these habitats. The Bracken stands (W25) at Punch Bowl (10b-c) had 90% bare ground beneath them. This can be typical of the dominance and shading that occurs with dense stands of Bracken. Next at Sister Dora (9b) was a community which did not conclusively key out a particular woodland community (see NVC section), this had a range of 40-80% bare ground, with a median of 75%. The last woodland habitat (W10) at Seven Springs (11b-c) had a median of 7%, with a range of 1-20%.

After woodlands, heathland had the biggest range (0-50%) with a very low median of 2%. The large range is due to one plot (Coppice Hill 8c, range 0-50%, median 2%) which had a heather cut taken last year with the associated scuffing from cutting machinery, and gaps from senescent heather, only now filling in. Removing this plot from the analysis, disturbance range drops to 0-15%, and a median of 2% again.

U4 grassland can have small areas of disturbance (0-10%, median 0%) with a closed sward (a more open sward, dominated by small tussocks of grasses belong to the related grassland community: U1 *Festuca ovina-Agrostis capillaris-Rumex acetosella* Sheep's Fescue-Common Bent-Sheep's Sorrel grassland which are found elsewhere on site.)

Table 14: Broad habitats and the range and median amount of bare ground present within quadrats.

Broad Habitat	Range	Median
Heathland (H9)	0-50%	2%
Mesotrophic Grassland (MG1)	0-4%	2%
Mesotrophic Grassland (MG6/7)	0-25%	1%
Open Vegetation (OV25)	0-10%	2%
Acid Grassland (U4)	0-10%	0%
Woodland (W10)	1-80%	10%
Woodland (W16)	0-2%	0%
Woodland (W25)	90%	90%

The presence and proportion of trampling by humans either by foot or bikes is reported in Table 16, as well as the presence of any littering. As anticipated, the most heavily impacted sites from bike tracks were the coarser grasslands (MG6/7), which were typically either forming parts of the footpaths/tracks near carparks and across the sites, or adjacent to footpaths. Heavy trampling was also found on acid grassland (1 plot untrampled, 2 plots with moderate and two with heavy trampling).

Heathland had the least impacts (12 out of 13 quadrats had no trampling; 1 quadrat had moderate trampling), this is partly due to site selection (deliberately choosing 'better' ecological areas), but also represented the general condition of these areas being less disturbed.

Summary of disturbance at Cannock Chase plots

It was clear that those habitats identified as Mesotrophic Grassland (MG6/7) had the most dog fouling, trampling and other disturbance.

Partly due to the design of the study, those habitats which were of more ecological importance generally had less impact from humans and associated animals. But this also reflected the distance away from car parks and footpaths and intentional/accidental impacts.

It was clear that nearer to the car parks were the highest impacts of trampling.

Table 15: Presence of bike tracks, amount of trampling, and presence of litter from different habitats

Broad Habitat	Bike tracks (no of plots)	Trampling				Litter	No of plots
		None	Low	Moderate	Heavy		
Heathland (H9)	None	12	-	1	-	1 (old)	13
Mesotrophic Grassland (MG1)	Yes (1)	1	1	2	-	-	4
Mesotrophic Grassland (MG6/7)	Yes (6)	-	1	6	2	-	9
Open Vegetation (OV25)	No	-	-	-	1	-	1
Acid Grassland (U4)	Yes (1)	1	-	2	2	-	5
Woodland (W10)	No	1	-	1	1	Den built nearby	3
Woodland (W16)	No	2	-	-	-	-	2
Woodland (W25)	No	2	-	-	-	1	2

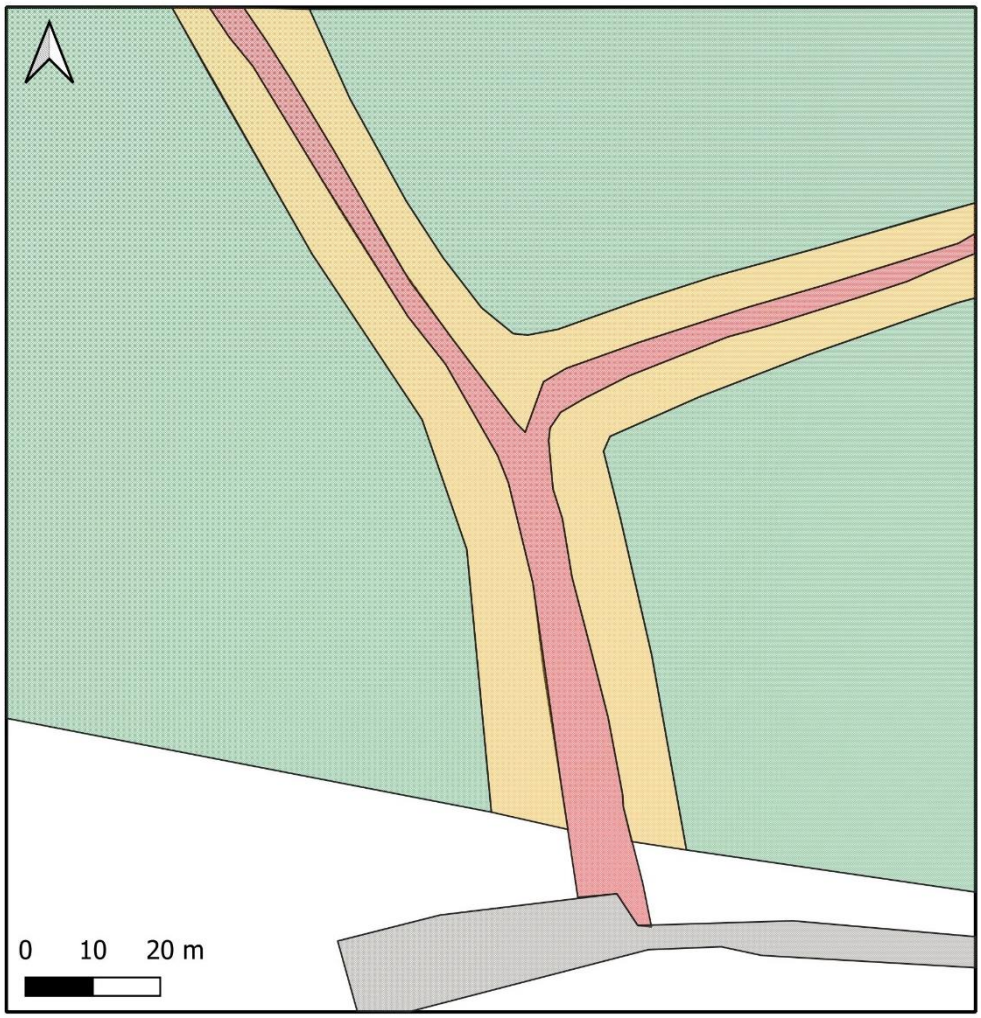

Figure 16: An illustration of typical distribution of dogs fouling across a given area based on the surveyor's experience of walking across these areas during the survey. Red areas are the main tracks/footpath leading from the car park (grey). The white area was not surveyed, but dog fouling was visible in some of these areas.

Traffic light colouring used (red highest amounts of dog fouling seen to green least or no dog fouling present). Typically, along the tracks and near car parks high quantities of dog fouling occurred. Either side of the main paths (yellow) vegetation indicating additional nutrients was visible for between 2-5m. Further away (green) areas of the good quality habitat occurred, but even here scattered dog fouling occurred, either as visible faeces or plants indicative of localised nutrient enrichment in the past (urine/faeces), from free roaming dogs which also impacts ground nesting birds.

The impacts of dog fouling and trampling (human and canine) are drivers for vegetation to change to more mesotrophic grassland (MG6/7), away from better quality habitats typical of Cannock Chase.

Future analysis

It is hoped that the study can be repeated (every 2-5 years) and the data collected can be compared to help show trends in vegetation distribution and occurrences.

The following changes should be detectable with the survey methods detailed above:

- Change in species present within each plot, and within each quadrat within these plots.
- Changes against plots that are near to or include public car parks against those areas which are near to where parking has ceased. It is hoped that if management is correct ruderal habitats will decrease and acid grassland/heathland habitats increase.
- Decline in eutrophic indicator species vis-à-vis increase in lower nutrient status species.
- Decline in disturbance (ruderal) species vis-à-vis increase in species that require undisturbed soils.
- Change in vegetation height.
- Changes in visual amounts of bare soil and trampling area (% of area).
- Changes in human pressures (trampling, fouling, litter, burning).

It may be that future studies identify a reduction in species found especially along edge habitats where trampling (but not eutrophication) has been an issue previously. These edge habitats can be more herb rich and species such as Harebell *Campanula rotundifolia*, Tormentil *Potentilla erecta* and Mouse-ear Hawkweed *Pilosella officinarum* are more apparent than when hidden and in lower cover values under denser heathland. These would apparently indicate a negative change due to lack of trampling, but in fact are more associated with the need to vary the age diversity of the heathland and continue maintaining short acid-grassland, through conservation management rather than pedestrian activity.

Future monitoring

This survey could form the baseline of a future monitoring scheme to assess how the landscape changes with the change of use of these areas. What needs to be considered for an effective monitoring scheme is suitable targets and actions should any of the parameters not be met.

Examples include:

- **Bare ground**
    - Monitor Increase/decrease due to trampling from cyclists/pedestrians.
    - What amount of bare ground is undesirable? (JNCC (2009) recommend not more than 10%).
    - What actions can be put in place to reduce impact? It could be as little as putting up signs, allowing scrub/brash to block/divert paths to more punitive fines or active targeting of locations/individuals.

- **Reduction in dwarf shrub cover.** Target set at between 25-90% cover with European Gorse at < 25%. If the gorse increases, then a management action needs to take place to reduce the amount to a predetermined level. If the cover reduces then suitable management needs to be implemented.

- **Reduction in dog fouling along tracks and adjacent to car park.** Regular checks, with enforcement to ensure collection of dog faeces to reduce further eutrophication. Encourage dog owners to keep dogs on leads to prevent fouling away from tracks (which is less likely to be collected). Addition of signage to explain reasons for keeping dogs on leads (additional to ground nesting birds).

- **Areas of ecological significance.** Reduce the overall nutrient enrichment (dog faeces and urine) by banning access to these areas by dogs. Even responsible dog owners cannot prevent eutrophication from dog urine.

Conclusion

Botanical Survey:
A total of 1006 botanical and bryological records were made for 113 different taxa (90 species of vascular plants, 20 bryophytes and 3 lichens). None of these plants belong on Schedule 8 (protected species) or 9 (invasive non-native species).

Habitats found:
The dominant habitats identified during the current survey belonged to grasslands, heathlands and woodlands. In many cases the sites surveyed showed a neat gradient of habitats from coarse mesotrophic grassland, through acid grassland to heathland. The latter two are of a greater ecological value. An NVC survey identified eight main communities, ranging from three types of mesotrophic grassland (MG1, MG6 and MG7) to acid grassland (U4, U20), lowland heathland (H9) and woodland (W10, W16 and W25).

The most species rich of these habitats was the MG1 mesotrophic grassland, although many of these species were 'weedy'. By contrast acid grassland and heathland had fewer species present but they were of higher ecological value. In contrast was the Bracken underscrub (W25) in which Bracken often formed a monoculture.

National Vegetation Communities
NVC surveys identified ten communities within five broad habitats: heathland (H9), mesotrophic grassland (MG1, MG6 and MG7), open vegetation (OV25), acid grassland (U4, U20), Woodland (W10, W16 and W25).

Ecologically the most important are H9, U4, W10, W16; of lesser importance is MG1. Of very low ecological importance are MG6, MG7 and OV25.

Large stands of good quality heathland (H9) were identified, but when crossed by a track, they are typically bordered by communities indicating some improvement (MG1, OV25). By the car park, and areas with high trampling and dog fouling then MG6 and MG7 grasslands predominate.

Various thoughts have been given on how these communities interact with associated management/nutrients. Key is the amount of nutrients from a mixture of sources which are in places transitioning desirable habitats to less desirable habitats.

Vegetation heights
Unmanaged areas of mesotrophic grassland (MG1) typically were the tallest grassland. Acid grassland had a higher median height (10cm) than either of the mesotrophic grasslands (MG6, MG7 – 6.8cm), but its range was much lower 2-25cm, compared to 0-66cm. Heathland (unless recently managed/cut) had a median of 22cm, although its height could exceed 100cm when flowering stems of Purple Moor-grass skewed the measurements. Vegetation height was also heavily influenced by both the plant communities present and current management/trampling.

Ellenberg Indicator Values
Only minor differences between light and moisture across the plots were identified. Reaction (pH) varied depending on the habitat, in part due to the underlying soils, with heathlands having the lowest EIVs and mesotrophic grasslands highest.

Nutrients were of particular interest, again with a trend of lower EIVs in the heathland compared to mesotrophic grasslands.

CSR Values
A clear distinction between mesotrophic grasslands, acid grasslands and heathlands plots are shown. As expected, more Stress and Competitor tolerant plants were found within the heathland communities, with very low ruderal values (suggesting low disturbance). Mesotrophic grassland was closer to the Ruderal values with less Stress tolerant values. Acid grasslands were intermediate between heathlands and mesotrophic grasslands as expected.

The data collected will be of use when compared to any future surveys.

Disturbance
Dog fouling: The areas with the highest incidence of dog fouling could be found in Mesotrophic grassland (particularly the MG6/7 communities), with heathlands typically lower (fouling absent from 9 of 13 plots). Acid grassland, (which is of a lower sward height and lacking the woody subshrubs) had higher amounts of dog fouling than much of the heathland (3 plots with a low score, 1 each of medium and high scores). Woodlands typically were fairly clear of dog fouling, perhaps as they are further off the main paths. There are additional concerns about ectoparasite treatment and its impact on invertebrate fauna (and potentially other organisms).

Trampling across plots was reviewed, this was similar to the amount of dog fouling with the highest being present in mesotrophic grassland (moderate 6, high 3), one acid grassland plot was also considered highly trampled. Heathlands were mixed, with 10 plots undisturbed (moderate 2, high 1). Woodlands were again relatively undisturbed.

Bike tracks and heavy trampling as expected was more evident nearer to car parks, then the pressures radiated out along footpaths and tracks, generally reducing the further away from car parks (although bottle necks did cause some excessive trampling elsewhere).

Bare ground (sometimes natural, but mostly caused by excessive wear from pedestrians and cyclists), was highest in woodland (likely natural), open vegetation (2% - likely shading from coarse 'weedy' vegetation due to excessive nutrients), heathland (0-50% - but much of this was either natural or caused by recent heather management), mesotrophic grassland (0-25% - typically caused by scuffing – otherwise a naturally tight sward).

Conclusion
It is clear that humans and their dogs are having a negative impact on vegetation at Cannock Chase.

Partly due to the design of the study, those habitats which were of more ecological importance generally had less impacts from humans and associated animals. But this also reflected the distance away from car parks and footpaths and intentional/accidental impacts.

Higher amounts of disturbance from pedestrians and bikes are present near to car parks, spreading out along tracks. Typically, it would seem that humans are mostly remaining on the paths, although some desire lines are present where they cut corners.

It was clear that those habitats identified as Mesotrophic Grassland (MG6/7) had the most dog fouling, trampling and other disturbance.

Of more concern is the presence and proportion of dog faeces (and in turn dog urine), which in some areas, particularly car parks and adjacent areas, can be excessive. Evidence of past faeces/urine actions can be seen in good quality habitats where dogs have been allowed to roam freely (Figure 16). Preventing dogs from roaming freely off leads would assist both with ground nesting birds and in preventing further local eutrophication of heathland.

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Appendices

Appendix 1: Species list from all plots.

Vascular Plants

Scientific Name	**Common Name**
Agrostis capillaris	Common Bent
Agrostis stolonifera	Creeping Bent
Anthoxanthum odoratum	Sweet Vernal-grass
Aphanes arvensis	Parsley-piert
Arrhenatherum elatius	False Oat-grass
Avenella flexuosa (Syn. *Deschampsia flexuosa*)	Wavy Hair-grass
Bellis perennis	Daisy
Betula pendula	Siver Birch
Betula pubescens	Downy Birch
Bromus hordeaceus	Soft-brome
Calluna vulgaris	Heather
Carex hirta	Hairy Sedge
Carex pilulifera	Pill Sedge
Cerastium fontanum	Common Mouse-ear
Chamaenerion angustifolium	Rosebay Willowherb
Cirsium arvense	Creeping Thistle
Cirsium vulgare	Spear Thistle
Crataegus monogyna	Hawthorn
Crepis capillaris	Smooth Hawk's-beard
Cynosurus cristatus	Crested Dog's-tail
Dactylis glomerata	Cock's-foot
Danthonia decumbens	Heath-grass
Digitalis purpurea	Foxglove
Dryopteris dilatata	Broad Buckler-fern
Dryopteris filix-mas	Male-fern
Elymus repens	Common Couch
Empetrum nigrum	Crowberry
Epilobium montanum	Broad-leaved Willowherb
Epilobium parviflorum	Hoary Willowherb
Erica cinerea	Bell Heather
Erica tetralix	Cross-leaved Heath
Fagus sylvatica	Beech
Festuca ovina	Sheep's-fescue
Festuca rubra	Red Fescue
Galium aparine	Cleavers
Galium saxatile	Heath Bedstraw
Geum urbanum	Wood Avens
Hedera helix	Common Ivy
Holcus lanatus	Yorkshire-fog
Holcus mollis	Creeping Soft-grass

Hypochaeris radicata	Cat's-ear
Jacobaea vulgaris (Syn. *Senecio jacobaea*)	Common Ragwort
Juncus bufonius sens. lat.	Toad Rush
Juncus effusus	Soft Rush
Ranunculus sardous	Hairy Buttercup
Juncus tenuis	Slender Rush
Lathyrus pratensis	Meadow Vetchling
Linaria vulgaris	Common Toadflax
Lolium perenne	Perennial Rye-grass
Lotus corniculatus	Common Bird's-foot-trefoil
Luzula campestris	Field Wood-rush
Luzula multiflora	Heath Wood-rush
Matricaria discoidea	Pineappleweed
Molinia caerulea	Purple Moor-grass
Nardus stricta	Mat-grass
Pinus sylvestris	Scots Pine
Plantago coronopus	Buck's-horn Plantain
Plantago lanceolata	Ribwort Plantain
Plantago major	Greater Plantain
Poa annua	Annual Meadow-grass
Poa humilis	Spreading Meadow-grass
Poa pratensis	Smooth-stalked Meadow-grass
Poa trivialis	Rough-stalked Meadow-grass
Polygonum aviculare	Knotgrass
Potentilla erecta	Tormentil
Prunus sp. (seedling)	A cherry/blackthorn
Pteridium aquilinum	Bracken
Quercus robur	Pedunculate Oak
Ranunculus repens	Creeping Buttercup
Rubus fruticosus agg.	a Bramble
Rumex acetosa	Common Sorrel
Rumex acetosella	Sheep's Sorrel
Rumex obtusifolius	Broad-leaved Dock
Sagina procumbens	Procumbent Pearlwort
Scorzoneroides autumnalis (Syn. *Leontodon autumnalis*)	Autumn Hawkbit
Sorbus aucuparia	Rowan
Stellaria graminea	Lesser Stitchwort
Taraxacum officinale agg.	Dandelion
Trifolium dubium	Lesser Trefoil
Trifolium repens	White Clover
Trisetum flavescens	Yellow Oat-grass
Ulex europaeus	Gorse
Urtica dioica	Common Nettle
Vaccinium myrtillus	Bilberry
Vaccinium vitis-idaea	Cowberry
Veronica chamaedrys	Germander Speedwell
Veronica serpyllifolia	Thyme-leaved Speedwell

Vicia cracca	Tufted Vetch
Vicia sepium	Bush Vetch
Vulpia bromoides	Squirrel-tail Fescue

Bryophytes

Atrichum undulatum
Brachythecium albicans
Brachythecium rutabulum
Bryum sp
Calliergonella cuspidata (Syn. *Calliergon cuspidata*)
Campylopus introflexus
Dicranella heteromalla
Dicranum scoparium
Kindbergia praelonga (Syn. *Eurhynchium praelongum*)
Hylocomium splendens
Hypnum cupressiforme sl.
Hypnum jutlandicum
Hypnum sp.
Lophocolea bidentata sl.
Pleurozium schreberi
Polytrichum commune
Polytrichum piliferum
Pseudoscleropodium purum (Syn. *Scleropodium purum*)
Rhytidiadelphus loreus
Rhytidiadelphus squarrosus

Lichens

Cladonia chlorophaea s.l.
Cladonia impexa
Cladonia portentosa

Appendix 2: Quadrat locations, abiotic notes and vegetation heights.

Site Name	Quadrat code	Grid Reference	Grid reference as Feno marker	Vegetation Height						Slope	Aspect	Altitude
				NW	NE	Centre	SW	SE	Mean			
Duffields	1Ai	SK00307 14802	No	5	7	13	6	10	8.2	-	-	167
	1Aii	SK00304 14802	No	8	5	6	7	6	6.4	-	-	167
	1Aiii	SK00312 14807	No	7	6	8	5	8	6.8	-	-	167
	1Aiv	SK00319 14805	No	4	8	4	4	5	5	-	-	167
	1Av	SK00325 14803	No	3	9	6	2	5	5	-	-	167
	1Bi	SK00235 14816	Yes	13	14	12	7	8	10.8	1	45	167
	1Bii	SK00235 14816	No	22	10	8	8	12	12	2	45	167
	1Biii	SK00237 14820	No	25	8	9	19	18	15.8	-	-	167
	1Biv	SK00234 14825	No	17	11	14	15	9	13.2	-	-	167
	1Bv	SK00238 14825	No	13	13	15	10	15	13.2	-	-	167
	1Ci	SK00178 14824	No	17	13	15	21	19	17	4	45	171
	1Cii	SK00186 14824	No	35	23	10	23	23	22.8	3	50	170
	1Ciii	SK00193 14828	No	58	46	36	18	32	38	-	-	169
	1Civ	SK00189 14820	No	33	36	30	49	51	39.8	2	76	170
	1Cv	SK00195 14823	No	12	12	19	30	13	17.2	3	45	169

				Vegetation Height	Slope	Aspect	Altitude

Site Name	Quadrat code	Grid Reference	Grid reference as Feno marker	NW	NE	Centre	SW	SE	Mean			
Flint Fields	2Ai	SJ99818 15656	No	7	6	5	7	9	6.8	-	-	199
	2Aii	SJ99821 15660	No	13	13	12	10	22	14	-	-	199
	2Aiii	SJ99825 15652	No	8	10	13	10	14	11	-	-	199
	2Aiv	SJ99828 15646	No	2	0	3	5	6	3.2	-	-	199
	2Av	SJ99824 15654	No	7	2	7	8	5	5.8	-	-	199
	2Bi	SJ99840 15557	No	2	9	21	8	24	12.8	4	240	194
	2Bii	SJ99840 15555	No	6	20	6	6	5	8.6	4	230	194
	2Biii	SJ99841 15543	No	26	7	10	7	11	12.2	-	-	194
	2Biv	SJ99839 15538	No	6	4	5	4	10	5.8	1	240	193
	2Bv	SJ99835 15535	No	3	5	5	4	12	5.8	4	234	193
	2Ci	SJ99848 15509	Yes	33	47	48	28	46	40.4	10	230	191
	2Cii	SJ99849 15503	No	28	35	26	14	46	29.8	9	290	191
	2Ciii	SJ99856 15492	No	25	19	25	22	>100	22.8	3	270	191
	2Civ	SJ99840 15495	No	19	10	18	16	15	15.6	5	308	190
	2Cv	SJ99842 15502	No	37	35	17	24	17	26	9	226	191

Site Name	Quadrat code	Grid Reference	Grid reference as Feno marker	Vegetation Height						Slope	Aspect	Altitude
				NW	NE	Centre	SW	SE	Mean			
Brindley Bottom	3Ai	SJ99533 15413	No	2	2	7	7	9	5.4	1	0	184
	3Aii	SJ99532 15415	No	4	5	8	4	2	4.6	-	-	184
	3Aiii	SJ99528 15411	No	9	7	7	6	5	6.8	-	-	184
	3Aiv	SJ99527 15417	No	7	4	7	7	9	6.8	-	-	184
	3Av	SJ99518 15419	No	4	6	4	5	4	4.6	-	-	184
	3Bi	SJ99589 15421	No	18	13	9	10	7	11.4	-	-	183
	3Bii	SJ99598 15423	No	15	7	16	7	8	10.6	-	-	183
	3Biii	SJ99599 15421	No	15	15	8	11	11	12	-	-	183
	3Biv	SJ99602 15421	No	10	11	11	14	6	10.4	-	-	183
	3Bv	SJ99605 15419	No	7	11	16	14	13	12.2	-	-	183
	3Ci	SJ 99577 15456	Yes	13	31	20	6	22	18.4	-	-	184
	3Cii	SJ99574 15460	No	7	11	13	40	24	19	-	-	184
	3Ciii	SJ99565 15462	No	66	60	34	23	53	47.2	-	-	184
	3Civ	SJ99584 15454	No	23	18	16	54	10	24.2	-	-	184
	3Cv	SJ99577 15454	No	25	20	9	24	20	19.6	-	-	184

Site Name	Quadrat code	Grid Reference	Grid reference as Feno marker	Vegetation Height						Slope	Aspect	Altitude
				NW	NE	Centre	SW	SE	Mean			
White House	4Ai	SJ99405 16184	Yes	10	25	13	29	13	18	-	-	204
	4Aii	SJ99411 16195	No	7	12	8	10	8	9	-	-	204
	4Aiii	SJ99411 16200	No	8	26	7	10	10	12.2	-	-	204
	4Aiv	SJ99416 16198	No	8	9	7	9	8	8.2	-	-	204
	4Av	SJ99412 16190	No	7	6	6	8	12	7.8	-	-	204
	4Bi	SJ99377 16151	Yes	42	50	6	47	58	40.6	-	-	203
	4Bii	SJ99381 16159	No	11	19	12	20	16	15.6	-	-	203
	4Biii	SJ99384 16153	No	41	41	12	19	7	24	-	-	203
	4Biv	SJ99385 16151	No	12	10	24	7	33	17.2	-	-	203
	4Bv	SJ99389 16148	No	34	17	32	16	19	23.6	-	-	203
	4Ci	SJ99319 16226	No	11	11	32	31	33	23.6	-	-	203
	4Cii	SJ99324 16232	No	20	64	23	26	15	29.6	-	-	203
	4Ciii	SJ99322 16225	No	15	44	34	26	18	27.4	-	-	203
	4Civ	SJ99320 16224	No	16	29	17	13	27	20.4	-	-	203
	4Cv	SJ99312 16228	No	66	63	41	16	37	44.6	-	-	202

Site Name	Quadrat code	Grid Reference	Grid reference as Feno marker	Vegetation Height						Slope	Aspect	Altitude
				NW	NE	Centre	SW	SE	Mean			
Penkridge Bank	5Ai	SK00098 16872	No	4	3	4	4	3	3.6	-	-	206
	5Aii	SK00096 16877	No	5	5	6	3	3	4.4	-	-	205
	5Aiii	SK00089 16872	No	8	3	4	11	4	6	-	-	205
	5Aiv	SK00091 16885	No	5	5	6	5	6	5.4	-	-	205
	5Av	SK00088 16888	No	9	6	9	9	6	7.8	-	-	205
	5Bi	SK00128 16964	No	55	9	41	48	12	33	-	-	204
	5Bii	SK00130 16962	No	3	27	34	33	31	25.6	-	-	204
	5Biii	SK00132 16964	No	18	40	44	13	58	34.6	-	-	204
	5Biv	SK00137 16956	No	23	60	59	33	22	39.4	-	-	204
	5Bv	SK00132 16953	No	21	15	45	40	22	28.6	-	-	204
	5Ci	SK00092 16946	No	17	16	10	26	19	17.6	-	-	204
	5Cii	SK00092 16944	No	23	9	30	28	27	23.4	-	-	204
	5Ciii	SK00090 16957	No	20	25	23	18	19	21	-	-	204
	5Civ	SK00088 16961	No	8	12	11	17	36	16.8	-	-	204
	5Cv	SK00095 16962	No	16	24	24	11	20	19	-	-	204

Site Name	Quadrat code	Grid Reference	Grid reference as Feno marker	Vegetation Height						Slope	Aspect	Altitude
				NW	NE	Centre	SW	SE	Mean			
Aspens	6Ai	SJ98228 15869	No	5	13	9	4	14	9	-	-	221
	6Aii	SJ98223 15871	No	6	13	8	13	16	11.2	-	-	221
	6Aiii	SJ98226 15878	No	10	8	10	5	7	8	-	-	221
	6Aiv	SJ98224 15883	No	9	11	4	4	9	7.4	-	-	221
	6Av	SJ98224 15889	No	6	3	2	4	2	3.4	-	-	221
	6Bi	SJ98213 15942	Yes	19	29	6	19	19	18.4	-	-	221
	6Bii	SJ98214 15949	No	21	15	25	48	22	26.2	-	-	221
	6Biii	SJ98210 15951	No	42	47	32	30	29	36	-	-	222
	6Biv	SJ98206 15956	No	17	25	28	15	14	19.8	-	-	222
	6Bv	SJ98203 15960	No	30	19	46	51	33	35.8	-	-	222
	6Ci	SJ98226 15963	No	21	26	21	40	19	25.4	-	-	221
	6Cii	SJ98223 15968	No	23	45	33	37	25	32.6	-	-	221
	6Ciii	SJ98225 15971	No	24	16	23	23	31	23.4	-	-	221
	6Civ	SJ98231 15969	No	17	17	20	16	24	18.8	-	-	221
	6Cv	SJ98232 15964	No	22	25	12	26	16	20.2	-	-	221

Site Name	Quadrat code	Grid Reference	Grid reference as Feno marker	Vegetation Height						Slope	Aspect	Altitude
				NW	NE	Centre	SW	SE	Mean			
Glacial Boulder	7Ai	SJ98062 18183	No	7	5	9	5	5	6.2	-	-	192
	7Aii	SJ98052 18188	No	2	2	2	3	3	2.4	-	-	192
	7Aiii	SJ98051 18195	No	2	2	2	2	2	2	-	-	192
	7Aiv	SJ98060 18195	No	4	4	4	7	3	4.4	2	40	192
	7Av	SJ98064 18193	No	2	4	2	2	5	3	-	-	192
	7Bi	SJ98081 18174	No	17	13	11	8	30	15.8	-	-	192
	7Bii	SJ98080 18179	No	19	5	>100	12	12	12	-	-	192
	7Biii	SJ98087 18179	No	8	4	22	4	14	10.4	-	-	192
	7Biv	SJ98090 18184	No	10	15	>100	13	9	11.8	-	-	192
	7Bv	SJ98097 18185	No	9	14	53	5	8	17.8	-	-	192
	7Ci	SJ98119 18172	Yes	14	5	15	11	11	11.2	-	-	192
	7Cii	SJ98120 18177	No	19	14	8	7	10	11.6	-	-	192
	7Ciii	SJ98121 18181	No	12	13	13	10	17	13	-	-	192
	7Civ	SJ98127 18181	No	21	13	15	12	12	14.6	-	-	192
	7Cv	SJ98134 18183	No	24	18	20	17	14	18.6	-	-	192

Site Name	Quadrat code	Grid Reference	Grid reference as Feno marker	Vegetation Height						Slope	Aspect	Altitude
				NW	NE	Centre	SW	SE	Mean			
Coppice Hill	8Ai	SJ98035 19058	No	7	3	7	11	9	7.4	-	-	184
	8Aii	SJ98031 19063	No	2	2	6	7	6	4.6	-	-	184
	8Aiii	SJ98025 19072	No	6	4	4	5	4	4.6	-	-	183
	8Aiv	SJ98021 19071	No	6	3	5	6	4	4.8	-	-	183
	8Av	SJ98021 19068	No	7	9	5	4	3	5.6	-	-	183
	8Bi	SJ98090 19020	Yes	11	25	5	4	6	10.2	1	140	183
	8Bii	SJ98090 19025	No	70	44	14	14	61	40.6	1	230	184
	8Biii	SJ98095 19021	No	73	56	38	7	47	44.2	-	-	183
	8Biv	SJ98096 19017	No	8	>100	9	10	>100	9	-	-	183
	8Bv	SJ98093 19018	No	6	35	34	13	11	19.8	-	-	183
	8Ci	SJ98168 19035	No	33	40	40	30	40	36.6	-	-	184
	8Cii	SJ98172 19032	No	34	10	38	42	11	27	-	-	184
	8Ciii	SJ98169 19028	No	41	16	9	38	10	22.8	-	-	184
	8Civ	SJ98166 19029	No	23	33	31	41	28	31.2	-	-	184
	8Cv	SJ98161 19030	No	46	40	52	56	54	49.6	5	180	184

Site Name	Quadrat code	Grid Reference	Grid reference as Feno marker	Vegetation Height						Slope	Aspect	Altitude
				NW	NE	Centre	SW	SE	Mean			
Sister Dora	9Ai	SJ97457 20808	No	14	36	46	5	36	27.4	-	-	108
	9Aii	SJ97453 20806	No	9	8	9	7	9	8.4	1	346	108
	9Aiii	SJ97457 20802	No	9	7	7	9	10	8.4	-	-	108
	9Aiv	SJ97454 20797	No	12	9	19	19	13	14.4	-	-	108
	9Av	SJ97454 20794	No	10	48	16	14	13	20.2	-	-	108
	9Bi	SJ97455 20846	Yes	2	2	2	2	2	2	6	290	107
	9Bii	SJ97449 20853	No	2	2	2	2	2	2	8	294	106
	9Biii	SJ97454 20858	No	2	2	2	2	2	2	3	100	106
	9Biv	SJ97459 20856	No	2	2	2	2	2	2	3	306	107
	9Bv	SJ97461 20848	No	2	2	2	2	2	2	6	294	107
	9Ci	SJ97446 20893	No	7	5	14	8	13	9.4	4	304	102
	9Cii	SJ97447 20889	No	52	25	17	20	10	24.8	4	270	103
	9Ciii	SJ97449 20880	No	19	30	26	36	27	27.6	8	312	104
	9Civ	SJ97447 20877	No	32	28	13	14	22	21.8	-	-	104
	9Cv	SJ97438 20884	No	2	7	18	39	10	15.2	9	270	103

Site Name	Quadrat code	Grid Reference	Grid reference as Feno marker	Vegetation Height						Slope	Aspect	Altitude
				NW	NE	Centre	SW	SE	Mean			
Punch Bowl	10Ai	SJ98339 20649	No	2	5	4	5	45	12.2	10	40	116
	10Aii	SJ98341 20650	No	6	5	8	6	44	13.8	8	40	116
	10Aiii	SJ98342 20650	No	2	2	6	9	19	7.6	10	40	116
	10Aiv	SJ98343 20650	No	3	6	6	4	4	4.6	5	62	116
	10Av	SJ98340 20652	No	16	62	24	17	8	25.4	10	80	116
	10Bi	SJ98295 20630	No	>100	>100	>100	>100	>100	-	6	90	121
	10Bii	SJ98297 20630	No	>100	>100	>100	>100	>100	-	6	90	121
	10Biii	SJ98299 20629	No	>100	>100	>100	>100	>100	-	6	90	121
	10Biv	SJ98302 20629	No	>100	>100	>100	>100	>100	-	6	90	120
	10Bv	SJ98303 20630	No	>100	>100	>100	>100	>100	-	6	90	120
	10Ci	SJ98290 20604	No	>100	>100	>100	>100	>100	-	9	82	122
	10Cii	SJ98290 20605	No	>100	>100	>100	>100	>100	-	9	82	122
	10Ciii	SJ98290 20606	No	>100	>100	>100	>100	>100	-	9	82	122
	10Civ	SJ98292 20606	No	>100	>100	>100	>100	>100	-	9	82	121
	10Cv	SJ98289 20604	No	>100	>100	>100	>100	>100	-	9	82	122

Site Name	Quadrat code	Grid Reference	Grid reference as Feno marker	Vegetation Height						Slope	Aspect	Altitude
				NW	NE	Centre	SW	SE	Mean			
Seven Springs	11Ai	SK00438 20469	Yes	>100	>100	>100	>100	>100	-	1	30	86
	11Aii	SK00451 20479	No	>100	>100	>100	>100	>100	-	1	30	85
	11Aiii	SK00452 20481	No	>100	>100	>100	>100	>100	-	1	30	85
	11Aiv	SK00453 20483	No	>100	>100	>100	>100	>100	-	1	30	85
	11Av	SK00455 20485	No	>100	>100	>100	>100	>100	-	1	30	85
	11Bi	SK00396 20478	No	9	35	7	4	11	13.2	20	100	93
	11Bii	SK00409 20473	No	30	17	65	3	15	26	18	114	88
	11Biii	SK00407 20471	No	4	9	5	11	9	7.6	21	98	88
	11Biv	SK00405 20469	No	4	5	5	4	5	4.6	16	110	89
	11Bv	SK00398 20470	No	6	8	8	4	2	5.6	20	110	91
	11Ci	SK00395 20480	No	>100	>100	>100	>100	>100	-	20	116	93
	11Cii	SK00387 20478	Yes	>100	>100	>100	>100	>100	-	20	116	94
	11Ciii	SK00391 20482	No	35	60	25	54	15	37.8	20	116	95
	11Civ	SK00383 20479	No	>100	>100	>100	>100	>100	-	20	116	96
	11Cv	SK00381 20479	No	>100	>100	>100	>100	>100	-	20	116	97

Site Name	Quadrat code	Grid Reference	Grid reference as Feno marker	Vegetation Height						Slope	Aspect	Altitude
				NW	NE	Centre	SW	SE	Mean			
Chase Road Corner	12Ai	SJ98118 17536	No	4	6	7	3	7	5.4	-	-	188
	12Aii	SJ98115 17535	No	5	3	4	15	3	6	-	-	187
	12Aiii	SJ98111 17538	No	10	9	3	15	4	8.2	-	-	187
	12Aiv	SJ98117 17542	No	4	5	5	3	2	3.8	-	-	187
	12Av	SJ98119 17544	No	3	4	4	2	3	3.2	-	-	187
	12Bi	SJ98117 17510	No	29	40	35	16	26	29.2	-	-	188
	12Bii	SJ98123 17508	No	29	18	29	35	26	27.4	-	-	188
	12Biii	SJ98127 17503	No	10	8	15	19	23	15	-	-	188
	12Biv	SJ98127 17500	No	8	8	18	28	21	16.6	1	20	188
	12Bv	SJ98129 17510	No	30	47	19	12	22	26	-	-	188
	12Ci	SJ98115 17467	No	40	34	38	30	33	35	-	-	190
	12Cii	SJ98115 17463	No	22	29	24	25	30	26	-	-	191
	12Ciii	SJ98112 17459	No	>100	>100	11	29	>100	20	-	-	191
	12Civ	SJ98111 17453	No	23	>100	8	10	50	22.8	-	-	191
	12Cv	SJ98112 17453	No	>100	>100	>100	>100	>100	-	-	-	191

Site Name	Quadrat code	Grid Reference	Grid reference as Feno marker	Vegetation Height						Slope	Aspect	Altitude
				NW	NE	Centre	SW	SE	Mean			
Anson's Bank	13Ai	SJ97978 17198	No	7	12	10	7	9	9	-	-	202
	13Aii	SJ97979 17191	No	15	6	11	7	8	9.4	-	-	203
	13Aiii	SJ97983 17185	No	6	6	6	3	6	5.4	-	-	203
	13Aiv	SJ97984 17171	No	9	9	10	7	20	11	-	-	204
	13Av	SJ97981 17174	No	11	5	11	6	9	8.4	-	-	203
	13Bi	SJ98000 17195	No	6	5	35	5	5	11.2	-	-	203
	13Bii	SJ98002 17201	No	5	18	9	29	9	14	-	-	203
	13Biii	SJ97997 17205	No	20	17	33	24	26	24	-	-	203
	13Biv	SJ97997 17212	No	10	13	26	5	5	11.8	-	-	202
	13Bv	SJ98000 17216	No	8	11	5	6	4	6.8	-	-	202
	13Ci	SJ98011 17196	Yes	35	60	48	28	24	39	-	-	203
	13Cii	SJ98011 17205	No	44	60	59	60	37	52	-	-	202
	13Ciii	SJ98017 17208	No	62	7	11	24	6	22	-	-	202
	13Civ	SJ98020 17211	No	12	48	58	23	15	31.2	-	-	202
	13Cv	SJ98016 17198	No	23	69	55	45	64	51.2	-	-	203

Appendix 3: Human and animal impacts, overall plot disturbance.

	Site Name	Duffields Car Park			Flint Fields			Brindley Bottom			White House		
	Site number	1			2			3			4		
	NVC	MG7	U4	H9	MG7	U4	H9	MG7	U4	H9	MG7	H9	MG1
	Plot number	a	b	c	a	b	c	a	b	c	a	b	c
Human Impacts	Bike tracks	Yes	No	No	Yes	No	No	Yes	No	No	No	No	No
					Along paths								
	Vehicle tracks	-	-	-	-	-	-	-	-	-	-	-	-
	Trampling: None	-	-	Yes	-	Yes	Yes	-	-	Yes	-	Yes	-
	Trampling: Low	-	-	-	-	-	-	-	-	-	-	-	-
	Trampling: Moderate	Yes	Yes	-	Yes	-	-	-	Yes	-	Yes	-	Yes
	Trampling: Heavy	-	-	-	-	-	-	Yes	-	-	-	-	-
	Burning or other damag	-	-	-	-	-	-	-	-	-	Yes	Yes	-
	Human impacts notes	-	-	-	-	-	-	Footfall	-	-	Littering	Old litter	-
Animal impacts	Dog fouling: None	-	-	None	-	-	None	-	-	None	-	None	-
	Dog fouling: Low	-	Yes		-	Yes		-	-	-	-	-	Yes
	Dog fouling: moderate	-	-	-	Yes	-	-	-	-	-	Yes	-	-
	Dog fouling: high	Yes	-	-	-	-	-	Yes	Yes	-	-	-	-
	Livestock present	-	-	-	-	-	-	-	-	-	-	-	-
	Deer grazing signs	Yes	-	Yes	-	Yes	-	-	Yes	-	-	-	-
	Deer dung present	Yes	-	Yes	-	-	Yes	-	Yes	Yes	-	-	Yes
	Animal impact notes	Horse dung	-	-	Mole hills	-	-	-	-	-	-	-	-
Site disturbance	None	-	-	None	-	-	None	-	-	None	-	None	-
	Moderate	Yes	Yes	-	Yes	Yes	-	-	Yes	-	-	-	-
	Heavy	-	-	-	-	-	-	Yes	-	-	Yes	-	-

	Site Name	Penkridge Bank			Aspens			Glacial Boulder			Coppice Hill		
	Site number	5			6			7			8		
	NVC	MG7	H9	MG1	MG7	H9	H9	U4	H9	H9	MG7	H9	H9
	Plot number	a	b	c	a	b	c	a	b	c	a	b	c
Human Impacts	Bike tracks	Yes	No	Yes	Yes	No	No	Yes	No	No	Yes	No	No
		Along paths		On paths									
	Vehicle tracks	-	-	-	-	-	-	-	-	-	-	-	-
	Trampling: None	-	Yes	-	-	Yes	Yes	-	Yes	Yes	-	Yes	Yes
	Trampling: Low	-	-	Yes	Yes	-	-	-	-	-	-	-	-
	Trampling: Moderate	Yes	-	-	-	-	-	-	-	-	-	-	-
	Trampling: Heavy	-	-	-	-	-	-	Yes	-	-	Yes	-	-
	Burning or other damag	-	-	-	Yes	-	-	-	-	-	-	-	-
	Human impacts notes	-	-	-	Litter	-	-	-	-	-	ths and track	-	-
Animal impacts	Dog fouling: None	-	None	-	-	-	None	-	-	None	-	-	None
	Dog fouling: Low	-	-	-	-	-	-	-	Yes	-	-	Yes	-
	Dog fouling: moderate	Yes	-	Yes	-	Yes	-	Yes	-	-	Yes	-	-
	Dog fouling: high	-	-	-	Yes	-	-	-	-	-	-	-	-
	Livestock present	-	-	-	-	-	-	-	-	-	-	-	-
	Deer grazing signs	-	-	-	-	-	-	-	-	-	-	-	-
	Deer dung present	-	Yes	-	Yes	-	-	Yes	-	-	Yes	-	-
	Animal impact notes	-	-	-	-	-	-	-	-	-	-	-	-
Site disturbance	None	-	None	None	-	-	None	-	-	None	-	None	None
	Moderate	Yes	-	-	Yes	Yes	-	-	Yes	-	Yes	-	-
	Heavy	-	-	-	-	-	-	Yes	-	Yes	-	-	-

	Site Name	Sister Dora			Punch Bowl			Seven Springs			Chase Road Corner		
	Site number	9			10			11			12		
	NVC	MG1	W10	H9	MG7	W25	W25	OV25	W10	W10	MG7	MG1	H9
	Plot number	a	b	c	a	b	c	a	b	c	a	b	c
Human Impacts	Bike tracks	No	No	No	No	No	No	No	No	No	No	No	No
	Vehicle tracks	-	-	-	-	-	-	-	-	-	-	-	-
	Trampling: None	-	-	-	-	Yes	Yes	-	-	Yes	-	Yes	Yes
	Trampling: Low	-	-	-	-	-	-	-	-	-	-	-	-
	Trampling: Moderate	Yes	Yes	Yes	Yes	-	-	-	Yes	-	Yes	-	-
	Trampling: Heavy	-	-	-	-	-	-	Yes	Yes	-	-	-	-
	Burning or other damag	-	-	-	-	Yes	-	-	-	-	Yes	-	-
	Human impacts notes	-	en built nearhs trampling		-	Litter	-	-	-	-	Litter	-	-
Animal impacts	Dog fouling: None	-	-	-	-	None	None	-	None	None	-	-	None
	Dog fouling: Low	Yes	Yes	Yes	-	-	-	-	-	-	-	-	-
	Dog fouling: moderate	-	-	-	-	-	-	-	-	-	-	Yes	-
	Dog fouling: high	-	-	-	Yes	-	-	Yes	-	-	Yes	-	-
	Livestock present	-	-	-	-	-	-	-	-	-	-	-	-
	Deer grazing signs	-	-	-	-	-	-	-	-	-	-	-	-
	Deer dung present	Yes	Yes	Yes	-	-	-	-	Yes	Yes	Yes	Yes	Yes
	Animal impact notes	-	-	-	-	-	-	-	-	-	-	-	-
Site disturbance	None	None	None	-	-	-	None	-	-	-	-	None	None
	Moderate	Yes	-	Yes	Yes	Yes	-	-	Yes	-	Yes	-	-
	Heavy	-	-	-	Yes	-	-	Yes	-	-	-	-	-

	Site Name	Anson's Bank		
	Site number	13		
	NVC	U4	W16	W16
	Plot number	a	b	c
Human Impacts	Bike tracks	No	No	No
	Vehicle tracks	Yes	-	-
	Trampling: None	-	Yes	Yes
	Trampling: Low	-	-	-
	Trampling: Moderate	-	-	-
	Trampling: Heavy	Yes	-	-
	Burning or other damag	-	-	-
	Human impacts notes	-	-	-
Animal impacts	Dog fouling: None	-	None	None
	Dog fouling: Low	Yes	-	-
	Dog fouling: moderate	-	-	-
	Dog fouling: high	-	-	-
	Livestock present	-	-	-
	Deer grazing signs	-	-	Yes
	Deer dung present	Yes	Yes	Yes
	Animal impact notes	-	-	-
Site disturbance	None	-	None	None
	Moderate	Yes	-	-
	Heavy	-	-	-

Appendix 4: Constancy tables for each plot (Constant species highlighted in bold).

Site Name	**Duffields**						
Taxon \ quadrat code	1Ai	1Aii	1Aiii	1Aiv	1Av	Frequency	Abundance Range
Agrostis capillaris	8	8	6	8	6	V	6_8
Dactylis glomerata	5	5	5	4	5	V	4_5
Holcus lanatus	3	-	-	-	4	II	3_4
Holcus mollis	4	5	6	5	-	IV	4_6
Lolium perenne	-	4	4	5	6	IV	4_6
Poa trivialis	2	2	-	-	-	II	2_2
Bare ground %	0	0	0	0	0		
Total number of species per quadrat	5	5	4	4	4		

Site Name	**Duffields**						
Taxon/quadrat code	1Bi	1Bii	1Biii	1Biv	1Bv	Frequency	Abundance Range
Agrostis capillaris	8	8	8	8	8	V	8_8
Arrhenatherum elatius	-	4	-	-	-	I	4_4
Brachythecium rutabulum	3	3	-	-	-	II	3_3
Festuca ovina agg.	7	4	6	6	6	V	4_7
Galium saxatile	3	4	4	4	4	V	3_4
Holcus lanatus	3	4	-	-	3	III	3_4
Holcus mollis	6	6	5	5	5	V	5_6
Juncus effusus	-	-	2	-	-	I	2_2
Poa humilis	-	2	-	-	-	I	2_2
Rhytidiadelphus squarrosus	3	3	3	3	3	V	3_3
Vaccinium vitis-idaea	-	2	-	-	-	I	2_2
Bare ground %	0	0	0	0	0		
Total number of species per quadrat	6	9	5	4	5		

Site Name	**Duffields**						
Taxon/quadrat code	1Ci	1Cii	1Ciii	1Civ	1Cv	Frequency	Abundance Range
Agrostis capillaris	4	-	-	-	-	I	4_4
Avenella flexuosa	4	4	-	4	3	IV	3_4
Calluna vulgaris	4	6	8	7	4	V	4_8
Festuca ovina	4	-	-	-	-	I	4_4
Galium saxatile	3	3	-	-	-	II	3_3
Hypnum jutlandicum	-	6	6	7	7	IV	6_7
Molinia caerulea	-	4	9	2	8	IV	2_9
Pleurozium schreberi	3	-	-	-	-	I	3_3
Rhytidiadelphus squarrosus	4	-	-	-	-	I	4_4
Scleropodium purum	-	2	-	-	-	I	2_2
Vaccinium vitis-idaea	10	9	8	9	9	V	8_10
Bare ground %	0	0	0	0	0		
Total number of species per quadrat	8	7	4	5	5		

Site Name	**Flint Fields**						
Taxon/quadrat code	2Ai	2Aii	2Aiii	2Aiv	2Av	Frequency	Abundance Range
Agrostis capillaris	7	5	6	5	5	V	5_7
Cynosurus cristatus	5	-	-	-	-	I	5_5
Dactylis glomerata	4	5	4	-	4	IV	4_5
Festuca rubra agg.	-	5	3	-	-	II	3_5
Holcus lanatus	7	7	9	4	5	V	4_9
Juncus tenuis	-	-	-	-	2	I	2_2
Lolium perenne	4	4	-	9	9	IV	4_9
Lotus corniculatus	3	4	-	-	-	II	3_4
Plantago lanceolata	2	-	-	-	-	I	2_2
Plantago major	-	-	-	2	-	I	2_2
Poa annua	-	-	-	6	5	II	5_6
Polygonum aviculare sl.	-	-	-	3	1	II	1_3
Ranunculus repens	3	-	-	-	-	I	3_3
Rubus fruticosus agg.	-	-	4	-	-	I	4_4
Taraxacum officinale agg.	2	1	-	1	-	III	1_2
Trifolium repens	3	3	-	-	4	III	3_4
Vicia sepium	-	3	2	-	-	II	2_3
Bare ground %	0	3	0	16	4		
Total number of species per quadrat	10	9	6	7	8		

Site Name	Flint Fields						
Taxon/quadrat code	2Bi	2Bii	2Biii	2Biv	2Bv	Frequency	Abundance Range
Agrostis capillaris	3	-	6	-	3	III	3_6
Avenella flexuosa	6	9	5	5	9	V	5_9
Calluna vulgaris	-	-	-	-	4	I	4_4
Carex pilulifera	-	-	-	-	4	I	4_4
Festuca ovina agg.	-	4	6	8	3	IV	3_8
Hypnum jutlandicum	3	6	-	5	5	IV	3_6
Molinia caerulea	4	4	-	-	4	III	4_4
Pteridium aquilinum	4	-	5	4	3	IV	3_5
Quercus robur (g)	-	-	4	-	-	I	4_4
Rhytidiadelphus squarrosus	4	5	6	3	-	IV	3_6
Rubus fruticosus agg.	4	3	-	-	-	II	3_4
Scleropodium purum	5	5	-	-	-	II	5_5
Vaccinium myrtillus	-	-	-	-	-		0_0
Vaccinium vitis-idaea	-	-	-	5	4	II	4_5
Bare ground %	2	4	0	1	1		
Total number of species per quadrat	8	7	6	6	9		

Site Name	Flint Fields						
Taxon/quadrat code	2Ci	2Cii	2Ciii	2Civ	2Cv	Frequency	Abundance Range
Brachythecium albicans	3	-	-	3	-	II	3_3
Avenella flexuosa	3	5	6	6	5	V	3_6
Calluna vulgaris	6	4	5	4	3	V	3_6
Hypnum jutlandicum	6	7	5	5	6	V	5_7
Molinia caerulea	-	4	4	4	3	IV	3_4
Vaccinium myrtillus	9	8	9	4	8	V	4_9
Vaccinium vitis-idaea	4	8	6	9	6	V	4_9
Bare ground %	4	3	4	2	3		
Total number of species per quadrat	6	6	6	7	6		

Site Name	Brindley Bottom						
Taxon/quadrat code	3Ai	3Aii	3Aiii	3Aiv	3Av	Frequency	Abundance Range
Agrostis capillaris	6	5	7	6	4	V	4_7
Dactylis glomerata	-	3	4	4	-	III	3_4
Festuca rubra agg.	-	-	3	4	-	II	3_4
Holcus lanatus	-	-	7	6	6	III	6_7
Lolium perenne	9	10	-	8	9	IV	8_10
Lotus corniculatus	4	-	-	4	-	II	4_4
Plantago lanceolata	-	1	-	2	2	III	1_2
Plantago major	-	2	-	-	-	I	2_2
Poa annua	3	3	-	-	-	II	3_3
Trifolium repens	5	5	3	6	4	V	3_6
Veronica serpyllifolia	1	-	-	-	-	I	1_1
Bare ground %	10	2	0	0	0		
Total number of species per quadrat	6	7	5	8	5		

Site Name	Brindley Bottom						
Taxon/quadrat code	3Bi	3Bii	3Biii	3Biv	3Bv	Frequency	Abundance Range
Agrostis capillaris	6	8	8	7	6	V	6_8
Calluna vulgaris	-	1	-	-	-	I	1_1
Eurhynchium praelongum	3	-	-	-	-	I	3_3
Festuca rubra agg.	6	6	6	6	6	V	6_6
Galium saxatile	3	-	-	-	-	I	3_3
Holcus lanatus	6	5	6	4	6	V	4_6
Hypochaeris radicata	-	-	1	-	-	I	1_1
Juncus effusus	-	-	-	-	2	I	2_2
Nardus stricta	-	4	4	5	-	III	4_5
Pteridium aquilinum	2	-	-	-	-	I	2_2
Rubus fruticosus agg.	1	-	-	-	-	I	1_1
Trifolium dubium	1	-	-	-	-	I	1_1
Bare ground %	0	0	0	0	0		
Total number of species per quadrat	8	5	5	4	4		

Site Name	Brindley Bottom						
Taxon/quadrat code	3Ci	3Cii	3Ciii	3Civ	3Cv	Frequency	Abundance Range
Avenella flexuosa	10	10	4	8	7	V	4_10
Betula pendula (g)	4	-	4	-	-	II	4_4
Calluna vulgaris	4	5	9	5	5	V	4_9
Campylopus introflexus	-	-	-	-	1	I	1_1
Dicranella heteromalla	-	-	-	1	-	I	1_1
Dicranum scoparium	-	-	-	3	-	I	3_3
Hypnum cupressiforme sl.	3	-	-	-	-	I	3_3
Hypnum jutlandicum	6	5	8	4	4	V	4_8
Molinia caerulea	4	4	4	-	4	IV	4_4
Pteridium aquilinum	4	3	4	6	-	IV	3_6
Rubus fruticosus agg.	-	-	-	1	-	I	1_1
Scleropodium purum	3	3	3	3	3	V	3_3
Vaccinium myrtillus	3	2	-	4	3	IV	2_4
Bare ground %	1	0	3	1	2		
Total number of species per quadrat	9	7	7	9	7		

Site Name	White House						
Taxon/quadrat code	4Ai	4Aii	4Aiii	4Aiv	4Av	Frequency	Abundance Range
Agrostis capillaris	5	8	5	5	6	V	5_8
Arrhenatherum elatius	6	-	4	-	-	II	4_6
Cirsium arvense	-	-	1	-	-	I	1_1
Dactylis glomerata	4	4	-	4	4	IV	4_4
Festuca rubra agg.	6	4	-	-	4	III	4_6
Holcus lanatus	-	-	9	9	9	III	9_9
Holcus mollis	-	8	-	-	-	I	8_8
Lolium perenne	-	-	-	4	4	II	4_4
Lotus corniculatus	-	4	-	-	-	I	4_4
Plantago lanceolata	4	4	3	-	3	IV	3_4
Rubus fruticosus agg.	-	-	4	-	-	I	4_4
Trifolium repens	3	3	-	2	3	IV	2_3
Veronica chamaedrys	5	-	-	-	-	I	5_5
Bare ground %	2	0	2	1	1		
Total number of species per quadrat	7	7	6	5	7		

Site Name	**White House**						
Taxon/quadrat code	4Bi	4Bii	4Biii	4Biv	4Bv	Frequency	Abundance Range
Agrostis capillaris	4	-	4	4	4	IV	4_4
Arrhenatherum elatius	-	-	-	4	-	I	4_4
Avenella flexuosa	6	6	7	5	5	V	5_7
Brachythecium albicans	2	2	-	3	2	IV	2_3
Calluna vulgaris	7	6	5	-	5	IV	5_7
Carex pilulifera	-	-	-	-	2	I	2_2
Chamaenerion angustifolium	4	-	-	3	4	III	3_4
Erica cinerea	3	-	-	3	5	III	3_5
Festuca ovina agg.	-	4	4	4	-	III	4_4
Galium saxatile	3	4	5	3	3	V	3_5
Holcus lanatus	4	6	4	5	5	V	4_6
Hypnum jutlandicum	6	5	4	3	5	V	3_6
Pleurozium schreberi	4	3	5	4	5	V	3_5
Rhytidiadelphus squarrosus	-	-	4	1	2	III	1_4
Rubus fruticosus agg.	4	5	5	4	6	V	4_6
Scleropodium purum	-	-	2	-	-	I	2_2
Vaccinium vitis-idaea	5	5	4	3	4	V	3_5
Bare ground %	2	1	1	4	2		
Total number of species per quadrat	12	10	12	14	14		

Site Name	**White House**						
Taxon/quadrat code	4Ci	4Cii	4Ciii	4Civ	4Cv	Frequency	Abundance Range
Agrostis capillaris	6	6	4	5	7	V	4_7
Arrhenatherum elatius	6	8	7	6	8	V	6_8
Cerastium fontanum	-	2	1	-	3	III	1_3
Chamaenerion angustifolium	3	-	-	-	4	II	3_4
Cirsium arvense	-	-	-	4	-	I	4_4
Cynosurus cristatus	-	-	3	-	-	I	3_3
Dactylis glomerata	-	2	3	-	-	II	2_3
Dryopteris filix-mas	-	-	-	-	4	I	4_4
Elytrigia repens	3	-	4	-	-	II	3_4
Festuca rubra agg.	7	5	6	4	6	V	4_7
Holcus lanatus	6	7	5	6	6	V	5_7
Jacobaea vulgaris	-	-	1	-	-	I	1_1
Linaria vulgaris	2	-	3	4	3	IV	2_4
Plantago lanceolata	2	3	3	-	-	III	2_3
Poa pratensis	2	-	3	-	-	II	2_3
Rhytidiadelphus squarrosus	4	-	6	-	-	II	4_6
Rumex acetosa	-	-	-	-	3	I	3_3
Trifolium repens	3	-	3	-	-	II	3_3
Trisetum flavescens	-	-	4	-	-	I	4_4
Vicia cracca	-	4	3	-	-	II	3_4
Bare ground %	3	1	1	4	0		
Total number of species per quadrat	11	8	16	6	9		

Site Name	**Penkridge Bank**						
Taxon/quadrat code	5Ai	5Aii	5Aiii	5Aiv	5Av	Frequency	Abundance Range
Agrostis capillaris	4	5	5	6	6	V	4_6
Anthoxanthum odoratum	4	4	-	-	-	II	4_4
Calliergonella cuspidata	-	2	-	-	-	I	2_2
Cerastium fontanum	-	1	-	-	1	II	1_1
Cynosurus cristatus	6	6	4	6	4	V	4_6
Dactylis glomerata	-	-	3	4	3	III	3_4
Elytrigia repens	-	-	4	-	-	I	4_4
Festuca rubra agg.	4	4	5	5	5	V	4_5
Holcus lanatus	-	2	-	4	4	III	2_4
Jacobaea vulgaris	3	3	2	-	3	IV	2_3
Lathyrus pratensis	-	-	-	-	1	I	1_1
Lolium perenne	5	4	5	5	5	V	4_5
Lotus corniculatus	4	-	-	-	4	II	4_4
Plantago lanceolata	5	5	2	1	-	IV	1_5
Poa annua	-	-	-	1	-	I	1_1
Poa trivialis	2	2	-	-	-	II	2_2
Ranunculus repens	2	2	-	-	-	II	2_2
Rhytidiadelphus squarrosus	3	5	-	3	3	IV	3_5
Rumex acetosa	-	1	-	-	-	I	1_1
Taraxacum officinale agg.	1	-	1	1	-	III	1_1
Trifolium repens	5	5	4	4	5	V	4_5
Urtica dioica	-	-	2	-	-	I	2_2
Veronica chamaedrys	1	-	2	1	-	III	1_2
Veronica serpyllifolia	2	3	-	-	-	II	2_3
Bare ground %	1	2	3	0	3		
Total number of species per quadrat	15	16	12	12	12		

Site Name	**Penkridge Bank**						
Taxon/quadrat code	5Bi	5Bii	5Biii	5Biv	5Bv	Frequency	Abundance Range
Agrostis capillaris	4	4	-	-	4	III	4_4
Avenella flexuosa	5	4	4	3	4	V	3_5
Betula pendula (g)	-	-	1	-	-	I	1_1
Calluna vulgaris	4	6	4	8	4	V	4_8
Crataegus monogyna	4	-	-	-	-	I	4_4
Dicranum scoparium	-	3	-	-	-	I	3_3
Dryopteris dilatata	-	1	-	-	-	I	1_1
Empetrum nigrum	7	9	7	8	6	V	6_9
Erica cinerea	-	3	-	-	-	I	3_3
Erica tetralix	-	2	4	4	4	IV	2_4
Festuca ovina agg.	4	2	-	-	-	II	2_4
Galium saxatile	1	-	-	-	-	I	1_1
Holcus lanatus	-	-	2	-	-	I	2_2
Hypnum jutlandicum	6	6	5	9	8	V	5_9
Molinia caerulea	-	2	7	5	4	IV	2_7
Pleurozium schreberi	3	-	-	-	-	I	3_3
Vaccinium myrtillus	5	5	6	-	6	IV	5_6
Vaccinium vitis-idaea	5	5	6	7	8	V	5_8
Bare ground %	1	0	2	0	2		
Total number of species per quadrat	11	13	10	7	9		

Site Name	**Penkridge Bank**						
Taxon/quadrat code	5Ci	5Cii	5Ciii	5Civ	5Cv	Frequency	Abundance Range
Agrostis capillaris	4	5	5	5	5	V	4_5
Anthoxanthum odoratum	5	6	6	5	5	V	5_6
Arrhenatherum elatius	6	5	7	6	6	V	5_7
Atrichum undulatum	1	-	-	-	-	I	1_1
Avenella flexuosa	-	-	-	1	-	I	1_1
Calliergonella cuspidata	-	-	-	-	1	I	1_1
Cerastium fontanum	-	1	-	-	-	I	1_1
Cirsium arvense	-	-	-	-	1	I	1_1
Crataegus monogyna	-	-	-	-	4	I	4_4
Cynosurus cristatus	4	6	-	-	-	II	4_6
Dactylis glomerata	4	4	-	-	-	II	4_4
Epilobium montanum	-	-	1	-	-	I	1_1
Festuca rubra agg.	4	4	4	6	5	V	4_6
Holcus lanatus	5	4	5	6	4	V	4_6
Jacobaea vulgaris	-	2	1	1	1	IV	1_2
Lathyrus pratensis	3	-	2	1	-	III	1_3
Lotus corniculatus	1	2	-	3	4	IV	1_4
Plantago lanceolata	1	3	-	-	-	II	1_3
Pleurozium schreberi	-	-	3	-	-	I	3_3
Rhytidiadelphus squarrosus	3	4	4	4	4	V	3_4
Rumex acetosa	-	-	1	2	2	III	1_2
Scleropodium purum	-	-	2	-	-	I	2_2
Stellaria graminea	1	-	3	-	-	II	1_3
Trifolium repens	-	4	-	3	2	III	2_4
Trisetum flavescens	3	4	-	-	-	II	3_4
Veronica chamaedrys	4	-	-	-	-	I	4_4
Vicia cracca	1	-	1	-	-	II	1_1
Vicia sepium	-	-	2	1	2	III	1_2
Bare ground %	2	2	2	3	4		
Total number of species per quadrat	16	14	15	13	14		

Site Name	Aspens						
Taxon/quadrat code	6Ai	6Aii	6Aiii	6Aiv	6Av	Frequency	Abundance Range
Agrostis capillaris	5	5	5	6	6	V	5_6
Agrostis stolonifera	-	-	-	-	3	I	3_3
Cynosurus cristatus	4	-	3	-	-	II	3_4
Dactylis glomerata	3	-	-	1	1	III	1_3
Holcus lanatus	4	6	4	-	-	III	4_6
Hypochaeris radicata	1	2	4	2	3	V	1_4
Juncus bufonius sl.	-	-	-	-	4	I	4_4
Juncus tenuis	-	-	-	4	4	II	4_4
Lolium perenne	9	9	9	6	5	V	5_9
Matricaria discoidea	-	-	-	-	1	I	1_1
Plantago lanceolata	3	-	-	-	-	I	3_3
Plantago major	2	-	3	-	3	III	2_3
Poa annua	4	-	-	4	4	III	4_4
Poa pratensis	3	3	4	-	3	IV	3_4
Polygonum aviculare sl.	-	-	-	2	3	II	2_3
Scorzoneroides autumnalis	-	-	-	-	2	I	2_2
Taraxacum officinale agg.	3	-	-	-	1	II	1_3
Trifolium repens	9	9	8	4	4	V	4_9
Bare ground %	1	1	2	15	25		
Total number of species per quadrat	12	6	8	8	15		

Site Name	Aspens						
Taxon/quadrat code	6Bi	6Bii	6Biii	6Biv	6Bv	Frequency	Abundance Range
Avenella flexuosa	4	6	7	5	5	V	4_7
Calluna vulgaris	5	4	4	5	4	V	4_5
Chamaenerion angustifolium	-	2	-	-	-	I	2_2
Dicranum scoparium	1	-	2	-	-	II	1_2
Festuca ovina agg.	6	3	-	-	-	II	3_6
Holcus lanatus	3	2	-	-	-	II	2_3
Hypnum jutlandicum	7	8	7	6	5	V	5_8
Molinia caerulea	8	8	8	8	9	V	8_9
Polytrichum piliferum	1	-	-	-	-	I	1_1
Pseudoscleropodium purum	-	-	3	-	-	I	3_3
Taraxacum officinale agg.	1	-	-	-	-	I	1_1
Vaccinium myrtillus	-	-	-	1	-	I	1_1
Vaccinium vitis-idaea	-	5	5	5	4	IV	4_5
Bare ground %	1	4	4	4	0		
Total number of species per quadrat	9	8	7	6	5		

Site Name	**Aspens**						
Taxon/quadrat code	6Ci	6Cii	6Ciii	6Civ	6Cv	Frequency	Abundance Range
Avenella flexuosa	4	4	2	1	2	V	1_4
Betula pendula (g)	-	-	-	-	1	I	1_1
Betula pubescens (g)	2	-	-	1	-	II	1_2
Calluna vulgaris	9	8	10	10	10	V	8_10
Cladonia impexa	-	-	-	-	2	I	2_2
Dicranella heteromalla	-	-	1	-	-	I	1_1
Dicranum scoparium	1	-	-	-	-	I	1_1
Festuca ovina agg.	-	-	-	-	2	I	2_2
Hypnum jutlandicum	5	6	6	4	6	V	4_6
Molinia caerulea	4	8	3	2	4	V	2_8
Pinus sylvestris	-	-	-	-	1	I	1_1
Vaccinium vitis-idaea	-	3	-	-	-	I	3_3
Bare ground %	10	2	6	6	4		
Total number of species per quadrat	6	4	5	5	8		

Site Name	**Glacial Boulder**						
Taxon/quadrat code	7Ai	7Aii	7Aiii	7Aiv	7Av	Frequency	Abundance Range
Agrostis capillaris	9	5	5	6	7	V	5_9
Arrhenatherum elatius	-	-	-	3	-	I	3_3
Bellis perennis	-	-	1	-	-	I	1_1
Bryum sp.	-	-	-	-	3	I	3_3
Calluna vulgaris	-	3	3	-	3	III	3_3
Chamaenerion angustifolium	-	-	-	-	1	I	1_1
Cynosurus cristatus	-	5	5	3	-	III	3_5
Danthonia decumbens	-	-	3	-	-	I	3_3
Eurhynchium praelongum	-	-	-	2	-	I	2_2
Festuca ovina agg.	4	7	7	4	7	V	4_7
Festuca rubra agg.	6	3	-	5	5	IV	3_6
Holcus lanatus	4	-	-	4	4	III	4_4
Hypnum sp.	-	-	-	-	2	I	2_2
Hypochaeris radicata	3	4	4	3	3	V	3_4
Jacobaea vulgaris	-	-	3	-	-	I	3_3
Juncus bufonius sl.	-	-	-	-	1	I	1_1
Luzula campestris	-	-	1	3	-	II	1_3
Nardus stricta	2	-	-	-	3	II	2_3
Plantago coronopus	-	3	3	-	2	III	2_3
Plantago lanceolata	-	2	1	-	-	II	1_2
Poa pratensis	-	2	3	-	-	II	2_3
Polytrichum piliferum	-	-	-	-	3	I	3_3
Rhytidiadelphus squarrosus	3	-	-	2	2	III	2_3
Rubus fruticosus agg.	-	-	-	-	1	I	1_1
Sagina procumbens	-	1	1	-	-	II	1_1
Scleropodium purum	-	-	-	-	2	I	2_2
Scorzoneroides autumnalis	2	2	3	-	2	IV	2_3
Trifolium repens	-	4	4	-	-	II	4_4
Veronica serpyllifolia	-	1	-	-	-	I	1_1
Vulpia bromoides	2	-	-	-	-	I	2_2
Bare ground %	0	6	2	1	10		
Total number of species per quadrat	9	13	15	10	17		

Site Name	Glacial Boulder						
Taxon/quadrat code	7Bi	7Bii	7Biii	7Biv	7Bv	Frequency	Abundance Range
Agrostis capillaris	-	-	4	3	-	II	3_4
Avenella flexuosa	4	7	5	6	7	V	4_7
Betula pubescens (g)	-	-	-	2	3	II	2_3
Calluna vulgaris	5	4	6	7	7	V	4_7
Carex pilulifera	4	4	2	-	2	IV	2_4
Festuca ovina agg.	4	4	-	3	2	IV	2_4
Holcus lanatus	2	-	-	-	-	I	2_2
Hypnum cupressiforme sl.	6	8	6	9	8	V	6_9
Juncus effusus	-	-	4	-	-	I	4_4
Juncus squarrosus	-	-	3	-	-	I	3_3
Molinia caerulea	4	4	4	4	4	V	4_4
Nardus stricta	4	4	4	4	3	V	3_4
Vaccinium myrtillus	-	-	4	-	6	II	4_6
Vaccinium vitis-idaea	6	7	-	-	-	II	6_7
Bare ground %	2	2	2	2	3		
Total number of species per quadrat	9	8	10	8	9		

Site Name	Glacial Boulder						
Taxon/quadrat code	7Ci	7Cii	7Ciii	7Civ	7Cv	Frequency	Abundance Range
Avenella flexuosa	6	6	7	6	6	V	6_7
Betula pubescens (g)	2	2	-	-	-	II	2_2
Calluna vulgaris	8	9	6	9	6	V	6_9
Carex pilulifera	3	-	-	-	-	I	3_3
Chamaenerion angustifolium	-	-	1	-	-	I	1_1
Cladonia chlorophaea s.l.	1	-	-	-	-	I	1_1
Cladonia impexa	3	-	2	-	-	II	2_3
Dicranum scoparium	2	2	2	1	-	IV	1_2
Eurhynchium praelongum	-	-	-	-	2	I	2_2
Festuca ovina agg.	-	1	-	-	-	I	1_1
Hylocomium splendens	-	-	-	-	3	I	3_3
Hypnum cupressiforme sl.	8	4	9	6	5	V	4_9
Molinia caerulea	3	-	1	4	-	III	1_4
Pteridium aquilinum	-	-	4	4	-	II	4_4
Scleropodium purum	-	-	-	-	2	I	2_2
Vaccinium myrtillus	-	4	8	5	10	IV	4_10
Vaccinium vitis-idaea	4	5	4	6	5	V	4_6
Bare ground %	6	2	0	0	0		
Total number of species per quadrat	10	8	10	8	8		

Site Name	**Coppice Hill**						
Taxon/quadrat code	8Ai	8Aii	8Aiii	8Aiv	8Av	Frequency	Abundance Range
Agrostis capillaris	7	8	7	7	7	V	7_8
Cerastium fontanum	1	-	-	-	-	I	1_1
Crataegus monogyna	1	-	-	-	-	I	1_1
Festuca rubra agg.	4	-	-	-	-	I	4_4
Holcus lanatus	7	8	5	7	7	V	5_8
Lolium perenne	4	7	6	6	2	V	2_7
Plantago major	-	2	-	-	-	I	2_2
Poa annua	-	4	-	4	-	II	4_4
Polygonum aviculare sl.	-	3	-	3	-	II	3_3
Rhytidiadelphus squarrosus	3	-	-	-	3	II	3_3
Rubus fruticosus agg.	4	-	1	-	2	III	1_4
Sagina procumbens	-	1	-	-	-	I	1_1
Trifolium repens	5	4	4	4	-	IV	4_5
Veronica serpyllifolia	-	-	-	1	-	I	1_1
Bare ground %	1	3	1	2	1		
Total number of species per quadrat	9	8	5	7	5		

Site Name	**Coppice Hill**						
Taxon/quadrat code	8Bi	8Bii	8Biii	8Biv	8Bv	Frequency	Abundance Range
Agrostis capillaris	2	-	3	-	-	II	2_3
Avenella flexuosa	4	6	4	-	3	IV	3_6
Betula pubescens (g)	1	-	1	1	-	III	1_1
Brachythecium rutabulum	-	1	-	-	-	I	1_1
Calluna vulgaris	8	4	4	5	6	V	4_8
Carex pilulifera	-	-	-	1	1	II	1_1
Chamaenerion angustifolium	-	-	1	-	-	I	1_1
Dicranella heteromalla	4	3	3	-	2	IV	2_4
Dicranum scoparium	-	-	-	-	-		0_0
Digitalis purpurea	-	1	2	2	4	IV	1_4
Festuca ovina agg.	1	-	4	4	2	IV	1_4
Galium saxatile	-	-	3	4	4	III	3_4
Holcus lanatus	-	-	1	1	1	III	1_1
Hypnum jutlandicum	4	6	-	-	5	III	4_6
Luzula multiflora	-	-	-	1	-	I	1_1
Molinia caerulea	2	-	-	1	2	III	1_2
Pteridium aquilinum	5	7	8	6	7	V	5_8
Rubus fruticosus agg.	1	1	-	1	-	III	1_1
Scleropodium purum	-	2	-	-	-	I	2_2
Sorbus aucuparia (sapling)	-	1	-	-	-	I	1_1
Vaccinium myrtillus	6	8	6	5	6	V	5_8
Vaccinium vitis-idaea	3	3	3	-	3	IV	3_3
Bare ground %	10	2	8	15	12		
Total number of species per quadrat	12	12	13	12	13		

Site Name	**Coppice Hill**						
Taxon/quadrat code	8Ci	8Cii	8Ciii	8Civ	8Cv	Frequency	Abundance Range
Avenella flexuosa	-	3	1	-	5	III	1_5
Calluna vulgaris	10	8	8	10	10	V	8_10
Cladonia impexa	2	3	1	-	-	III	1_3
Cladonia portentosa	-	-	-	1	-	I	1_1
Dicranum scoparium	3	1	-	2	3	IV	1_3
Hypnum jutlandicum	10	6	8	9	9	V	6_10
Vaccinium myrtillus	-	1	4	-	3	III	1_4
Bare ground %	0	50	15	2	0		
Total number of species per quadrat	4	6	5	4	5		

Site Name	**Sister Dora**						
Taxon/quadrat code	9Ai	9Aii	9Aiii	9Aiv	9Av	Frequency	Abundance Range
Agrostis capillaris	5	8	6	7	7	V	5_8
Anthoxanthum odoratum	-	-	5	-	-	I	5_5
Arrhenatherum elatius	-	-	-	5	4	II	4_5
Brachythecium rutabulum	-	-	-	2	-	I	2_2
Bromus hordeaceus	-	-	-	3	3	II	3_3
Carex hirta	-	4	-	3	-	II	3_4
Cerastium fontanum	3	-	3	2	4	IV	2_4
Crepis capillaris	2	-	-	1	-	II	1_2
Dactylis glomerata	-	-	-	-	3	I	3_3
Epilobium parviflorum	1	-	-	-	-	I	1_1
Festuca ovina agg.	4	5	6	3	4	V	3_6
Festuca rubra agg.	-	-	-	4	-	I	4_4
Holcus lanatus	7	8	5	6	8	V	5_8
Jacobaea vulgaris	4	2	4	4	4	V	2_4
Lolium perenne	3	-	-	-	-	I	3_3
Luzula campestris	1	-	-	-	-	I	1_1
Plantago lanceolata	4	-	3	-	2	III	2_4
Rumex acetosella	-	-	3	1	3	III	1_3
Taraxacum officinale agg.	-	-	-	1	-	I	1_1
Trifolium repens	4	3	4	-	-	III	3_4
Vulpia bromoides	2	-	-	-	-	I	2_2
Bare ground %	3	2	3	2	4		
Total number of species per quadrat	12	6	9	13	10		

Site Name	Sister Dora						
Taxon/quadrat code	9Bi	9Bii	9Biii	9Biv	9Bv	Frequency	Abundance Range
Agrostis capillaris	5	6	6	6	6	V	5_6
Brachythecium rutabulum	-	3	1	-	-	II	1_3
Dactylis glomerata	-	-	-	-	2	I	2_2
Galium saxatile	3	-	1	-	-	II	1_3
Quercus robur	10	10	10	10	10	IV	10
Rhytidiadelphus squarrosus	3	4	4	3	3	V	3_4
Rubus fruticosus agg.	-	-	-	-	1	I	1_1
Bare ground %	75	75	80	60	40		
Total number of species per quadrat	4	4	5	3	5		

Site Name	Sister Dora						
Taxon/quadrat code	9Ci	9Cii	9Ciii	9Civ	9Cv	Frequency	Abundance Range
Agrostis capillaris	5	-	4	3	5	IV	3_5
Aphanes arvensis	-	-	-	-	1	I	1_1
Arrhenatherum elatius	-	-	4	3	4	III	3_4
Avenella flexuosa	4	3	3	5	3	V	3_5
Brachythecium rutabulum	-	3	3	3	1	IV	1_3
Calluna vulgaris	5	10	10	8	5	V	5_10
Dryopteris dilatata	-	-	1	1	4	III	1_4
Dryopteris filix-mas	-	2	1	-	-	II	1_2
Eurhynchium praelongum	-	-	3	-	-	I	3_3
Festuca ovina agg.	6	-	-	-	-	I	6_6
Galium saxatile	-	1	-	-	-	I	1_1
Holcus lanatus	3	3	4	3	6	V	3_6
Hypnum cupressiforme sl.	3	-	-	-	-	I	3_3
Hypnum jutlandicum	-	4	4	4	4	IV	4_4
Lophocolea bidentata sl.	-	1	2	-	1	III	1_2
Nardus stricta	4	-	-	-	-	I	4_4
Polytrichum commune	3	-	-	-	-	I	3_3
Quercus robur (g)	-	2	-	-	2	II	2_2
Rhytidiadelphus squarrosus	5	-	3	4	3	IV	3_5
Rubus fruticosus agg.	-	-	-	-	6	I	6_6
Vaccinium myrtillus	-	-	-	5	-	I	5_5
Bare ground %	1	2	2	2	4		
Total number of species per quadrat	9	9	12	10	13		

Site Name	Punch Bowl						
Taxon/quadrat code	10Ai	10Aii	10Aiii	10Aiv	10Av	Frequency	Abundance Range
Agrostis capillaris	-	6	8	-	-	II	6_8
Dactylis glomerata	3	-	-	2	4	III	2_4
Holcus lanatus	8	8	6	4	7	V	4_8
Lolium perenne	6	6	6	8	6	V	6_8
Plantago major	-	-	3	-	-	I	3_3
Poa annua	4	4	4	2	-	IV	2_4
Poa trivialis	-	-	3	-	3	II	3_3
Polygonum aviculare sl.	-	2	3	2	3	IV	2_3
Pteridium aquilinum	5	4	-	-	7	III	4_7
Rubus fruticosus agg.	-	-	5	-	-	I	5_5
Trifolium repens	3	2	-	4	-	III	2_4
Urtica dioica	-	3	-	1	-	II	1_3
Bare ground %	3	3	10	3	0		
Total number of species per quadrat	6	8	8	7	6		

Site Name	Punch Bowl						
Taxon/quadrat code	10Bi	10Bii	10Biii	10Biv	10Bv	Frequency	Abundance Range
Rubus fruticosus agg.	4	4	3	-	-	III	3_4
Pteridium aquilinum	10	10	10	10	10	V	10_10
Bare ground %	90	90	90	90	90		
Total number of species per quadrat	2	2	2	1	1		

Site Name	Punch Bowl						
Taxon/quadrat code	10Ci	10Cii	10Ciii	10Civ	10Cv	Frequency	Abundance Range
Brachythecium rutabulum	3	3	-	-	-	II	3_3
Pteridium aquilinum	10	10	10	10	10	V	10_10
Rubus fruticosus agg.	4	4	3	4	4	V	3_4
Bare ground %	90	90	90	90	90		
Total number of species per quadrat	1	1	1	1	1		

Site Name	Seven Springs						
Taxon/quadrat code	11Ai	11Aii	11Aiii	11Aiv	11Av	Frequency	Abundance Range
Arrhenatherum elatius	6	4	4	5	5	V	4_6
Brachythecium rutabulum	-	3	3	-	-	II	3_3
Cirsium arvense	2	-	-	-	-	I	2_2
Cirsium vulgare	-	1	2	-	-	II	1_2
Dactylis glomerata	3	-	-	-	-	I	3_3
Dryopteris filix-mas	-	1	-	-	-	I	1_1
Festuca rubra agg.	-	-	-	-	3	I	3_3
Galium aparine	-	-	1	-	-	I	1_1
Geum urbanum	-	-	-	-	4	I	4_4
Holcus lanatus	8	8	8	8	8	V	8_8
Quercus robur (g)	-	-	-	1	-	I	1_1
Rubus fruticosus agg.	4	-	4	6	-	III	4_6
Rumex obtusifolius	-	-	1	-	-	I	1_1
Urtica dioica	9	9	10	9	10	V	9_10
Veronica serpyllifolia	-	2	-	-	-	I	2_2
Bare ground %	0	2	3	2	10		
Total number of species per quadrat	6	7	8	5	5		

Site Name	Seven Springs						
Taxon/quadrat code	11Bi	11Bii	11Biii	11Biv	11Bv	Frequency	Abundance Range
Brachythecium albicans	-	-	-	3	-	I	3_3
Hypnum jutlandicum	-	-	-	3	-	I	3_3
Brachythecium rutabulum	4	4	-	4	3	IV	3_4
Dicranella heteromalla	-	-	-	3	-	I	3_3
Fagus sylvatica (g)	1	-	1	-	-	II	1_1
Hedera helix	-	-	2	3	-	II	2_3
Holcus mollis	8	9	10	9	10	V	8_10
Pteridium aquilinum	6	7	5	4	-	IV	4_7
Rubus fruticosus agg.	8	6	6	5	6	V	5_8
Urtica dioica	-	-	1	-	-	I	1_1
Bare ground %	4	4	3	20	1		
Total number of species per quadrat	5	4	6	8	3		

Site Name	Seven Springs						
Taxon/quadrat code	11Ci	11Cii	11Ciii	11Civ	11Cv	Frequency	Abundance Range
Avenella flexuosa	-	3	-	-	-	I	3_3
Brachythecium rutabulum	3	3	3	-	4	IV	3_4
Dicranella heteromalla	-	3	-	-	-	I	3_3
Holcus mollis	3	-	-	-	-	I	3_3
Pteridium aquilinum	10	10	6	10	10	V	6_10
Rubus fruticosus agg.	6	7	8	9	9	V	6_9
Bare ground %	4	10	10	10	10		
Total number of species per quadrat	4	5	3	2	3		

Site Name	Chase Road Corner						
Taxon/quadrat code	12Ai	12Aii	12Aiii	12Aiv	12Av	Frequency	Abundance Range
Agrostis capillaris	6	6	6	6	6	V	6_6
Holcus lanatus	4	4	4	-	2	IV	2_4
Jacobaea vulgaris	2	3	4	2	-	IV	2_4
Lolium perenne	10	10	10	9	10	V	9_10
Plantago lanceolata	2	2	-	3	3	IV	2_3
Plantago major	3	2	-	4	3	IV	2_4
Poa annua	-	3	-	3	3	III	3_3
Polygonum aviculare sl.	1	-	-	2	-	II	1_2
Ranunculus repens	-	-	4	3	-	II	3_4
Trifolium repens	9	9	9	9	9	V	9_9
Bare ground %	1	2	1	5	2		
Total number of species per quadrat	8	8	6	9	7		

Site Name	**Chase Road Corner**						
Taxon/quadrat code	12Bi	12Bii	12Biii	12Biv	12Bv	Frequency	Abundance Range
Agrostis capillaris	5	9	10	9	7	V	5_10
Arrhenatherum elatius	5	6	6	6	5	V	5_6
Avenella flexuosa	2	2	-	-	3	III	2_3
Brachythecium rutabulum	3	3	3	-	-	III	3_3
Chamaenerion angustifolium	2	-	-	-	-	I	2_2
Cirsium vulgare	-	-	-	-	2	I	2_2
Dactylis glomerata	3	1	-	-	-	II	1_3
Digitalis purpurea	-	3	-	-	-	I	3_3
Eurhynchium praelongum	-	-	-	-	3	I	3_3
Festuca ovina agg.	4	-	-	-	4	II	4_4
Festuca rubra agg.	-	-	4	4	-	II	4_4
Holcus lanatus	4	5	4	6	4	V	4_6
Jacobaea vulgaris	-	-	-	-	1	I	1_1
Molinia caerulea	4	4	-	-	-	II	4_4
Nardus stricta	-	-	-	-	4	I	4_4
Poa pratensis	-	-	-	-	2	I	2_2
Poa trivialis	-	2	3	-	-	II	2_3
Potentilla erecta	2	1	-	-	-	II	1_2
Rhytidiadelphus squarrosus	-	2	-	-	3	II	2_3
Rubus fruticosus agg.	7	4	-	-	4	III	4_7
Scleropodium purum	-	-	-	-	3	I	3_3
Trifolium repens	-	-	3	4	-	II	3_4
Vaccinium myrtillus	-	-	-	-	4	I	4_4
Vaccinium vitis-idaea	-	-	-	-	3	I	3_3
Bare ground %	0	3	0	0	0		
Total number of species per quadrat	11	12	7	5	15		

Site Name	**Chase Road Corner**						
Taxon/quadrat code	12Ci	12Cii	12Ciii	12Civ	12Cv	Frequency	Abundance Range
Avenella flexuosa	4	4	5	4	4	V	4_5
Betula pendula (g)	-	-	-	4	-	I	4_4
Brachythecium rutabulum	3	-	-	3	-	II	3_3
Calluna vulgaris	4	4	-	5	4	IV	4_5
Eurhynchium praelongum	3	-	-	3	3	III	3_3
Festuca ovina agg.	-	-	6	-	-	I	6_6
Galium saxatile	2	-	3	3	5	IV	2_5
Hypnum cupressiforme sl.	2	6	4	4	3	V	2_6
Hypnum jutlandicum	-	-	-	-	3	I	3_3
Molinia caerulea	9	4	6	5	8	V	4_9
Rhytidiadelphus squarrosus	2	-	2	-	-	II	2_2
Rubus fruticosus agg.	2	4	-	-	3	III	2_4
Vaccinium myrtillus	5	4	2	-	-	III	2_5
Vaccinium vitis-idaea	5	9	8	9	6	V	5_9
Bare ground %	2	0	0	0	0		
Total number of species per quadrat	11	7	8	9	9		

Site Name	**Anson's Bank**						
Taxon/quadrat code	13Ai	13Aii	13Aiii	13Aiv	13Av	Frequency	Abundance Range
Agrostis capillaris	8	8	10	9	10	V	8_10
Anthoxanthum odoratum	-	-	-	-	4	I	4_4
Cirsium arvense	-	-	1	-	-	I	1_1
Festuca rubra agg.	4	4	3	5	4	V	3_5
Galium saxatile	3	4	-	-	-	II	3_4
Holcus lanatus	6	4	2	4	-	IV	2_6
Juncus effusus	-	1	-	2	-	II	1_2
Luzula campestris	4	4	2	3	3	V	2_4
Molinia caerulea	-	5	-	-	-	I	5_5
Nardus stricta	-	-	4	-	3	II	3_4
Poa annua	-	-	2	-	-	I	2_2
Poa trivialis	-	-	-	-	2	I	2_2
Potentilla erecta	4	5	3	4	4	V	3_5
Rhytidiadelphus squarrosus	6	5	2	5	-	IV	2_6
Trifolium repens	4	-	4	4	4	IV	4_4
Vaccinium myrtillus	-	4	-	-	-	I	4_4
Bare ground %	1	4	0	0	1		
Total number of species per quadrat	8	10	10	8	8		

Site Name	Anson's Bank						
Taxon/quadrat code	13Bi	13Bii	13Biii	13Biv	13Bv	Frequency	Abundance Range
Agrostis capillaris	6	9	7	6	7	V	6_9
Avenella flexuosa	6	4	-	5	5	IV	4_6
Betula pubescens (g)	-	-	-	1	-	I	1_1
Betula pubescens	10	10	10	10	10	V	10_10
Crataegus monogyna	-	1	-	-	-	I	1_1
Dactylis glomerata	1	-	-	-	-	I	1_1
Fagus sylvatica (g)	1	-	-	-	-	I	1_1
Galium saxatile	-	-	1	3	-	II	1_3
Holcus lanatus	-	-	4	4	4	III	4_4
Holcus mollis	6	4	5	6	6	V	4_6
Quercus robur (sapling)	-	-	-	2	1	II	1_2
Quercus seedling/sp	1	2	1			III	1_2
Rhytidiadelphus squarrosus	6	5	6	7	6	V	5_7
Rubus fruticosus agg.	5	5	9	6	6	V	5_9
Sorbus aucuparia (g)	1	-	-	-	-	I	1_1
Ulex europaeus	2	-	-	1	-	II	1_2
Bare ground %	0	0	0	0	0		
Total number of species per quadrat	11	8	8	11	8		

Site Name	Anson's Bank						
Taxon/quadrat code	13Ci	13Cii	13Ciii	13Civ	13Cv	Frequency	Abundance Range
Agrostis capillaris	5	4	5	-	4	IV	4_5
Avenella flexuosa	6	4	5	6	5	V	4_6
Brachythecium rutabulum	3	6	6	5	5	V	3_6
Dryopteris dilatata	-	3	-	4	-	II	3_4
Eurhynchium praelongum	4	-	-	3	-	II	3_4
Galium saxatile	3	-	-	-	-	I	3_3
Holcus lanatus	4	2	5	5	5	V	2_5
Holcus mollis	-	-	-	5	-	I	5_5
Hypnum cupressiforme sl.	4	-	-	-	-	I	4_4
Prunus sp (seedling)	1	-	-	-	-	I	1_1
Quercus seedling/sp	1	-	-	-	-	I	1_1
Rhytidiadelphus loreus	2	-	-	-	-	I	2_2
Rubus fruticosus agg.	10	10	8	9	10	V	8_10
Sorbus aucuparia (sapling)	-	1	-	-	-	I	1_1
Ulex europaeus	-	-	4	-	-	I	4_4
Bare ground %	0	0	2	2	0		
Total number of species per quadrat	11	7	6	7	5		

Appendix 5: Results from MAVIS analysis of NVC data (Communities considered correct highlighted in bold).

Duffields

1A	
Community	**Co-efficient**
MG7d	**43.48**
MG7b	**42.98**
MG7a	**41.84**
MG7	**41.79**
MG7e	**39.22**
MG9b	35.18
MG6c	34.86
MG7c	**32.94**
MG7f	**32.58**
OV23b	32.48

1B	
Community	**Co-efficient**
U20a	41.67
U1e	39.75
U20	36.44
W23	36.36
U4e	**36.23**
U6d	36.17
U5d	35.16
OV27a	34.95
W23b	34.84
SD12b	34.67

1C	
Community	**Co-efficient**
H9e	**50.98**
H12a	50.85
H2a	45.45
H12	45.24
H2	44.71
U2	43.73
H12b	42.52
H2c	42.33
H8e	41.56
H9d	**41.34**

Flint Fields

2A	
Community	**Co-efficient**
MG7	**55.68**
MG7E	**54.58**
MG7A	**53.15**
MG7F	**52.05**
MG11a	51.45
MG7B	**50.85**
MG7D	**50.26**
MG6a	48.74
OV23c	47.90
MG6	45.65

2B	
Community	**Co-efficient**
U2a	44.50
H8e	42.28
W16	42.01
U20b	41.79
W16a	40.28
U20	40.08
H2b	39.86
U20c	39.16
U5a	39.01
H12a	38.46

2C	
Community	**Co-efficient**
H9e	**50.93**
H2b	50.31
H12a	49.35
H2	43.72
H12	41.67
H12b	41.59
U2b	39.51
H2a	38.40
H9a	**38.18**
W18b	38.11

Brindley Bottom

3A	
Community	**Co-efficient**
MG7	**52.63**
MG7B	**52.13**
MG7A	**52.03**
MG7E	**51.84**
MG7F	**51.17**
MG11a	50.97
OV23c	49.27
MG6	48.54
MG6c	48.22
MG6a	47.62

3B	
Community	**Co-efficient**
OV27	47.02
OV27a	42.17
W23a	38.68
W23b	37.95
W23	37.50
MC9e	35.90
SD6e	35.43
U1f	33.59
MC8d	32.79
MC9a	32.79

3C	
Community	**Co-efficient**
H2b	57.21
H2	51.79
H12a	49.95
W16	46.87
H9e	**45.52**
W16a	45.30
H9a	**45.27**
U2	43.11
H2a	42.84
H8e	41.37

White House

4A	
Community/Co-efficient	
MG11a	47.90
MG7E	**47.72**
MG6c	47.30
MG7	**46.45**
MG1a	46.22
MG9b	46.17
MG6	45.71
MG6a	44.75
MG6b	43.88
MG9	43.87

4B	
Community/Co-efficient	
OV27a	45.07
H12a	44.78
H12c	44.69
H8e	44.08
H12	43.03
U2a	42.70
U20b	42.04
U5a	41.49
U5d	41.36
H16a	39.60

4C	
Community/Co-efficient	
MG1a	**50.55**
MG6b	48.00
MG9b	46.87
MG6	46.77
MG1b	**46.73**
SD9a	46.39
MG1	**45.59**
MG12a	45.57
SD9	45.53
MG6a	44.01

Penkridge Bank

5A	
Community/Co-efficient	
MG6	**63.51**
MG6a	**63.08**
MG6b	**62.22**
MG6c	**58.99**
MG7	57.82
MG7D	56.77
MG7E	55.60
MG11a	52.85
MG5a	52.34
MG7C	52.32

5B	
Community/Co-efficient	
H12a	51.09
H8e	46.86
H12	46.44
H2b	45.17
H4	45.14
M15d	44.15
H12b	44.12
H2	43.48
U2	43.20
H12c	41.64

5C	
Community/Co-efficient	
MG1e	**50.97**
U4b	49.79
MG6b	48.06
MG5a	47.00
MG5	46.90
MC9e	46.67
MG5b	45.28
MG1	**44.28**
MG5c	44.22
MG1c	**44.01**

Aspens

6A	
Community/Co-efficient	
OV23c	55.31
MG7F	**52.82**
OV21	52.58
OV21b	51.81
MG6	50.87
MG6c	50.59
MG6b	50.58
MG7	**50.24**
MG6a	50.16
MG11a	50.05

6B	
Community/Co-efficient	
H9e	**51.70**
H2	48.72
H2b	47.45
H2a	46.90
H12a	46.72
U2	43.26
H12	41.99
H9a	**41.67**
H9	**40.71**
H12b	39.93

6C	
Community/Co-efficient	
H9e	**56.24**
H2	48.71
H2a	47.41
H2b	47.38
H12a	45.24
H2c	42.14
H9a	**38.81**
M16a	38.23
H9	**37.85**
H9d	35.35

Glacial Boulder

7A	
Community/Co-efficient	
MG6b	43.31
U4	**41.80**
U4b	**41.33**
U4a	**41.17**
H7e	40.85
SD12a	40.79
SD12	40.43
U1f	39.90
MG6	39.55
U1b	39.34

7B	
Community/Co-efficient	
H9a	**50.12**
U5a	47.62
H8e	46.74
U2	46.46
U5d	45.65
H1d	44.85
H9e	**44.51**
H10	43.62
H10a	43.40
U5e	42.98

7C	
Community/Co-efficient	
H9a	**63.29**
H12a	56.74
H1	50.44
H2b	50.38
H8e	49.70
H2	48.89
W18d	47.18
H9	**47.09**
H12	46.77
U2	46.73

Coppice Hill

8A	
Community/Co-efficient	
MG7B	**42.46**
MG7A	**41.48**
MG6b	40.82
MG11a	40.72
MG7E	**40.57**
MG7	**39.63**
OV23c	39.13
MG6a	39.00
MG6	38.22
MG7F	**37.54**

8B	
Community/Co-efficient	
H8e	49.34
U20c	45.45
H12a	44.44
U20	43.41
U20b	43.25
W16a	43.14
H2b	43.09
H12c	42.74
H12	41.12
U2	40.93

8C	
Community/Co-efficient	
H12a	59.22
H9a	**48.11**
H2	46.08
H12	45.77
H2b	44.82
H2a	43.62
H12b	43.60
H9c	**41.98**
H1	41.67
H9	**40.68**

Sister Dora

9A	
Community/Co-efficient	
U1b	48.92
U1e	46.07
SD10b	45.40
U1	44.85
MG6b	**44.77**
U1d	43.58
W23b	43.51
MG6	42.59
OV23d	42.26
CG4c	40.58

9B	
Community/Co-efficient	
W23	25.28
U1e	24.83
W23b	24.80
W23a	24.77
U6d	23.39
W10d	**23.22**
U16c	22.64
U20a	20.49
U4a	20.29
U4e	20.06

9C	
Community/Co-efficient	
U16c	39.43
H12a	37.63
U2	36.55
W16	35.71
U20b	34.31
H8e	34.30
W16a	34.25
W17d	32.97
U20	32.34
W16b	31.61

Punch Bowl

10A	
Community/Co-efficient	
MG7A	**48.05**
MG7	**47.11**
OV21	45.98
OV23c	45.74
MG7B	**45.15**
MG11a	44.79
MG7E	**44.62**
OV10	42.94
OV21c	42.42
MG7D	**41.53**

10B	
Community/Co-efficient	
U20c	24.45
W25b	**22.08**
W25	**19.23**
W10d	19.12
W15d	16.10
W16a	15.38
W25a	**15.17**
W16	15.01
W23c	14.35
H2b	14.16

10C	
Community/Co-efficient	
W25b	**35.79**
W25	**34.54**
W10d	34.36
W23c	34.19
W22a	28.48
W25a	**28.21**
W10c	27.62
OV27c	26.82
W22	25.69
OV27	24.39

Seven Springs

11A	
Community/Co-efficient	
SD18b	44.56
MG1b	44.06
OV27	43.55
OV27b	42.70
S26b	37.20
W24	36.36
OV24	35.57
OV24a	34.92
OV25b	**34.36**
MG1c	34.19

11B	
Community/Co-efficient	
W16a	35.22
W10d	**32.22**
W16	32.18
W10a	**28.90**
W10c	**27.66**
W14	27.48
W10	**27.13**
W10b	**25.05**
W22	24.83
W22a	24.63

11C	
Community/Co-efficient	
W10d	**44.84**
W25b	34.97
W10c	**34.53**
W25	34.43
W16a	33.95
W16	33.28
W10a	**33.00**
W14	31.48
W10	**31.01**
W23c	30.30

Chase Road Corner

12A	
Community/Co-efficient	
OV23c	52.85
MG7E	**50.68**
OV21	49.69
OV21b	46.91
MG7B	**44.92**
MG7F	**44.04**
OV23	43.31
MG11a	43.29
OV21c	43.10
MG7A	**42.49**

12B	
Community/Co-efficient	
OV27	49.53
MG1a	**47.04**
W23	46.04
OV27b	45.05
W23b	43.99
MG1b	**43.85**
MG1	**43.61**
W23a	43.59
MG9b	43.52
MG1c	**43.23**

12C	
Community/Co-efficient	
U2	46.78
H8e	45.41
H9e	**44.18**
H9a	**44.10**
U2b	43.57
H9d	**43.09**
U16c	40.16
U2a	39.43
H2b	38.03
H9	**37.64**

Anson's Bank

13A	
Community/Co-efficient	
U4a	**49.30**
U4b	**48.40**
U4	**47.58**
U20a	44.19
U4e	**43.76**
U4d	**41.67**
MC9e	41.49
MG6b	39.85
W23a	38.57
U20	38.43

13B	
Community/Co-efficient	
W23a	40.44
W23	40.00
W16a	**39.05**
W23b	38.32
W16	**36.02**
U1e	33.93
W4	33.72
W16b	**32.73**
W10d	31.81
W17c	31.31

13C	
Community/Co-efficient	
W16	**44.03**
OV27	42.81
W10d	42.20
W16a	**40.43**
OV27c	40.11
W23a	38.42
W25b	37.94
W16b	**37.62**
W23	37.36
W23b	35.79

Appendix 6a: Ellenberg Indicator Values for all plots/quadrats.

Duffields

	L	F	R	N
1Ai	6.5	5.4	5.0	4.6
1Aii	6.6	5.3	4.9	4.7
1Aiii	6.6	5.3	4.8	4.6
1Aiv	6.6	5.2	4.8	4.6
1Av	7.0	5.2	5.7	5.2
Mean	**6.5**	**5.4**	**5.0**	**4.6**

	L	F	R	N
1Bi	6.4	5.4	3.9	3.3
1Bii	6.5	5.5	4.3	3.8
1Biii	6.3	5.5	3.6	3.2
1Biv	6.3	5.4	3.6	3.1
1Bv	6.3	5.5	3.9	3.3
Mean	**6.4**	**5.4**	**3.9**	**3.3**

	L	F	R	N
1Ci	6.3	5.2	2.7	2.5
1Cii	6.4	5.8	2.3	2.3
1Ciii	6.7	6.4	2.4	2
1Civ	6.4	5.6	2.1	2.2
1Cv	6.5	6.2	2.3	2.1
Mean	**6.3**	**5.2**	**2.7**	**2.5**

Flint Fields

	L	F	R	N
2Ai	6.8	5.3	5.8	4.8
2Aii	7.0	5.1	5.9	4.9
2Aiii	6.7	5.5	5.7	5.1
2Aiv	7.1	5.1	5.7	5.9
2Av	7.1	5.3	5.8	5.6
Mean	**6.8**	**5.3**	**5.8**	**4.8**

	L	F	R	N
2Bi	6.2	5.8	3.4	3.5
2Bii	6.4	5.8	3.2	3
2Biii	6.4	5	3.6	3.2
2Biv	6.4	5	2.9	2.4
2Bv	6.4	5.5	2.7	2.5
Mean	**6.2**	**5.8**	**3.4**	**3.5**

	L	F	R	N
2Ci	6.3	5.7	2	2.1
2Cii	6.3	5.8	2.1	2.2
2Ciii	6.3	5.9	2.1	2.2
2Civ	6.3	5.7	2.1	2.2
2Cv	6.2	5.8	2.1	2.2
Mean	**6.3**	**5.7**	**2.0**	**2.1**

Brindley Bottom

	L	F	R	N
3Ai	7.1	4.9	5.6	5.1
3Aii	7.2	5.0	5.8	5.8
3Aiii	6.8	5.3	5.6	5.0
3Aiv	7.1	5.1	5.8	5.0
3Av	7.2	5.2	5.7	5.3
Mean	**7.1**	**4.9**	**5.6**	**5.1**

	L	F	R	N
3Bi	6.8	5.4	4.9	4.4
3Bii	6.9	5.6	4.7	4
3Biii	7	5.5	4.8	4.1
3Biv	7	5.6	4.7	4
3Bv	7	5.5	5.2	4.6
Mean	**6.8**	**5.4**	**4.9**	**4.4**

	L	F	R	N
3Ci	6.4	5.7	2.6	2.8
3Cii	6.4	5.8	2.3	2.5
3Ciii	6.7	5.8	2.6	2.6
3Civ	6.2	5.4	2.4	2.8
3Cv	6.5	6.1	2.2	2.4
Mean	**6.4**	**5.7**	**2.6**	**2.8**

White House

	L	F	R	N
4Ai	6.9	5.0	5.9	5.2
4Aii	6.7	5.1	5.0	4.1
4Aiii	6.7	5.5	5.8	5.2
4Aiv	7.0	5.4	5.8	5.2
4Av	7.1	5.3	5.8	5.1
Mean	**6.9**	**5.0**	**5.9**	**5.2**

	L	F	R	N
4Bi	6.3	5.5	3.5	3.4
4Bii	6.4	5.6	3.6	3.3
4Biii	6.3	5.5	3.5	3.4
4Biv	6.4	5.3	4.3	4
4Bv	6.4	5.4	3.6	3.5
Mean	**6.3**	**5.5**	**3.5**	**3.4**

	L	F	R	N
4Ci	7	5.1	6	5.4
4Cii	7	5.3	6	5.2
4Ciii	7	5	6.3	5.3
4Civ	7.1	5.2	6.3	5.5
4Cv	6.7	5.2	5.8	5.1
Mean	**7.0**	**5.1**	**6.0**	**5.4**

Penkridge Bank

	L	F	R	N
5Ai	7.0	5.1	5.6	4.6
5Aii	7.0	5.2	5.6	4.7
5Aiii	7.0	5.0	6.0	5.3
5Aiv	7.1	5.1	5.8	5.1
5Av	7.0	4.9	5.7	4.6
Mean	**7.0**	**5.1**	**5.6**	**4.6**

	L	F	R	N
5Bi	6.4	5.4	2.9	2.6
5Bii	6.6	5.8	2.4	2.1
5Biii	6.7	6.3	2.4	2
5Biv	6.8	6.2	2.1	1.7
5Bv	6.5	6	2.3	2
Mean	**6.4**	**5.4**	**2.9**	**2.6**

	L	F	R	N
5Ci	6.9	5.2	5.9	4.8
5Cii	7	5	5.8	4.6
5Ciii	6.9	5.4	5.5	4.9
5Civ	7	5.2	5.5	4.7
5Cv	6.9	5.1	5.7	4.8
Mean	**6.9**	**5.2**	**5.9**	**4.8**

Aspens

	L	F	R	N
6Ai	7.1	5.1	5.8	5.4
6Aii	7.2	5.1	5.6	5.4
6Aiii	7.2	5.0	5.7	5.3
6Aiv	7.1	5.2	5.4	5.3
6Av	7.1	5.5	5.6	5.3
Mean	**7.1**	**5.1**	**5.8**	**5.4**

	L	F	R	N
6Bi	6.9	6.2	3.3	2.6
6Bii	6.6	6	3	2.6
6Biii	6.5	6.2	2.3	2.3
6Biv	6.5	6.3	2.3	2.2
6Bv	6.6	6.4	2.4	2.2
Mean	**6.9**	**6.2**	**3.3**	**2.6**

	L	F	R	N
6Ci	6.8	6.1	2.4	2.4
6Cii	6.7	6.4	2.3	2.2
6Ciii	6.9	6.3	2.2	2.1
6Civ	6.9	6.3	2.3	2.2
6Cv	6.9	6.2	2.5	2.2
Mean	**6.8**	**6.1**	**2.4**	**2.4**

Glacial Boulder

	L	F	R	N
7Ai	7.1	5.2	4.8	3.8
7Aii	7.2	5.1	5.0	3.8
7Aiii	7.1	5.1	5.0	3.6
7Aiv	7.1	4.9	5.3	4.0
7Av	7.1	5.5	4.6	3.6
Mean	**7.1**	**5.2**	**4.8**	**3.8**

	L	F	R	N
7Bi	6.7	5.8	2.8	2.3
7Bii	6.6	5.7	2.6	2.2
7Biii	6.6	6.2	2.7	2.6
7Biv	6.7	6.1	2.8	2.6
7Bv	6.6	6.1	2.6	2.4
Mean	**6.7**	**5.8**	**2.8**	**2.3**

	L	F	R	N
7Ci	6.6	5.8	2.4	2.4
7Cii	6.4	5.6	2.2	2.4
7Ciii	6.2	5.5	2.3	2.5
7Civ	6.4	5.8	2.2	2.3
7Bv	6.2	5.6	2	2.2
Mean	**6.6**	**5.8**	**2.4**	**2.4**

Coppice Hill

	L	F	R	N
8Ai	6.9	5.3	5.6	5.2
8Aii	7.0	5.2	5.6	5.6
8Aiii	6.9	5.3	5.4	5.2
8Aiv	7.0	5.2	5.6	5.5
8Av	6.6	5.5	5.2	4.8
Mean	**6.9**	**5.3**	**5.6**	**5.2**

	L	F	R	N
8Bi	6.4	5.7	2.6	2.6
8Bii	6.1	5.5	2.5	2.7
8Biii	6.3	5.5	3	2.9
8Biv	6.4	5.8	3.1	2.8
8Bv	6.3	5.7	2.8	2.7
Mean	**6.4**	**5.7**	**2.6**	**2.6**

	L	F	R	N
8Ci	7.0	6.0	2.0	2.0
8Cii	6.7	5.8	2.0	2.3
8Ciii	6.6	5.9	2.0	2.1
8Civ	7.0	6.0	2.0	2.0
8Cv	6.6	5.7	2.0	2.3
Mean	**7.0**	**6.0**	**2.0**	**2.0**

Sister Dora

	L	F	R	N
9Ai	7.0	5.0	5.5	4.3
9Aii	6.7	5.5	5.3	4.4
9Aiii	6.8	5.2	4.9	3.8
9Aiv	7.0	5.1	5.7	4.6
9Av	6.9	5.0	5.5	4.4
Mean	**7.0**	**5.0**	**5.5**	**4.3**

	L	F	R	N
9Bi	6.0	5.4	3.6	3.6
9Bii	6.0	5.0	4.0	4.0
9Biii	6.0	5.1	3.9	3.9
9Biv	6.0	5.0	4.0	4.0
9Bv	6.2	5.1	4.9	4.7
Mean	**6.0**	**5.4**	**3.6**	**3.6**

	L	F	R	N
9Ci	6.7	5.6	3.4	2.9
9Cii	6.6	5.8	3.2	3.1
9Ciii	6.6	5.6	3.8	3.8
9Civ	6.5	5.6	3.3	3.4
9Cv	6.4	5.6	4.7	4.6
Mean	**6.7**	**5.6**	**3.4**	**2.9**

Punch Bowl

	L	F	R	N
10Ai	7.0	5.3	5.6	5.3
10Aii	6.8	5.3	5.4	5.4
10Aiii	6.8	5.4	5.6	5.4
10Aiv	7.3	5.2	6.1	6.1
10Av	7.0	5.3	5.4	5.2
Mean	**7.0**	**5.3**	**5.6**	**5.3**

	L	F	R	N
10Bi	6	5.3	3.9	3.9
10Bii	6	5.3	3.9	3.9
10Biii	6	5.2	3.7	3.7
10Biv	6	5	3	3
10Bv	6	5	3	3
Mean	**6.0**	**5.3**	**3.9**	**3.9**

	L	F	R	N
10Ci	6	5.3	3.9	3.9
10Cii	6	5.3	3.9	3.9
10Ciii	6	5.2	3.7	3.7
10Civ	6	5.3	3.9	3.9
10Cv	6	5.3	3.9	3.9
Mean	**6.0**	**5.3**	**3.9**	**3.9**

Seven Springs

	L	F	R	N
11Ai	6.7	5.7	6.6	6.5
11Aii	6.6	5.7	6.5	6.4
11Aiii	6.4	5.9	6.5	6.7
11Aiv	6.5	5.8	6.4	6.4
11Av	6.4	5.7	6.6	6.6
Mean	**6.7**	**5.7**	**6.6**	**6.5**

	L	F	R	N
11Bi	6.1	5.6	4.1	4.1
11Bii	6.2	5.6	3.9	3.9
11Biii	5.9	5.6	4.2	4.2
11Biv	6.0	5.5	4.2	4.1
11Bv	6.2	5.8	4.1	4.1
Mean	**6.1**	**5.6**	**4.1**	**4.1**

	L	F	R	N
11Ci	6.0	5.5	3.9	3.9
11Cii	6.0	5.3	3.9	4.0
11Ciii	6.3	5.4	4.5	4.5
11Civ	6.2	5.4	4.3	4.3
11Cv	6.0	5.5	4.4	4.4
Mean	**6.0**	**5.5**	**3.9**	**3.9**

Chase Road Corner

	L	F	R	N
12Ai	7.1	5.1	5.7	5.5
12Aii	7.1	5.0	5.7	5.5
12Aiii	7.0	5.2	5.7	5.5
12Aiv	7.0	5.1	5.7	5.8
12Av	7.1	5.1	5.7	5.6
Mean	**7.1**	**5.1**	**5.7**	**5.5**

	L	F	R	N
12Bi	6.6	5.7	5.1	4.5
12Bii	6.5	5.8	4.9	4.8
12Biii	6.8	5.2	5.5	5.3
12Biv	6.8	5.2	5.6	5.2
12Bv	6.5	5.4	4.4	4
Mean	**6.6**	**5.7**	**5.1**	**4.5**

	L	F	R	N
12Ci	6.4	6.3	2.6	2.5
12Cii	6.3	5.8	2.7	2.7
12Ciii	6.4	5.8	2.7	2.3
12Civ	6.5	5.8	2.5	2.5
12Cv	6.4	6.2	2.8	2.7
Mean	**6.4**	**6.3**	**2.6**	**2.5**

Anson's Bank

	L	F	R	N
13Ai	6.8	5.4	4.8	4.0
13Aii	6.7	5.9	3.9	3.2
13Aiii	6.8	5.5	4.6	4.1
13Aiv	6.9	5.4	4.8	4.1
13Av	6.8	5.5	4.5	3.8
Mean	**6.8**	**5.4**	**4.8**	**4.0**

	L	F	R	N
13Bi	6.0	5.4	3.9	4.0
13Bii	6.1	5.4	4.1	4.2
13Biii	6.2	5.7	4.8	4.6
13Biv	6.2	5.6	4.1	4.0
13Bv	6.2	5.6	4.2	4.2
Mean	**6.0**	**5.4**	**3.9**	**4.0**

	L	F	R	N
13Ci	6.2	5.6	4.5	4.5
13Cii	6.0	5.7	4.6	4.9
13Ciii	6.3	5.5	4.7	4.4
13Civ	6.0	5.8	4.4	4.6
13Cv	6.4	5.4	4.0	4.0
Mean	**6.2**	**5.6**	**4.5**	**4.5**

Appendix 6b: Ellenberg Indicator Values for Light (L)

Ellenberg Indicator values for Light (L) are showing the open nature of the site, with some shading present around the edges from taller vegetation. The EIVs for light levels is relatively high, described as 'Plant generally in well-lit places, but also occurring in partial shade', though showing some variation (L = 6.0-7.0, mean 6.5). A partial list of the Ellenberg Light values is contained below.

Partial Ellenberg Indicator Values for Light from PLANTATT (Hill *et al.,* 2004)

L Value	Definition	Example species	Nº of species
3	Shade plant, mostly less than 5% relative illumination, seldom more than 30% illumination when trees are in full leaf	*Fagus sylvatica*	1
4	Between 3 and 5	*Geum urbanum, Hedera helix*	4
5	Semi-shade plant, rarely in full light, but generally with more than 10% relative illumination when trees are in leaf	*Dryopteris dilatata, D. filix-mas*	5
6	Between 5 and 7	*Avenella flexuosa, Galium saxatile, Pteridium aquilinum, Vaccinium myrtillus*	25
7	Plant generally in well-lit places, but also occurring in partial shade	*Agrostis stolonifera, Calluna vulgaris, Cerastium fontanum, Empetrum nigrum, Holcus lanatus, Rumex acetosella*	56
8	Light-loving plant rarely found where relative illumination in summer is less than 40%	*Aphanes arvensis, Erica tetralix, Festuca rubra, Lolium perenne, Scorzoneroides autumnalis*	14
		Total	105

Appendix 6c: Ellenberg Indicator Values for Moisture (F)

Ellenberg Indicator Values for Moisture (F) are showing the general uniformity of moisture values across the plots (F = 4.0-6.3, mean 5.4). The site contains species that are between 'Moist site indicators, mainly on fresh soils of average dampness'.

Partial Ellenberg Indicator values for Moisture from PLANTATT (Hill *et al.,* 2004)

F Value	Definition	Example species	Nº of species
3	Dry-site indicator, more often found on dry ground than in moist places	*Brachythecium albicans, Polytrichum piliferum*	2
4	Between 5 and 8	*Aphanes arvensis, Jacobaea vulgaris, Lotus corniculatus, Trisetum flavescens*	11
5	Moist-site indicators; mainly on fresh soils of average dampness	*Avenella flexuosa, Erica cinerea, Festuca ovina, Lolium perenne, Prunella vulgaris*	45
6	Between 5 and 7	*Agrostis stolonifera, Calluna vulgaris, Empetrum nigrum, Galium saxatile, Holcus lanatus*	33
7	Dampness indicator; mainly on constant moist or damp, but not on wet soils.	*Betula pubescens, Juncus bufonius, Nardus stricta, Potentilla erecta*	10
8	Between 7 and 9	*Erica tetralix, Molinia caerulea*	2
9	Wet-site indicators; often on water-saturated, badly aerated soils	*Epilobium parviflorum*	1
		Total	105

Appendix 6d: Ellenberg Indicator Values for Reaction (R)

The EIVs for Reaction (linked to pH value) show the range for the site to be a gradient from lowest in heathland (R = 2.0-3.5, mean 2.7), through acid grassland (R = 3.9-4.9, mean 4.6), and into Mesotrophic grassland (R = 5.0-6.0, mean 5.6). Woodland plots were similar in reaction value to acid grassland with medium low values (R = 3.9-4.5, mean 4.0). The area as a whole ranged from 2.0-6.0, with a mean of 4.6.

Partial Ellenberg Indicator values for Reaction from PLANTATT (Hill *et al.,* 2004)

R Value	**Definition**	**Example species** (bracketed species not found during current survey)	**N° of species**
1	Indicator of extreme acidity, never found on weakly acid or basic soils	(*Andromeda polifolia, Rubus chamaemorus*)	0
2	Between 1 and 3	*Avenella flexuosa, Calluna vulgaris, Erica cinerea, Vaccinium vitis-idaea.*	13
3	Acidity indicator, mainly on acid soils, but exceptionally also on neutral ones	*Holcus mollis, Nardus stricta, Potentilla erecta, Pteridium aquilinum*	11
4	Between 3 and 5	*Betula pendula, Digitalis purpurea, Festuca ovina, Rumex acetosella.*	13
5	Indicator of moderately acid soils, only found on very acid or on neutral to basic soils	*Cerastium fontanum, Luzula campestris, Quercus robur, Stellaria graminea*	14
6	Indicator of moderately acid soils, only found on very acid or on neutral to basic soils	*Aphanes arvensis, Cynosurus cristatus, Plantago lanceolata, Veronica chamaedrys*	33
7	Between 5 and 7	*Agrostis stolonifera, Galium aparine, Trisetum flavescens, Vicia cracca*	20
8	Indicator of weakly acid to weakly basic conditions; never found on very acid soils	*Linaria vulgaris*	1
		Total	105

Appendix 6e: Ellenberg Indicator Values for Fertility (N)

The EIVs for fertility (linked to nitrogen) shows the most range across the different broad habitats, and it is these differences which are in part the reason for this study. The site with the lowest nutrient value were the heathland plots (N = 2.0-3.4, mean 2.5). Acid grassland plots were then the next lowest (N = 3.3-4.4, mean 3.9). Woodland plots were intermediate between the two grasslands (N = 3.8-4.5, mean 4.0). Mesotrophic grassland (whether MG1, MG6 or MG7 NVC communities), were similar (N = 4.3-5.5, mean 5.0). One plot (Seven Springs 11a) which had an open vegetation community dominated by False Oat-grass *Arrhenatherum elatius,* Yorkshire Fog *H. lanatus* and Nettle *Urtica dioica* had the highest N value of 6.5. If taken as a whole, the range for all plots is 2.0-6.5, mean 4.3.

Partial Ellenberg Indicator values for Nitrogen from PLANTATT (Hill *et al.,* 2004)

N Value	Definition	Example species	Nº of species
1	Indicator of extremely infertile sites	*Empetrum nigrum, Erica tetralix, Polytrichum piliferum*	3
2	Between 1 and 3	*Calluna vulgaris, Erica cinerea, Potentilla erecta, Vaccinium myrtillus, V. vitis-idaea*	20
3	Indicator of more or less infertile sites	*Avenella flexuosa, Galium saxatile, Pteridium aquilinum, Ulex europaeus*	13
4	Between 3 and 5	*Betula pubescens, Cynosurus cristatus, Quercus robur, Trisetum flavescens*	24
5	Indicator of sites of intermediate fertility	*Digitalis purpurea, Festuca rubra, Lathyrus pratensis, Veronica chamaedrys*	18
6	Between 5 and 7	*Agrostis stolonifera, Cirsium arvense, Lolium perenne, Rubus fruticosus*	16
7	Plant often found in richly fertile places	*Elymus repens, Plantago major, Poa annua, Polygonum aviculare*	8
8	Between 7 and 9	*Galium aparine, Urtica dioica*	2
9	Indicator of extremely rich situations, such as cattle resting places or near polluted rivers	*Rumex obtusifolius*	1
		Total	105

Appendix 7: CSR values for all plots/quadrats.

Duffields

	C	S	R
1Ai	3.41	2.50	2.59
1Aii	3.42	2.33	2.58
1Aiii	3.52	2.29	2.48
1Aiv	3.41	2.36	2.59
1Av	3.24	2.48	2.76
Mean	**3.41**	**2.50**	**2.59**

	C	S	R
1Bi	2.48	3.52	2.04
1Bii	2.75	3.25	2.06
1Biii	2.48	3.52	1.84
1Biv	2.35	3.65	1.91
1Bv	2.42	3.58	2.04
Mean	**2.48**	**3.52**	**2.04**

	C	S	R
1Ci	2.03	3.97	1.28
1Cii	2.27	3.73	1.00
1Ciii	2.68	3.32	1.00
1Civ	2.41	3.59	1.00
1Cv	2.50	3.50	1.00
Mean	**2.03**	**3.97**	**1.28**

Flint Fields

	C	S	R
2Ai	2.98	2.60	2.88
2Aii	3.08	2.68	2.70
2Aiii	3.21	2.79	2.50
2Aiv	2.30	2.00	3.70
2Av	2.76	2.12	3.24
Mean	**2.98**	**2.60**	**2.88**

	C	S	R
2Bi	3.10	2.90	1.29
2Bii	2.15	3.85	1.00
2Biii	2.73	3.27	1.46
2Biv	2.18	3.82	1.00
2Bv	2.38	3.62	1.18
Mean	**3.10**	**2.90**	**1.29**

	C	S	R
2Ci	2.68	3.32	1.00
2Cii	2.55	3.45	1.00
2Ciii	2.60	3.40	1.00
2Civ	2.44	3.56	1.00
2Cv	2.56	3.44	1.00
Mean	**2.68**	**3.32**	**1.00**

Brindley Bottom

	C	S	R
3Ai	2.61	2.39	3.11
3Aii	2.83	2.10	3.17
3Aiii	3.17	2.71	2.83
3Aiv	3.00	2.67	2.81
3Av	3.00	2.48	3.00
Mean	**2.61**	**2.39**	**3.11**

	C	S	R
3Bi	2.84	3.04	2.56
3Bii	2.67	3.33	2.58
3Biii	2.68	3.32	2.68
3Biv	2.55	3.45	2.55
3Bv	3.1	2.9	2.8
Mean	**2.84**	**3.04**	**2.56**

	C	S	R
3Ci	3.07	2.93	1
3Cii	2.83	3.17	1
3Ciii	3.32	2.68	1
3Civ	3.17	2.83	1
3Cv	2.63	3.37	1
Mean	**3.07**	**2.93**	**1.00**

White House

	C	S	R
4Ai	3.21	2.69	2.79
4Aii	3.23	2.69	2.54
4Aiii	3.23	2.77	2.46
4Aiv	3.17	2.58	2.83
4Av	3.12	2.67	2.88
Mean	**3.21**	**2.69**	**2.79**

	C	S	R
4Bi	2.70	3.30	1.40
4Bii	2.25	3.75	1.33
4Biii	2.24	3.76	1.42
4Biv	2.61	3.39	1.58
4Bv	2.62	3.38	1.43
Mean	**2.70**	**3.30**	**1.40**

	C	S	R
4Ci	3.38	2.38	2.63
4Cii	3.32	2.57	2.68
4Ciii	3.28	2.38	2.72
4Civ	3.48	2.24	2.52
4Cv	3.30	2.43	2.61
Mean	**3.38**	**2.38**	**2.63**

Penkridge Bank

	C	S	R
5Ai	2.76	2.67	2.98
5Aii	2.77	2.47	3.15
5Aiii	3.21	2.26	2.79
5Aiv	3.03	2.58	2.97
5Av	2.86	2.56	2.92
Mean	**2.76**	**2.67**	**2.98**

	C	S	R
5Bi	2.38	3.63	1.25
5Bii	2.47	3.53	1.26
5Biii	2.62	3.38	1.12
5Biv	2.48	3.52	1.00
5Bv	2.53	3.47	1.24
Mean	**2.38**	**3.63**	**1.25**

	C	S	R
5Ci	3.11	2.78	2.74
5Cii	2.96	2.67	2.84
5Ciii	3.08	2.68	2.76
5Civ	2.92	2.80	2.73
5Cv	3.00	2.76	2.49
Mean	**3.11**	**2.78**	**2.74**

Aspens

	C	S	R
6Ai	2.80	2.32	3.20
6Aii	3.00	2.47	3.00
6Aiii	2.92	2.50	3.08
6Aiv	2.56	2.08	3.44
6Av	2.33	2.02	3.58
Mean	**2.80**	**2.32**	**3.20**

	C	S	R
6Bi	2.37	3.56	1.33
6Bii	2.62	3.38	1.14
6Biii	2.50	3.50	1.00
6Biv	2.58	3.42	1.00
6Bv	2.59	3.41	1.00
Mean	**2.37**	**3.56**	**1.33**

	C	S	R
6Ci	2.89	3.11	1.00
6Cii	2.70	3.30	1.00
6Ciii	2.87	3.13	1.00
6Civ	3.00	3.00	1.00
6Cv	2.74	3.26	1.00
Mean	**2.89**	**3.11**	**1.00**

Glacial Boulder

	C	S	R
7Ai	2.44	3.31	2.69
7Aii	2.51	3.17	2.59
7Aiii	2.33	3.15	2.57
7Aiv	2.74	3.26	2.55
7Av	2.38	3.38	2.31
Mean	**2.44**	**3.31**	**2.69**

	C	S	R
7Bi	1.97	4.03	1.12
7Bii	1.88	4.12	1.00
7Biii	2.56	3.44	1.22
7Biv	2.38	3.62	1.21
7Bv	2.47	3.53	1.00
Mean	**1.97**	**4.03**	**1.12**

	C	S	R
7Ci	2.46	3.54	1.00
7Cii	2.59	3.41	1.00
7Ciii	2.97	3.03	1.00
7Civ	2.88	3.12	1.00
7Cv	2.59	3.41	1.00
Mean	**2.46**	**3.54**	**1.00**

Coppice Hill

	C	S	R
8Ai	2.97	2.70	2.73
8Aii	2.56	2.25	3.44
8Aiii	3.00	2.57	2.91
8Aiv	2.53	2.22	3.47
8Av	3.00	2.89	2.78
Mean	**2.97**	**2.70**	**2.73**

	C	S	R
8Bi	3.06	2.94	1.12
8Bii	3.16	2.81	1.06
8Biii	2.95	3.00	1.30
8Biv	2.78	3.16	1.19
8Bv	2.85	3.05	1.26
Mean	**3.06**	**2.94**	**1.12**

	C	S	R
8Ci	3.00	3.00	1.00
8Cii	2.75	3.25	1.00
8Ciii	2.92	3.08	1.00
8Civ	3.00	3.00	1.00
8Cv	2.72	3.28	1.00
Mean	**3.00**	**3.00**	**1.00**

Sister Dora

	C	S	R
9Ai	2.40	2.73	3.00
9Aii	2.73	2.97	2.60
9Aiii	2.31	2.92	2.87
9Aiv	2.73	2.50	2.92
9Av	2.64	2.60	2.90
Mean	**2.40**	**2.73**	**3.00**

	C	S	R
9Bi	2.67	3.33	1.56
9Bii	3.00	3.00	1.75
9Biii	2.88	3.12	1.71
9Biv	3.00	3.00	1.75
9Bv	3.11	2.89	1.74
Mean	**2.67**	**3.33**	**1.56**

	C	S	R
9Ci	2.11	9	1.59
9Cii	2.76	3.24	1.38
9Ciii	3.04	2.96	1.81
9Civ	2.93	3.07	1.57
9Cv	2.97	2.94	1.92
Mean	**2.11**	**3.89**	**1.59**

Punch Bowl

	C	S	R
10Ai	3.17	1.97	2.83
10Aii	3.06	2.03	2.94
10Aiii	2.63	2.39	3.11
10Aiv	2.83	1.96	3.17
10Av	3.40	1.90	2.60
Mean	**3.2**	**2.0**	**2.8**

	C	S	R
10Bi	4.43	1.57	1.00
10Bii	4.43	1.57	1.00
10Biii	4.54	1.46	1.00
10Biv	5.00	1.00	1.00
10Bv	5.00	1.00	1.00
Mean	**4.4**	**1.6**	**1.0**

	C	S	R
10Ci	4.43	1.57	1
10Cii	4.43	1.57	1
10Ciii	4.54	1.46	1
10Civ	4.43	1.57	1
10Cv	4.43	1.57	1
Mean	**4.4**	**1.6**	**1.0**

Seven Springs

	C	S	R
11Ai	3.97	2.03	1.78
11Aii	3.80	1.96	2.16
11Aiii	3.77	1.92	1.92
11Aiv	3.79	2.21	1.72
11Av	3.70	2.30	2.03
Mean	**4.0**	**2.0**	**1.8**

	C	S	R
11Bi	3.89	2.11	1.29
11Bii	4.04	1.95	1.33
11Biii	3.90	2.10	1.33
11Biv	3.85	2.15	1.35
11Bv	3.71	2.29	1.48
Mean	**3.9**	**2.1**	**1.3**

	C	S	R
11Ci	4.21	1.79	1.16
11Cii	3.85	2.15	1.00
11Ciii	3.89	2.11	1.00
11Civ	4.04	1.96	1.00
11Cv	4.05	1.95	1.00
Mean	**4.2**	**1.8**	**1.2**

Chase Road Corner

	C	S	R
12Ai	2.81	2.24	3.19
12Aii	2.72	2.15	3.28
12Aiii	2.89	2.05	3.11
12Aiv	2.61	1.98	3.39
12Av	2.75	2.22	3.25
Mean	**2.8**	**2.2**	**3.2**

	C	S	R
12Bi	3.00	3.00	1.74
12Bii	3.11	2.76	2.24
12Biii	3.20	2.60	2.80
12Biv	3.21	2.66	2.79
12Bv	2.58	3.26	1.88
Mean	**3.0**	**3.0**	**1.7**

	C	S	R
12Ci	2.58	3.42	1.00
12Cii	2.55	3.45	1.00
12Ciii	1.97	4.03	1.00
12Civ	2.50	3.50	1.00
12Cv	2.33	3.67	1.00
Mean	**2.6**	**3.4**	**1.0**

Anson's Bank

	C	S	R
13Ai	2.58	3.30	2.58
13Aii	2.59	3.41	2.05
13Aiii	2.52	3.10	2.65
13Aiv	2.84	3.03	2.65
13Av	2.50	3.21	2.62
Mean	**2.6**	**3.3**	**2.6**

	C	S	R
13Bi	3.28	2.72	1.49
13Bii	3.29	2.71	1.63
13Biii	3.35	2.65	1.73
13Biv	3.14	2.86	1.59
13Bv	3.28	2.72	1.72
Mean	**3.3**	**2.7**	**1.5**

	C	S	R
13Ci	2.59	3.41	1.62
13Cii	2.83	3.17	1.63
13Ciii	2.81	3.19	1.74
13Civ	2.97	3.03	1.66
13Cv	2.64	3.36	2.29
Mean	**2.6**	**3.4**	**1.6**

Appendix 8: Example photographs of sites and individual quadrats.

Example of lowland heathland (H9), with good botanical diversity at Duffields (Quadrat 1Cii). Ericoids include Heather and Bilberry, with Wavy Hair-grass and Purple Moor-grass also present. Several bryophytes also dominate.

Example of lowland heathland (H9), with good botanical diversity at Penkridge Bank (Quadrat 5Bv). Ericoids include Heather, Crowberry, Bell Heather, Cross-leaved Heath, Bilberry and Cowberry, with Wavy Hair-grass and Purple Moor-grass also present. A number of bryophytes also dominate.

Coarse grassland (MG1) at White House (Quadrat 4Ci). Note tall grasses including False Oat-grass, Yorkshire Fog, and underneath Red Fescue. Occasional pockets of better areas here included Yellow Oat-grass and Common Toadflax.

Example of coarse grassland formed by sides of footpath at Duffield (Quadrat 1Ai). Grassland an example of MG7 dominated by Common Bent, Cock's-foot, and Creeping Soft-grass, with Perennial Rye-grass, Yorkshire Fog and Rough-stalked Meadow-grass also present.

Example of coarse grassland (MG7) formed by sides of footpath at Brindley Bottom (Quadrat 3Aii). Note trampling, disturbed patches from heavy pedestrian activity. Botanically very poor, dominated by Perennial Rye-grass and Common Bent with White Clover the only common herb.

Example of poor-quality acid grassland (U4), with low botanical diversity at Duffields (Quadrat 1Bi). Dominating is Common Bent, Sheep's Fescue, Creeping Soft-grass, herbs include Heath Bedstraw. In some places False Oat-grass had started to colonise (a sign of lack of grazing/cutting)

Note good quality heathland in distance.

Example of short acid grassland, with heavy trampling, (but retaining high botanical diversity) at Glacial Boulder (Quadrat 7Av). Dominant grasses include Common Bent, Sheep's Fescue and Red Fescue, with Common Cat's-ear and Autumn Hawkbit. Species present here included many examples of low grasslands e.g. Buck's-horn Plantain. Other acid indicators included Heath Grass and a suite of bryophytes. The same habitat is present in the longer grassland adjacent, just without the trampling by path edges.

Tall coarse vegetation, typical of nutrient enrichment by the sides of paths at Seven Springs (Quadrat 11Ai). Dominating area are Creeping Thistle and Common Nettle, with False Oat-grass and Yorkshire Fog the main grasses present.

Oak woodland with a bracken understorey (W10), at Seven Springs (plot view).

Oak-Birch-Wavy Hair-grass woodland with a bramble understorey (W16), at Anson's Bank (plot view).

Bracken dominated ground flora, with occasional Birch and Oak in the canopy (W25) at Punch Bowl (plot view).

Figure 17: *Vaccinium* species found at Flint Field. Left to right Cowberry *V. vitis-idaea,* Cannock-berry/Hybrid Bilberry *V. x intermedium* and Bilberry *V. myrtillus.*

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