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Measuring Long Term Ecological Change in British woodlands (1971-2000)

A pilot re-survey of 14 sites from the ITE/NCC 'Bunce 1971' woodland survey and two sites from the 1971 Native Pinewood Survey

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Summary

Objectives and policy context

1. The most important current policy context for the conservation of broadleaved woodland in Britain is the UK Biodiversity Action Plan for the Broadleaved, Mixed and Yew Woodland Broad Habitat. Its aims include the maintenance of the extent and habitat quality of existing woodland especially ancient and semi-natural woods. Progress towards management goals on individual sites can be better evaluated by setting sites in the context of national scale changes in the ecology of broadleaved woods. Characterising large-scale vegetation change can pinpoint convergent, cross-site patterns of environmental and floristic change. These changes maybe associated with environmental drivers operating at-large, where site managers may not be in a position to directly affect causes but only symptoms. Such information is important if both small and large-scale conservation initiatives are to be effectively designed and their progress realistically assessed.

2. We report a pilot analysis of change in 14 broadleaved woodlands and 2 native Scot's pine woodlands between 1971 and 2000. The analysis attempts to partition spatial and temporal variation in population structure of the tree canopy, soil measurements and plant species composition in such a way that cross-site changes can be identified and related to potential causes. Being a pilot survey our goal was not to derive a final model of woodland change across Britain but to test out analytical techniques against the variation present in the 16 pilot sites.

Site selection and survey

1. In 1971 103 broadleaved woodland sites across Britain were surveyed. On each site sixteen random 200m^2 plots were located and in each counts were made of the diameter and numbers of stems of shrubs, saplings and trees. The herbaceous species composition of each plot was also recorded and cover estimates made for vascular plants and selected lower plants. Soil samples were taken and measured for Soil Organic Matter (SOM) and pH.

2. In the Summer of 2000, fourteen of the 103 woodland sites were visited and all sixteen plots relocated. Repeat vegetation records were made and soils resampled. Fourteen out of the fifteen woodland site types defined in the 1989 Bunce classification of British woodland vegetation were represented.

3. The 103 woodland sites were originally selected in 1971 to represent nodal points across the British sample of 2,463 woodlands inspected as part of the Nature Conservation Review of the mid-seventies. In the 2000 pilot re-survey a random sample of 14 sites was selected from the 103 with the additional proviso that England, Wales and Scotland should all be represented. These 14 locations were supplemented by two sites also surveyed in 1971 as part of the native pinewoods survey of Scotland. One site was taken at random from the central and eastern group (Forest of Mar) and one from the western and southern group (Shieldaig).

4. The original site maps, mainly at 1:25000 scale, were used to relocate the 16 sample plots on each pilot site. Plots were located as accurately as possible using compass bearings and paced estimated distances.

5. Field recording in each plot and site followed the original methods set down in the 1971 field handbook.

6. A pilot analysis of the accuracy of plot relocation was carried out by comparing the similarity of the species composition between temporal pairs, ostensibly in the same location, with temporal pairs for plots in different locations on the same site. Soil and Diameter at Breast Height (dbh) data were also used as a guide to the degree of auto-correlation between relocated plot pairs over time. In general, a remarkably high degree of correlation was observed. The similarity profiles showed how suspect plot pairs could be easily identified and excluded, if necessary, from paired tests of change. dbh data for each plot were complex, multivariate and potentially more prone to relocation error when compared over time at the individual plot level. This concern, combined with the need to reduce dbh data to summary variables for multivariate analyses, resulted in computation of a single, integrated measure of change in the skewness of age-class distribution data for each plot. The raw count data was however, graphed and interpreted at the whole site level for each tree and shrub species.

Site descriptions

1. Individual descriptions were drafted for each site giving details of situation in the landscape, habitat and management information, and changes in canopy and field layer. These descriptions give an overall picture of the variability within each site and focus on site detail and the availability of evidence for the location and types of management that may have shaped the structure and species composition of the woodland on each site.

2. Six sites were in private ownership, four were estate owned and six were owned by organisations whose primary objective of management was conservation in the broadest sense.

3. The pilot site series showed evidence of a range of different perturbations. The most extensive on individual sites included the storm of 1987 (1 site) and clear felling and clearance for intensive agriculture (1 site). Cross-site declines in the abundance of *Ulmus* spp. presumably reflected Dutch Elm disease. Other potential cross-site impacts such as the 1976 drought as well as regional changes in grazing pressure from sheep and deer were less obvious, not because evidence refuted their operation but probably because of small sample size.

4. Management also varied in type and extent across and between sites. Types of management included traditional coppicing, non-intervention (usually apparent disuse rather than goal-led non-intervention), local felling without restocking, planting of scattered exotics, removal of exotics and management for game.

5. The impact of these perturbations and management practices was evident within sites and often between individual plots as conveyed by changes in age-class distribution data and field layer species composition data between 1971 and 2000. Recording in fixed and relocatable positions allowed a more precise assessment of apparently atypical changes in soil variables: For example, a massive increase in Soil Organic Matter in a small number of plots on one site could be understood by reference to vegetation data for the same locations. These showed consolidation and ageing of rhododendron between 1971 and 2000.

6. The number of plot records available (256 x 2 in total) allowed statistical analyses of change to be carried out at the individual site as well as all-sites level. The algorithm used for all-sites tests was the same as that developed for analyses of Countryside Survey 2000 vegetation data since both sampling designs shared a similarly nested arrangement of sample plots within much more widely separated sampling units. Analyses allowed decomposition of the amount of variation between and within sites, and over time hence enabling identification of common trends or divergence among specific sites over time. Spatial and temporal variation was also modelled in terms of a minimum number of explanatory variables that could indicate the relative importance of regional effects, soil changes, canopy disturbance and implicit shifts along key environmental gradients.

Changes in tree structure and composition

1. Considering the site series as a whole, between 1971 and 2000 there was a statistically significant decline in numbers of stems in the smallest age-classes (0-20 cms) and a corresponding increase in medium-sized individuals between 20-50cm in diameter. Whilst this could be said to show a decline in regenerative vigour it certainly represents a general cross-site ageing of mixed tree populations. This strong convergence in population structure also appeared to be correlated with an increase in shade at ground level although expansions in vigorous field layer competitors were also implicated (see below). This cross-site pattern may reflect a long-term response to the widespread disturbance and harvesting that occurred in many British woodlands during the second world war.

2. Two sites showed marked increases in the number of woody stems in the youngest age-classes between 1971 and 2000. On one site this was a consequence of recovery following the impact of the 1987 storm. On the other site this was linked to restocking after widespread felling.

3. In addition to a net reduction in younger cohorts of trees, there was also a net loss of older individuals. On some sites this appeared to have resulted from deliberate harvesting while windthrow was clearly responsible on the storm-affected site. These trees are a vulnerable ecological resource since they clearly cannot be replaced except over very long time scales.

4. The only woody species that showed widespread net increases in numbers of younger stems were sycamore and holly although there were a small number of sites where sycamore counts decreased. Most trees and shrubs showed a net cross-site loss of younger stems although again, individual sites could always be found where the reverse was observed.

5. Most sites displayed much variation in age-class distribution, direction of change and relative abundance of different tree and shrub species between plots but not enough to obscure the overall cross-site and cross-species lack of new recruitment. However at the level of simple between-plot frequency of woody species there was remarkably little change on most sites. Therefore at the coarse between-plot scale, all the woodland canopies had retained their essential floristic composition over the 29-year period.

6. Notwithstanding the general loss in numbers from the youngest age-classes, all sites, apart from the two native pinewood sites, showed relatively youthful age-class distributions if old-growth, oceanic forests are used as a reference point. Older individuals were relatively scarce. Also the majority of broadleaved sites were under 100ha in size and usually surrounded by unwooded farmland.

7. There was little evidence from pilot sites of an expansion in exotics including conifers. For example larch was uncommon overall. On one site it had increased but was still infrequent while deliberate removal appeared to have happened on one other site. Rhododendron and laurel were rare and confined to two sites. However within these sites their local dominance was associated with extremely low plant diversity.

8. Fifteen out of the sixteen sites had retained their original boundaries and extent over the 29 year period. One site saw half of its 1971 area completely removed and replaced with *Lolium perenne* dominated grassland. In terms of tree canopy continuity, most sites showed little cause for long-term concern. However two of the Scottish sites showed very unbalanced age-class distributions with an apparent long-term absence of new recruitment. On one site deer grazing was probably implicated while on the other site considerable bracken expansion had taken place while the level of deer grazing was not known.

Soil sampling and change between 1971 and 2000

1. Soil samples were taken from each sample plot in each site in 1971 and again in 2000. Soil Organic Matter (SOM) and pH were measured for each sample. Variation in methodology over time was assessed and discounted following re-analysis of the stored 1971 samples from the same plots.

2. Soil pH increased significantly over the twenty nine year period and increased most where the pH in 1971 was <6. More acid soils increased in pH and more basic soils decreased in pH. This pattern is strikingly similar to that already reported by Countryside Survey 2000 for 1978 to 1998 based on soil samples from a complete range of vegetation types across Britain. These patterns may however be partly due to a sampling artefact that manifests itself when values for *each plot* are plotted against subsequent change in those values. Soil pH increased significantly across one of the native pinewood sites (Forest of Mar) but did not change across the other (Shieldaig).

3. Soil Organic Matter (SOM) showed no overall significant change. However when broken down by SOM class in 1971, higher SOM classes saw significant reductions in SOM over the twenty-nine year period. A ‘regression to the mean’ effect is also likely

to have contributed to this pattern and so caution should again apply to this conclusion.

4. Changes in soil pH and SOM tended to occur at soil type level rather than site level ie. soils of different pH and SOM within the same site changed differently while soils of the same pH and SOM class across all sites tended to change in a similar manner.

5. Detected change in soil properties appears to have occurred across all sites and it is likely that they at least partly, reflect the operation of a national scale driver. The most obvious would be reduced acidification. Changes in pH and especially SOM may also be consistent with expectations under current climate change scenarios.

Herbaceous species composition and change between 1971 and 2000

1. A total of 451 plant species were recorded in the pilot survey data for the 16 sites combining all records from 1971 and 2000 but excluding rare bryophytes only recorded in 1971.

2. The primary gradient across the sampled vegetation reflected a GB-wide continuum from more fertile, largely higher pH, lowland woods to less fertile, more acid, upland woods. This gradient also correlates well with northing and the first axis of landscape scale environmental variation that underlies the ITE Land Classification of British 1km squares. A secondary gradient again picked out pH but also shade and disturbance; the two were negatively correlated across sites and plots reflecting the fact that the less shaded or/and more disturbed woods tended to be in more northern and upland situations.

3. Change in field layer species composition between 1971 and 2000 correlated best with changes in pH and shade/disturbance. Plot records in 2000 were more likely to have a lower contribution from ruderal plant species and species compositions that reflected more shaded and more fertile conditions.

4. Plot level changes in soil pH were positively correlated with change in the mean cover-weighted Ellenberg pH value for the vegetation, albeit with high residual variation. However changes in soil pH did not appear to be related to changes in field layer dominance or change in age-class distributions of trees and shrubs.

5. Species richness declined significantly over the whole series of sites. The only two sites that saw increases in mean species richness showed independent evidence of marked disturbance due to the 1987 storm and to deliberate felling. The mean decline in richness on each site was proportional to the mean richness in plots in 1971. One site lost an average of 50% of herbaceous species in sample plots while most sites lost between 20 and 30%. The two pinewood sites did not show individually significant declines in species richness and appeared to be quite stable over the twenty-nine year interval.

6. The best predictors of species richness change in the 14 pilot broad-leaved sites were change in mean cover-weighted Ellenberg light value (largest decreases in light score implied greater shade which was associated with the greatest reductions in plot richness), northing (more northern sites lost a greater number of species but partly

because they started with more in 1971), change in ruderal proportion (reductions in ruderals paralleled reductions in species richness) and dbh curve in 1971 (plots with a larger relative abundance of younger stems in 1971 tended to lose species while plots with fewer younger stems in 1971 lost or gained varying numbers of species.

7. When cover in plots was summed across ten potentially dominant field layer species, a statistically significant cross-site increase in mean cover was detected. There was however, no consistent correlation with species richness change probably due to differences in initial abundance between sites.

8. Changes in mean cover of selected individual plant species again highlighted the apparent increase in shaded conditions and lack of disturbance across most sites. *Rubus fruticosus* agg. showed the most widespread increase across the largest number of sites. On one site the collapse in abundance of *Mercurialis perennis* and increase in *Brachypodium sylvaticum* since 1971 was linked anecdotally to a dramatic increase in deer grazing. Regional differences in the impact of grazing on British woodlands remain unclear from this survey probably because of small sample size particularly in south east England.

9. Of nineteen significant changes in frequency of strict Ancient Woodland Indicator species, seventeen decreased and two increased. Despite this these indicators still appeared to be more frequent across the pilot sites than in copses and woods randomly sampled in the Countryside Survey 1km squares.

Representativeness of the full 103 sites

1. Woodland sites represent at least 22 out of the 32 ITE Land Classes while the number of sites is proportional to the estimated extent of broadleaved woodland in 1990 across four broad environmental zones that cover Britain. The number of land classes is probably underestimated because the large altitudinal range of many upland sites was not taken into account.

2. The 103 sites were selected originally from the woodlands covered by the Nature Conservation Review which focussed on sites of potential nature conservation value. Recent analysis has shown that the majority of these sites have not been designated but include a large proportion of listed Ancient Woodlands. The full resurvey would constitute a sample-based audit of the state of such woods. In contrast, the Countryside Surveys include a wide variety of woodland types found in the countryside including large and small sites, plantations and native woods, scrub, copses, thickets and hedgerows.

1. Introduction

1.1 Background

In the early-1970s the Nature Conservation Review (NCR) (Ratcliffe 1977) was carried out with the aim of evaluating all sites of the potentially highest conservation value across Britain. All habitat types were represented and from those sites surveyed a subset were selected to form a representative series of designated nature reserves. Using numerical techniques that were at that time, still novel and under rapid development, the 2,463 woodland sites from which the published NCR list was eventually chosen, were classified into 103 units defined by their similarity of plant species composition (Hill *et al* 1975; Bunce & Jeffers 1979). The most typical site from each unit was selected and the resulting 103 sites surveyed in detail in 1971. Within each woodland sixteen relocatable 200m^2 plots were randomly placed. In each plot the herbaceous flora was recorded and soil samples were taken. In addition all tree and shrub stems >1.3 m in height were counted and diameter measured in sub-sections of each plot. In 2000 fourteen of the 103 sites were resurveyed. All sixteen plots on each site were located and new records made of plant species composition and the age-class distributions of trees and shrubs. Soil sampling was also repeated. The representation of Scottish woodlands was supplemented by the addition of two sites surveyed as part of the Native Pinewoods Survey also carried out originally in 1971 using the same field methodology as the Bunce broad-leaved woodland survey.

This report presents the results of an analysis of the changes that have taken place in these sixteen woods over the twenty nine year interval. The fourteen Bunce 1971 sites are treated as a sample from the 2,463 and so the inference is that changes reported here reflect with varying precision, changes likely to have affected the wider population of sites. Being a pilot survey the sample is inevitably small so that some regional differences are likely to have been missed or remain poorly expressed. Changes on local sites resulting from specific management goals may well diverge from any cross-site trends revealed by a sample based exercise such as this. The potential power of this exercise is in providing a larger scale context in which to better evaluate local changes. Using a limited resurvey of sixteen sites we ask whether convergent changes across sites can be detected even when expectedly large differences in species composition and management history are taken into account. If there are common directions of change are they a function of plot or site ie. did similar changes take place across like plots on different sites or did plots within the same sites tend to follow each other despite different starting points in terms of soil, vegetation and canopy population structure?

Once change has been detected the next step is to try and say what caused the change. We use a number of analytical techniques to try and explain species compositional change in terms of independent explanatory variables derived from the location of each site, soil data for each plot and canopy structure for each plot. There are two main caveats: firstly, small sample sizes will mean less precision than larger sample sizes so that predictions based on fewer sites will apply less accurately to other sites. A small sample is also likely to mean accidental omission of sub-populations of sites defined by common changes under particular regional drivers or by major differences in species composition. The second caveat relates to the fact that change in time is based on two snapshots separated by twenty nine years of inestimable dynamics. The length of the interval makes it more likely that slow, long-term directional changes can be detected but cyclic and random dynamics could obscure such signals or be missed altogether (eg Gunnasson *et al* 2000).

1.2 The current forestry policy context and recent changes

The last thirty years have seen a significant shift in the emphasis of forest policy in Britain. The late eighties witnessed the end of long-standing tax concessions on new planting (largely coniferous) while there was a major change toward encouragement of new planting on arable and improved grasslands rather than on agriculturally marginal land. Current regional initiatives that reflect this shift include the Community Forests and the National Forest in the Midlands (Watkins 2000; Forestry Commission 1994). The effects of these policy shifts are more likely to impact on changes in the area and distribution of woodland rather than ecological aspects of existing native woodland.

The most important policy context in terms of the conservation and management of existing woodlands is the UK Biodiversity Action Plan (BAP) for the Broadleaved , Mixed and Yew woodland Broad Habitat and the three Priority Habitats *Wet Woodland, Upland mixed ashwoods* and *Lowland beech and yew woodland* (UK Steering Group 1995). The UK woodland BAP recognised and built upon existing legal instruments that offered differing levels of protection for existing woodland as well as statements of intent to conserve woodlands at large scales based on international political consensus. These policies included a) the international recognition of broadleaved woodland in the EC Habitats Directive of 1994, which promises to promote 'favourable conservation status' rather than simply site safeguard on existing SSSI, b) the 1985 *Guidelines to the Management of Broadleaved Woodland* set out a national position which presumed against clearance for other uses, c) the *Resolution for the Conservation of Biodiversity of European Forests* signed by the UK in 1993 that promotes woodland conservation via integrated, sustainable management, d) woodland conservation schemes funded by the statutory conservation bodies occasionally as part of a consortium of other sponsors, and e) the former Farm Woodland Premium Scheme administered by DEFRA and the Woodland Grant Scheme run by the Forestry Commission. Following changes in 1990, the Woodland Grant Scheme now pays higher rates for woodland management tied to public recreation and conservation goals (Watkins 2000).

The effects of these policies and schemes are likely to be seen on woodland sites in the form of managed disturbance, for example coppicing reinstatement, ride management, grazing control and the removal of conifers and exotics. Although there is a current presumption against woodland clearance it is also possible that unplanted, secondary woodland might be removed in pursuance of restoration objectives for other biotopes such as raised mire, calcareous grassland, open fen and lowland heath.

1.3 Why the need for a pilot survey?

A resurvey of twelve of the 103 woods was carried out in 1998 (Hirst & Bunce 1999). This resurvey strongly suggested that a wider repeat survey could usefully capture important directional changes occurring across British woodland sites. However the Hirst & Bunce survey focussed largely on Cumbria while quantitative analyses of change were also limited in scope and only based on a repeat of eight out sixteen plots. Moreover, soil sampling was not repeated. A pilot resurvey was therefore required to:

- assess the logistic implications of scaling up to a complete resurvey of all 103 sites;

- partition species compositional variation in space and time ie. between plots, sites and years of survey;

- explain change in the floristic data with a minimum number of predictive variables and thus evaluate links to potential causes of change;

- repeat soil sampling and test the reliability of analyses of change in soil attributes.

1.4 Expected changes in the 29 year period

We would expect that only sixteen sites would not provide us with enough statistical power to detect the effects of potential drivers of woodland change that operated in relatively local areas between 1971 and 2000. These probably include the 1987 storm and fluctuations in deer grazing intensity at least for sites other than the two native Scottish pinewoods. Some of the major drivers that are likely to have impacted woodlands in the survey interval are listed in Table 1. The effects of many of these have already been detected at smaller scales and reported in other single-site based monitoring studies.

Table 1 Potential cross-site drivers of woodland change that changed in intensity between 1971 and 2000

Potential driver of change	References that present evidence of operation of drivers or/and hypothesise local effects of drivers
Increased grazing by deer & sheep	Mountford & Peterken 1998; Kirby & Thomas 2000; UK Steering Group Report 1995
1976 drought and other drought years	Ratcliffe 1984; Mountford & Peterken 1998
NOx and ammonia deposition	DETR 1984; Firbank *et al* 2000; Brown 1992; Hogg *et al* 1995
Reduced acidification	NEGTAP 2001
1987 storm	Kirby & Buckley 1995; Whitbread 1991
Conservation management	Solly *et al* 1999; Pryor 1998; Kirby *et al* 1998
Dutch Elm disease	Kirby & Thomas 2000; Mountford & Peterken 1998
Warmer winters	Hulme & Jenkins 1998
Management for game	Firbank 1999
Dereliction (includes deliberate non-intervention as well as disuse by default)	

In addition Countryside Survey 2000 results for vegetation change across plots that remained in the Broadleaved, Mixed and Yew woodland Broad Habitat between 1990 and 1998 revealed the following recent changes:

- reduction in mean species richness in England & Wales but not significant in Scotland;
- shift toward species compositions associated with higher fertility in England & Wales but not significant in Scotland;
- shift toward species compositions associated with greater shade or/and less disturbance in England & Wales but not significant in Scotland.

2. Methods

2.1 Site selection

Sixteen sites were chosen to represent the range of Bunce site types (Bunce 1989) with at least one site located in each country in GB. As a result fourteen of the 103 broadleaved woods were selected. Two additional sites were also revisited from the native pinewood survey of 1971 that adopted the same field methodology as the GB survey (Hill *et al* 1975; Bunce & Jeffers 1979).

Table 2 Sites surveyed in 2000. Mar Lodge and Sheildaig were surveyed in 1971 as part of the Native Pinewoods Survey

Site number	Site Name	Land Class	Grid ref	Bunce site type	Area (ha)	SSSI	Ancient woodland
31	Balsham	3	TL 588 496	8	28	y	y
28	Spital	11	SK 689 484	5	12		y
20	Wellhanger Copse	2	SU 870 145	6	44		y
24	Hill wood	2	ST 782 573	7	20		y
101	Oakers	2	SY 808 916	11	48	y	y
66	Glan Morlies	1	SN 403 114	4	20		
14	Birds Marsh	1	ST 917 517	2	24		
51	Cil-Hen-Ros	6	SJ 137 215	1	12		?
73	Great Knott	16	SD 330 910	10	16		y
72	Hall Brow	16	SD 347 885	10	20		
60	Eaves wood	16	SD 465 762	3	20	y	y
95	Priestfield	25	NZ 155 568	9	16		y
42	Callender	28	NJ 150 367	13	60		
40	Mill wood	28	NJ 455 505	15	12		
21	Shieldaig	29	NG 820 530	n/a	160	y	y
3	Mar Lodge	23	NO 100 900	n/a	440	y	y

2.2 Field survey

The majority of the field work was carried out by Bob Bunce who set up the survey and carried out some of the fieldwork in 1971. Professor Bunce visited every site and recorded all dbh, tree height, habitat and plot management information. Floristic data from each plot was recorded by Bob Bunce with help from Simon Smart, Freda Bunce, Nick Ray, Keith Kirby and Rebecca Watson.

Detailed field protocols are given in Appendix 12. This is a copy of the original 1971 field handbook that was adhered to again for the pilot repeat in 2000.

2.3 Plot relocation

Sixteen plots were randomly positioned within each site in 1971 and the location of each marked on a 1:25 000 map. The original maps were used to find the same position as accurately as possible. Some relocation error was inevitable given the limited information available. However, processing and analysis of the 256 plot records taken in 1971 and 2000 assumed that they could be treated as paired plots. The advantage of paired data is that derived variables such as species richness can be reduced to differences for purposes of statistical testing. The power of tests is thereby increased since paired records will be correlated so that the total variation across time and sites will be less than if two completely random samples were collected in each year. The accuracy of plot relocation was evaluated by examining soil pH and soil organic matter content (LOI %) data for each year and also quantified by comparing similarity coefficients for the true temporal pair with similarity coefficients computed for each plot record in 2000 and all other unpaired plot records for 1971 (BOX 1). On average similarity coefficients should be higher for paired plots than unpaired if relocation has been effective. Relocation accuracy was particularly important if changes in dbh age-class distribution in each plot were to be interpreted in terms of population change without relocation error. For this reason, detailed changes in age-class distributions are presented at the site level only while plot based analyses used a derived variable which would be less sensitive to relocation error (see below).

2.4 Soil sampling, processing and analyses

Soil samples were taken from every plot in all woodlands, using the same protocols as used during the 1971 woodland survey. These protocols are detailed in the Appendices. All samples were placed in air-tight containers for long-term storage. Soil pH (on both fresh soil and air-dried soil) and soil organic matter content were measured on all soil samples. The air-dried pH measurement can be used to further validate methods in any future analyses of change.

2.5 Soil samples from 1971 original survey

The original soil samples, matching those from 2000, were retrieved from long-term storage at CEH Merlewood. Each sample was transferred into a new labelled, air-tight container. A sub-sample was taken from each for the analyses of air-dry pH which was measured using the same protocol and pH meter as used for the re-sampled sites. Another sub-sample was taken from 5% of the samples (1 from most sites) for repeat analyses of loss-on-ignition (LOI) to obtain soil organic matter content, again using the same protocols as for the re-sampled sites. All analytical methods were the same as those used for Countryside Survey 2000. Protocols for processing the soils were adapted from those used in CS2000, to be more appropriate for the purposes of this project (Appendix 10).

2.6 Validation of analytical methods

Changes in analytical precision over the intervening period since 1971, due to modifications in technical equipment etc., could influence the significance of the results obtained from both pH and LOI. Therefore repeat analyses of LOI on the 1971 samples and comparisons between fresh and air-dry soil samples from 1971 and 2000 were used to check the comparability of analytical methods between 1971 and 2000. Since no air-dry pH analyses were carried out in 1971, it was not possible to directly compare analyses. However, if analytical precision had improved significantly over the last 29 years then this would be reflected in a significant difference in the difference between fresh and air dry samples from 1971 and 2000.

a. Soil pH

T-tests for dependant samples indicated that there was no significant difference between air-dried and fresh soil pH values for the same 1971 samples nor was there a significant difference between 2000 air-dried and fresh values. We conclude that there is no detectable effect of changes in methods over the intervening 29 years.

b. Soil organic matter content

Repeat loss-on-ignition analyses were carried out on 5% of the 1971 soil samples using the same methodology as for the soil samples collected in 2000. The repeat values and the original 1971 LOI values for the same sample are shown in Table 3. There was no significant difference between these data from a t-test for dependant samples; p>0.05.

Table 3 Original 1971 values and repeat values from 2000 for loss-on-ignition analyses on the same soil samples collected in 1971

These soil samples have been stored at CEH Merlewood since 1971.

Site	LOI 1971	LOI 1971 repeat
101	14.82	15.6
14	8.762	7.38
20	19.646	19.3
28	8.636	8.31
31	12.112	10.7
40	12.12	10.5
42	93.33	91.7
51	14.04	14
60	36.41	28.6
66	6.34	6.42
72	33.69	35.5
73	25.59	25.5
95	7.3	8.8

2.7 Data transfer and storage

dbh and floristic data were all checked for completeness by field recorders. Transfer from field sheets to spreadsheet was carried out by Caroline Hallam, a consultant who had previously been sub-contracted by CEH to input Countryside Survey 2000 plot data. Transfer of soil analyses data to spreadsheets was done by staff in Soil Ecology and Environmental Chemistry Sections and validated using standard protocols.

2.8 Analytical methods

Univariate analyses; tests of change in plot-based variables ie. one value for each variable per plot

Univariate tests were used to quantify change over time in the floristic, soil and dbh data. Firstly, plant species lists for each plot were converted into a series of summary indicator variables designed to convey implicit shifts along key environmental gradients (Table 4). These included mean Ellenberg scores for each plot based on values recalibrated for the British situation (Hill *et al* 1999; Hill & Carey 1997; Smart 2000) and mean values for Grimes' three established strategies of plant growth; Competitors, Stress-tolerators and Ruderals (Grime 1979; Grime *et al* 1995; Thompson 1994). Summarising multivariate data in this way both reduces variation, leading to more sensitive tests, and builds in an assumed link to proximal causes of change (Smart 2000). For example, increasing Ellenberg fertility score implies (but is not direct evidence for) an increase in nutrient availability. Other variables analysed included simple species richness, soil pH, soil organic matter content (LOI %), change in cover of potential field layer dominants, change in the proportion of numbers of trees to shrubs and saplings and a measure of change in the shape of the dbh based age-class distribution curve for each plot (Box 2).

Paired t-tests were carried out on differences between years for all these varaiables. Tests were done within each site and across all sites. For the latter, a modified algorithm was used that takes account of the nestedness of plots within each site and therefore corrects for the degree of autocorrelation found between them. This is exactly the same as the approach used in Countryside Survey 2000 reflecting the equivalence in sample structure between the two schemes.

2.8.1 Univariate analyses; tests on individual species abundance

Changes in frequency (ie. presence and absence) between 1971 and 1990 were carried out using McNemar chi-square (Zar 1984). Tests of change in mean cover used the Wilcoxon matched pairs test (Zar 1984).

Multivariate analyses

Ordination techniques were used to extract the major gradients of floristic variation in the plot data recorded in 1971 and 2000. Both years' data were analysed together. Partial Canonical Correspondence Analysis (PCCA) was used to regress explanatory variables onto the gradients in the species by plot data after removing variation due to either time or site. These analyses allowed the total variation in the plot data to be decomposed by site and by time, and by a minimum number of explanatory variables (eg Marrs & LeDuc 2001). Analyses were based on presence/absence data only for plant species in plots. In addition, tree and shrub species recorded in each plot for dbh were omitted since these data were already included in the analysis as explanatory variables. Separate sequences of analyses were carried out treating site or time as covariables. Initial ordinations incorporated all possible variables comprising those in Table 4. Subsequent runs excluded the vegetation derived indicators and the site level variables thus focussing on independent soil and dbh variables that could be linked to environment and management induced changes at the plot level. The independent contribution of each explanatory variable was evaluated using permutation tests conditioned on covariables, either site or time. All analyses were carried out in CANOCO for Windows version 4.0.

Table 4 List of variables derived from site data, species lists, dbh measurements and soil samples

All variables were tested for change over time both within and between sites. A subset of these were also entered into constrained ordinations to search for the miminum number of variables that could best explain temporal and spatial variation in the data.

Explanatory variable	Weighting	Transformation	Interpretation	Entered into constrained ordination	SITE or PLOT level
Species richness	n/a	none			p
Mean Ellenberg pH	cover	none	decrease = implied lowering of pH	y	p
Mean Ellenberg Fertility	cover	none	decrease = lower fertility	y	p
Mean Ellenberg Light	cover	none	decrease = greater shade	y	p
Mean Competitor proportion	cover	none	decrease=lower contribution from competitive traits	y	p
Mean Stress-tolerator proportion	cover	none	decrease=lower contribution from stress-tolerant traits	y	p
Mean Ruderal proportion	cover	none	decrease=lower contribution from ruderal traits	y	p
Soil pH	n/a			y	p
Soil Organic Matter	n/a	square root		y	p
dbh curve	n/a	$\log_{10}(x+1)$	decrease = age-class distribution skewed more to right ie. fewer stems in younger dbh classes	y	p
Count of stems in DBH classes 1,2 & 3 (ie. 0-15cm)	n/a	$\log_{10}(x+1)$	decrease = fewer stems in 3 smallest dbh classes	y	s
Proportion of trees to saplings & shrubs	n/a	$\log_{10}(x+1)$	increase = greater proportion of trees	y	s
Cover of potentially dominant field layer species	n/a	$\log_{10}(x+1)$		y	p
Land Class	n/a	n/a		y	s
Land Class PCA axis 1 score	n/a	n/a	higher score = more western and upland	y	s
Easting	n/a	n/a	higher = more eastern	y	s
Northing	n/a	n/a	higher = more northern	y	s

3. Results

3.1 Patterns of change in age-class distribution of tree and shrub species

Between 1971 and 2000 there was a clear overall trend for reductions in the youngest and oldest age classes and a net increase in numbers of stems between 25 and 50 cm in diameter (Figure 1). The overall cross-site pattern described an ageing series of mixed tree species populations. Differences between sites and plots were not large enough to obscure this overall pattern; indeed the only sites that exhibited overall net increases in the youngest age-classes were Cil-Hen-Ros, Priestfield and Shieldaig. Mar Lodge also showed a net increase in dbh class 1 but this was entirely due to one outlying plot in which large numbers of young *Betula pendula* were recorded in 2000. The increases on Shieldaig were of small magnitude with a small increase in *Pinus sylvestris* in class 1 (0-5cm) and a larger increase in *Betula pendula* in class 2. Overall both Shieldaig and Mar exhibited less change in age-class distributions than the other 14 broadleaved sites. As seemed typical of these native pinewood sites, trees were present at much lower densities in part, presumably reflecting the greater skew toward older trees as well as local topography.

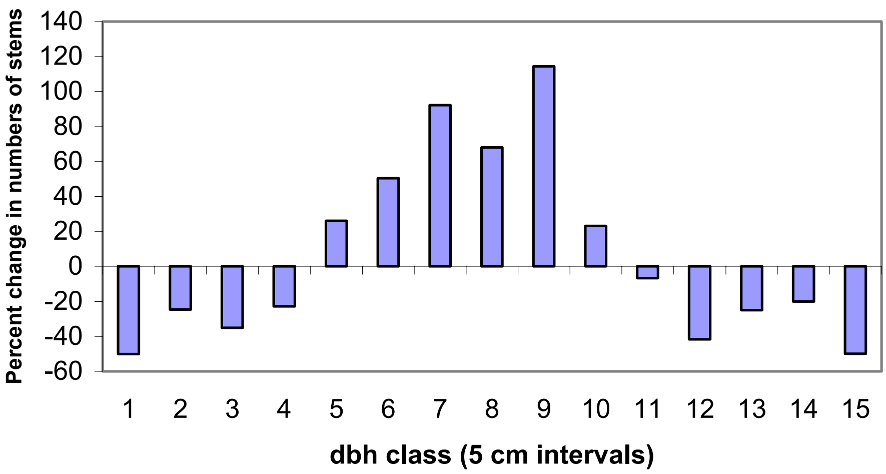


Figure 1 Net percentage change in counted stems across all sites and tree/shrub species between 1971 and 2000.

3.2 Changes in age-class distribution of common trees and shrubs between 1971 and 2000

Acer campestre **(field maple)**

- Recorded in relatively small numbers on four sites.
- Most abundant at Balsham wood where class counts were similar in 1971 and 2000.

***Acer pseudoplatanus* (sycamore)**

- Present on nine sites.
- Exhibited the largest increases in stem counts of any species recorded.
- Large numbers recruited into class 1 at Priestfield. Also increased overall at Cil-Hen-Ros, Balsham and Bird's Marsh.
- Small ageing population with no apparent new recruitment at Wellhanger Copse.
- Populations declined at Eaves Wood and Spital probably as a result of deliberate removal under conservation management plans.

***Alnus glutinosa* (alder)**

- Found on nine sites in generally low numbers. Most abundant at Bird's Marsh, Glan Morlies and Callender.
- Ageing populations, with no apparent new recruitment at all sites except Bird's Marsh.

***Betula pendula* (silver birch)**

- Recorded on twelve sites, most showing an ageing population with little new recruitment.
- Overall decreases in population size with no new recruitment were seen at Bird's Marsh, Callender, Eaves Wood, Great Knott, Hall Brow and Hill Wood.
- Small increase in class 1 at Wellhanger Copse while marked new recruitment was seen at Priestfield and a more modest increase in class 1 at Shieldaig.

***Crataegus monogyna* (hawthorn)**

- Recorded at eleven sites and scarce on five of these.
- Declining numbers with no new recruitment seen at Wellhanger Copse, Hill Wood, Eaves Wood and Cil-Hen-Ros.
- Some new recruitment seen at Spital and Balsham while age-class distribution at Glan Morlies was similar in both 1971 and 2000.

***Fagus sylvatica* (beech)**

- Recorded on eleven sites where counts were all low apart from Bird's Marsh, Wellhanger Copse and Priestfield.
- Ageing populations with some new recruitment into class 1 seen at Wellhanger and Priestfield while population declined with no new recruitment at Bird's Marsh.

***Fraxinus excelsior* (ash)**

- Recorded on eleven sites.

- Ageing population but with new recruitment recorded at Balsham.
- Numbers declined overall with no replacement of juveniles at Bird's Marsh, Eaves Wood, Hill Wood and Spital. Recruitment but in smaller numbers than in 1971 at Wellhanger Copse.
- All other sites stable or with low counts in both years.

***Ilex aquifolium* (Holly)**

- Recorded on seven sites, on three of which it was present in low numbers while on the other four there were marked increases in juveniles.
- One of very few species to experience an overall increase in numbers of the smallest stems.
- New recruitment seen at Priestfield, Glan Morlies, Eaves Wood and Cil-Hen-Ros.

***Larix* spp. (larch)**

- Only recorded on five sites.
- At Wellhanger and Spital, reduction in numbers across all dbh classes suggests deliberate removal.
- Present in low numbers in both 1971 and 2000 at Eaves Wood while a small increase in numbers was seen at Priestfield.

***Prunus laurocerasus* (laurel)**

- Found on two sites. On Bird's Marsh it dominated some plots to the exclusion of all other species in canopy and field layers such that two of these plots had to be excluded from the multivariate analysis as they acted as influential outliers in an exploratory ordination.
- On Bird's Marsh there was little difference in age-class distribution between recording episodes while the species appeared to have invaded some plots at Wellhanger Copse since 1971.

***Pinus sylvestris* (Scot's pine)**

- Recorded at seven sites in generally low numbers.
- Marked decreases were seen at Balsham and at Eaves Wood while a small increase in numbers in dbh class 1 was recorded at the Shieldaig pinewood site.

***Prunus spinosa* (blackthorn)**

- Only recorded at four sites and in generally low numbers.
- The species disappeared completely from recorded plots at Eaves Wood and Wellhanger Copse while there was a small increase in numbers of stems newly recruited into class 1 at Balsham.

***Quercus* spp (oak)**

- Recorded at twelve sites.
- The overall trend was for ageing populations with lack of new recruitment. This was certainly the case at Eaves Wood, Great Knott, Hall Brow, Hill Wood and Spital.
- The age-class distribution appeared to be more stable at Wellhanger Copse while Priestfield was the only site to show marked signs of new recruitment and ageing across the youngest dbh classes.

***Rhododendron* spp**

- Only recorded at Bird's Marsh where numbers of recorded individuals were lower overall but the shape of the age-class distribution remained the same as in 1971.

***Salix* spp. (willow)**

- Recorded on seven sites but relatively infrequent at most of these.
- Only apparent new recruitment was at Glan Morlies.
- Went from low numbers to zero at Balsham, Callender, Cil-Hen-Ros, Eaves Wood, Great Knott and Mill Wood.

***Sambucus nigra* (elder)**

- Found at eight sites in generally low numbers.
- Small amount of new recruitment at Hill Wood.
- Number of recorded stems declined at Bird's Marsh and Spital.

***Sorbus aucuparia* (rowan)**

- Found at seven sites.
- Ageing populations with much little or no new recruitment recorded at Shieldaig, Mill Wood and Callender.
- Marked decrease in numbers seen at Eaves Wood.
- The only clear evidence of new and increased numbers of dbh class 1 stems was at Priestfield.

***Taxus baccata* (yew)**

- Only recorded at Eaves Wood where the population structure seemed stable with equivalent numbers of individuals in the youngest classes in both years and with evidence of movement into older dbh classes between 1971 and 2000.

***Ulmus* spp (suckering elms)**

- Only recorded in four sites. In two of these individuals were very infrequent while in Spital and Hill Wood numbers dropped by 70% and 93% respectively across all dbh classes between 1971 and 2000.

***Ulmus glabra* (wych elm)**

- Recorded at six sites in mainly low numbers.
- While numbers remained low but stable at Eaves Wood the species disappeared at Cil-Hen-Ros, Balsham and Hill Wood and saw a 90% reduction at Spital.

***Corylus avellana* (hazel)**

- The species was recorded at often high numbers on twelve sites.
- The overall pattern was for reduced numbers of stems across most age classes and especially the smallest classes, between 1971 and 2000.
- The largest reductions were seen at Hall Brow and Great Knott while declining population sizes were also seen at Mill Wood, Hill Wood, Eaves Wood and Balsham.
- New recruitment into the youngest age classes was seen at Priestfield, Bird's Marsh and Cil-Hen-Ros.

3.3 Change in basal area of trees and shrubs between 1971 and 2000

Neither total live or dead basal area appeared to show any clear cross-site trends. Some sites saw net increases while others decreased (Figures 2 and 3). Lack of site-based patterns is partly attributable to variation between plots being subsumed within the overall site total (see Site Statements – Appendix 1). Also *fallen* dead wood is not counted in these data despite being present in substantial amounts on sites such as Wellhanger and Cil-Hen-Ros.

It is notable that the low productivity pine wood sites – Callender, Mar Lodge and Shieldaig – exhibited the lowest live basal areas values. Hill Wood is artificially low because this site only contributed eight plots to the graph; the other eight plots recorded woodland destruction and replacement by improved grassland (see Box 3).

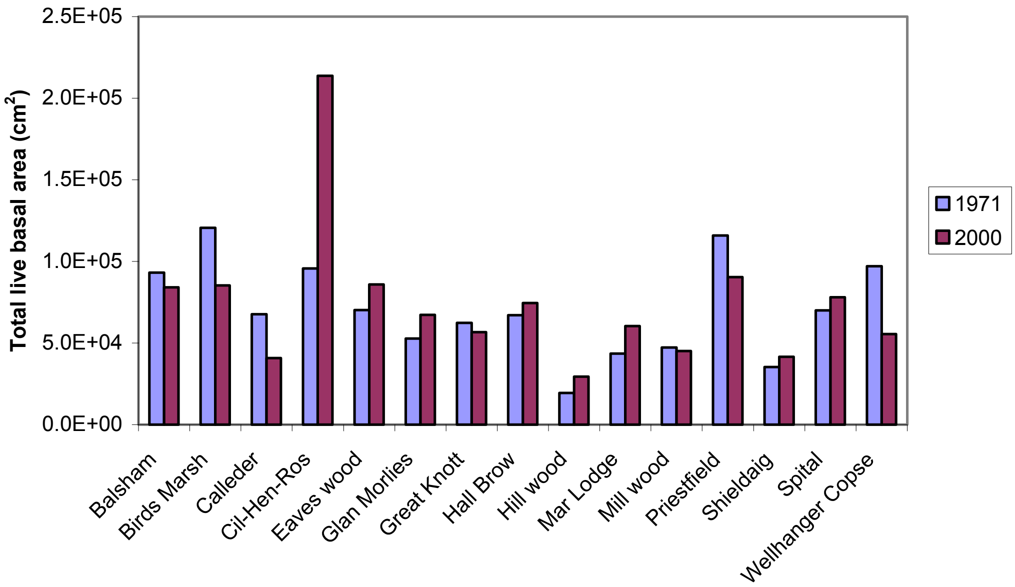


Figure 2 Change in total live basal area of trees and shrubs between 1971 and 2000.

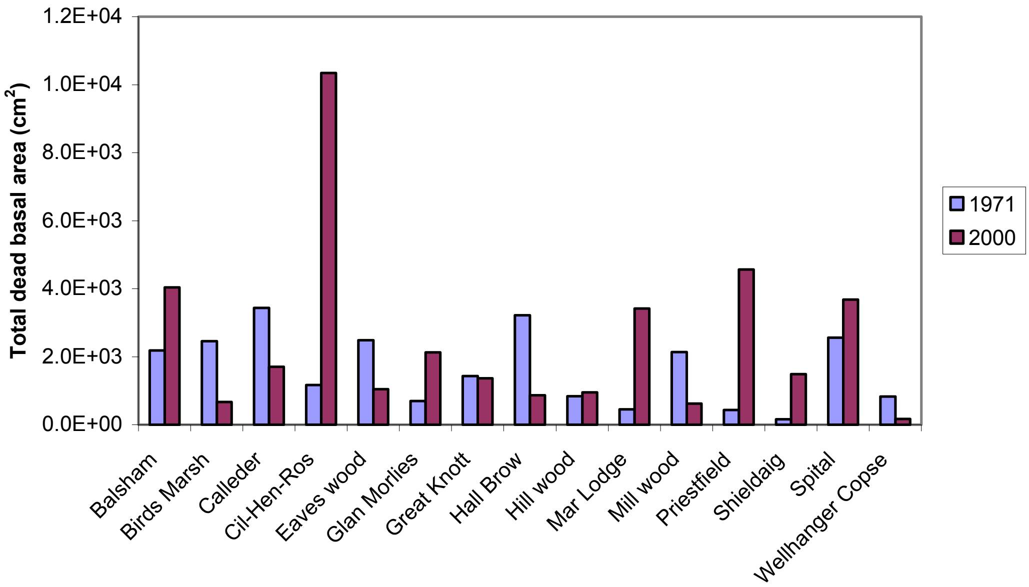


Figure 3 Change in total dead basal area of trees and shrubs between 1971 and 2000.

3.4 Changes in derived vegetation and environmental variables between and within sites

3.4.1 Ellenberg fertility

Four out of fourteen sites showed a statistically significant increase in mean Ellenberg fertility score while one site – Eaves Wood - showed a significant decrease (Table 5). Analyses across all sites together showed no statistically significant change (Figure 4).

Both native pinewood sites showed statistically significant reductions in mean Ellenberg fertility value. This appeared to be related to a reduction in frequency of low cover associates that tended to be small and more typical of more basic and therefore rather more fertile conditions. Species included *Festuca ovina* and *Succisa pratensis*. On both sites *Vaccinium myrtillus* increased in cover. This would have contributed to decreased mean fertility, pH and light values.

Ellenberg light

At the within site level (Table 5) five statistically significant changes were detected; four decreases and one increase. No significant change was seen at the GB or zonal level (Figure 4). Decreased light score indicates that shade tolerant or shade casting species may have increased or/and that species more suited to open, well-lit situations have declined.

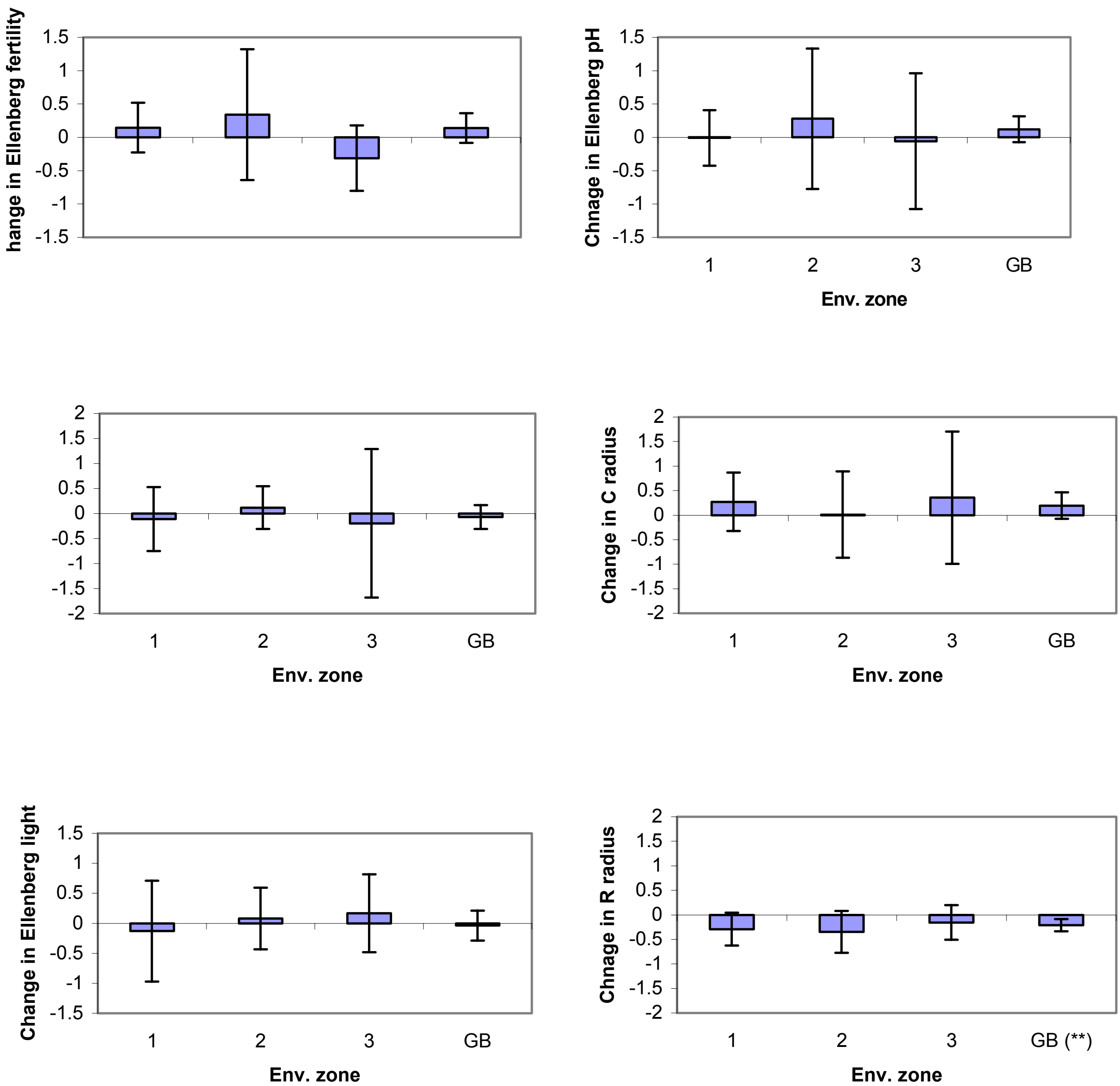


Figure 4 Change in derived vegetation indices between 1971 and 2000.

Analyses carried out at plot level across all sites. Evironmental zones correspond to broad regions of England & Wales defined and used in the Countryside Survey 2000 report (Haines-Young et.al. 2000). Zone 1: Easterly lowlands (number of plots=72). Zone2: Westerly lowlands (n=48). Zone 3: Uplands (n=48). GB: All of England, Wales and Scotland (n=216). Too few sites were available in Scotland for meaningful division by Scottish zones. The two Scottish Pinewood sites, Mar Lodge and Shieldaig, were analysed separately. All indices were weighted by plant species cover (see table 4 for explanation of variable types). Wide bars indicate mean difference +/- the 95% confidence interval of the change (narrow bars).

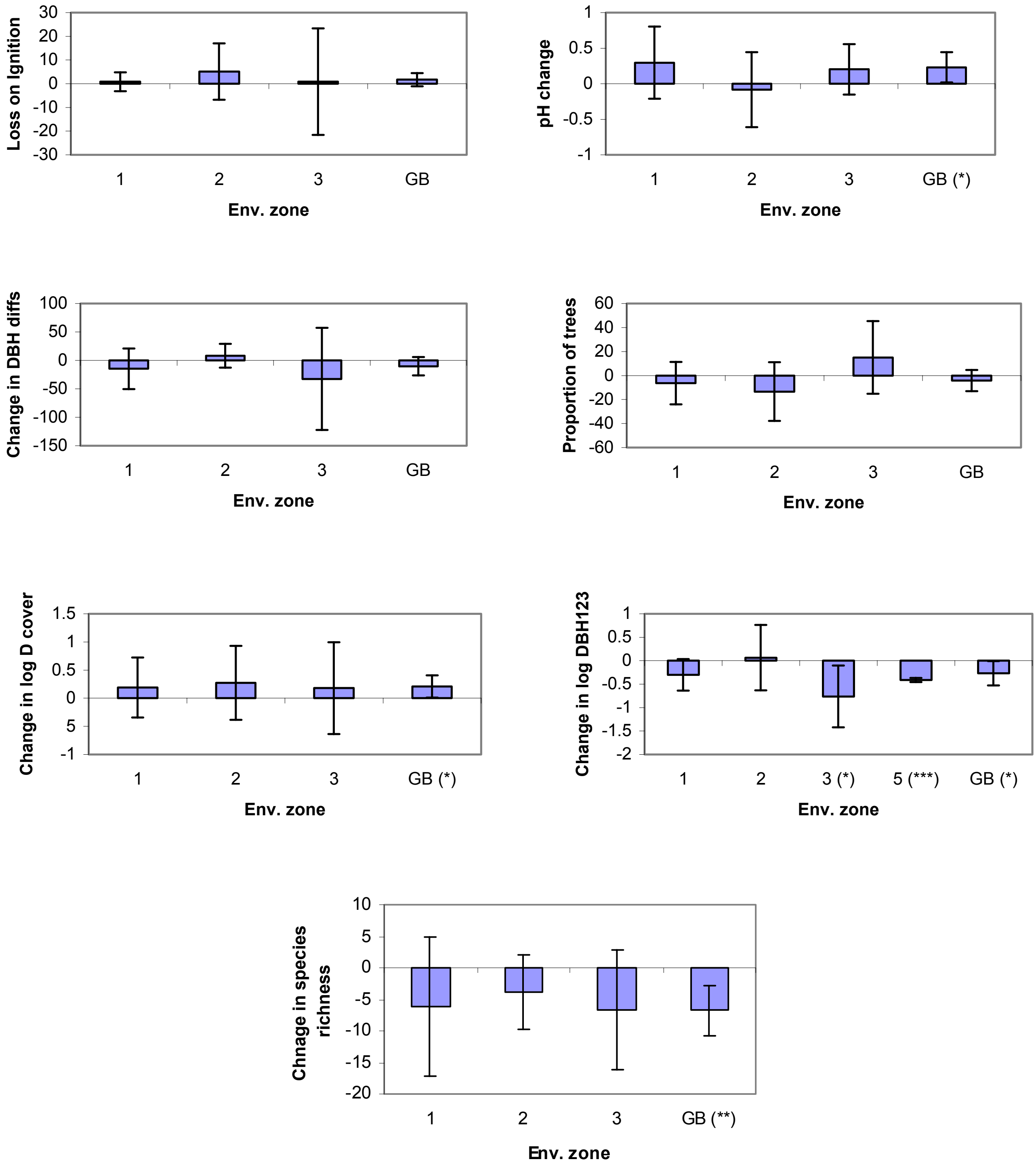


Figure 5 Change in soil and dbh-based variables between 1971 and 2000.

Analyses carried out at plot level across all sites. Evironmental zones correspond to broad regions of England & Wales defined and used in the Countryside Survey 2000 report (Haines-Young et.al. 2000). Zone 1: Easterly lowlands (number of plots=72). Zone2: Westerly lowlands (n=48). Zone 3: Uplands (n=48). GB: All of England, Wales and Scotland (n=216). Too few sites were available in Scotland for meaningful division by Scottish zones. The two Scottish Pinewood sites, Mar Lodge and Shieldaig, were analysed separately (see table 4 for explanation of variable types).

Table 5 Change in derived vegetation indices, dbh-based variables and soil measurements

Bold values were significant at $p<0.05$. [#]

Site	Species Richness		Ellenberg ph		Ellenberg fertility		Ellenberg light		Competitor sore	
	Mean	*p*	Mean	*p*	Mean	*p*	Mean	*p*	Mean	*p*
14 Birds Marsh	-2.69	0.32	0.77	**0.03**	0.75	**0.03**	0.25	0.34	-0.30	0.39
20 Wellhanger Copse	3.63	0.41	-0.08	0.68	0.01	0.97	0.30	0.49	0.27	**0.05**
24 Hill wood	-17.75	**0.00**	0.33	**0.04**	0.43	0.20	-0.81	0.08	0.46	**0.03**
28 Spital	-1.94	**0.04**	-0.05	0.49	0.51	**0.00**	0.72	**0.02**	0.85	**0.00**
31 Balsham	-5.00	0.23	0.16	0.32	0.13	0.46	-0.63	0.08	0.26	0.17
40 Mill wood	-20.56	**0.00**	0.50	**0.05**	0.52	**0.04**	0.05	0.75	0.13	0.20
42 Calleder	-12.06	**0.00**	-0.01	0.91	0.02	0.90	-0.12	0.35	0.73	**0.00**
51 Cil-Hen-Ros	-5.56	**0.00**	0.01	0.95	-0.04	0.81	0.14	0.40	-0.08	0.23
60 Eaves wood	-10.88	**0.01**	0.19	0.08	-0.50	**0.03**	0.45	0.06	-0.27	0.08
66 Glan Morlies	-3.19	0.29	0.06	0.83	0.31	0.20	-0.15	0.45	0.39	**0.00**
72 Hall Brow	-5.94	**0.02**	-0.53	**0.03**	-0.33	0.09	0.12	0.39	0.63	**0.03**
73 Great Knott	-3.31	0.18	0.16	0.34	-0.10	0.35	-0.06	0.32	0.71	**0.00**
95 Priestfield	0.69	0.74	0.52	**0.05**	0.61	**0.01**	-0.60	**0.00**	-0.56	**0.04**
101 Oakers	-15.38	**0.00**	-0.23	0.67	-0.21	0.66	-0.56	**0.02**	-0.39	0.05
3 Forest of Mar	3.31	0.11	-0.34	**0.03**	-0.38	**0.01**	-1.17	**0.00**	0.12	0.09
21 Shieldaig	-0.94	0.67	-0.63	**0.00**	-0.54	**0.00**	-1.86	**0.00**	-0.08	0.58

Site	Stress-tolerator score		Ruderal score		DBH slope		Cover of key field layer dominants	
	Mean	*p*	Mean	*p*	Mean	*p*	Mean	*p*
14 Birds Marsh	0.03	0.90	-0.38	**0.03**	11.38	0.20	0.05	0.85
20 Wellhanger Copse	-0.23	0.16	-0.04	0.73	-11.50	0.50	0.34	0.09
24 Hill wood	0.34	0.09	-0.42	**0.04**	-55.13	**0.00**	-0.39	0.06
28 Spital	-0.81	**0.00**	-0.10	0.49	-37.06	**0.00**	0.65	**0.01**
31 Balsham	0.44	**0.00**	-0.29	0.11	12.88	0.35	-0.27	0.17
40 Mill wood	-0.03	0.83	-0.03	0.77	-12.19	0.11	0.43	**0.00**
42 Calleder	-0.48	**0.02**	-0.05	0.54	-11.56	**0.03**	0.50	**0.00**
51 Cil-Hen-Ros	0.15	**0.04**	-0.17	0.06	14.56	**0.00**	0.21	**0.01**
60 Eaves wood	0.47	**0.01**	-0.20	**0.03**	-74.13	**0.00**	-0.15	**0.05**
66 Glan Morlies	0.17	0.31	-0.50	**0.01**	-1.38	0.69	0.56	**0.00**
72 Hall Brow	-0.38	0.11	-0.27	**0.04**	-13.56	**0.01**	0.51	**0.02**
73 Great Knott	-0.68	**0.00**	0.01	0.97	-9.81	**0.01**	0.18	0.25
95 Priestfield	0.29	0.22	0.07	0.65	21.63	**0.01**	-0.33	0.08
101 Oakers	-0.05	0.80	-0.67	**0.00**	-	-	0.34	0.06
3 Forest of Mar	-0.09	0.17	0.07	0.36	0	1	n/a	
21 Shieldaig	-0.08	0.57	0.1	0.30	-6.25	0.22	n/a	

[#] A total of 138 tests were carried out so between 6 and 7 significant results expected by chance at $p<0.05$, 1 at $p<0.01$ and none at $p<0.001$.

3.4.2 Ellenberg pH

At the site level, seven statistically significant changes were detected. Four of these were increases indicating a shift toward a species composition typically associated with higher base status (Table 5). Overall nine sites showed increased Ellenberg pH scores while seven showed decreases; two of these were attributable to significant decreases on the two native pinewood sites. Change in this indicator variable was not statistically significant at the GB level although the 95% confidence interval indicates that there is a greater likelihood that woods in general have seen increased rather than decreased scores. The magnitude of change over time is relatively small compared to between site differences in means (Figure 6). The acidic woodlands of Callender (H) and Great Knott (M) stand out well in this respect. However the between-site trend has greater ecological significance in light of the soil pH changes described below.

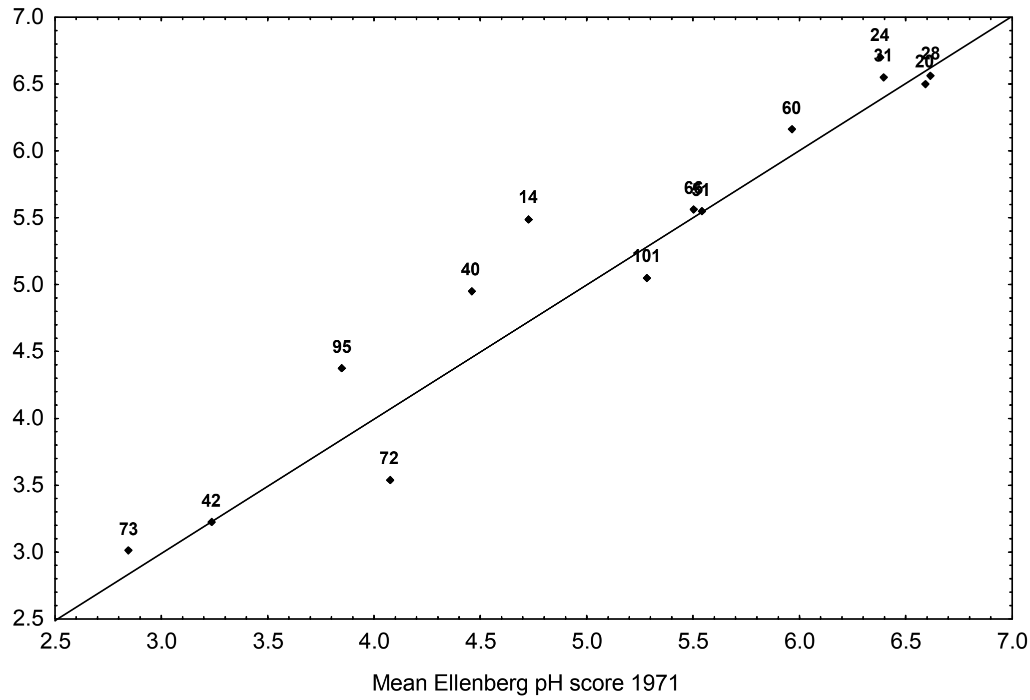


Figure 6 Scatter plot showing the change in mean cover-weighted Ellenberg pH score on each of 14 pilot sites surveyed in 1971 and 2000.

16 plots were located on each site except Hill Wood where 8 plots that recorded complete removal of broadleaved woodland were excluded from the analysis. Site codes are as follows: 101, Oakers; 14, Bird's Marsh; 20, Wellhanger Copse; 24, Hill Wood; 28, Spital; 31, Balsham Wood; 40, Mill Wood; 42, Callender; 51, Cil-Hen-Ros; 60, Eaves Wood; 66, Glan Morlies; 72, Hall Brow; 73, Great Knott; 95, Priestfield.

3.4.3 Species richness

The magnitude and prevalence of the changes in species richness was dramatic and constitutes one of the most striking results seen in the analysis of the pilot survey data (Figure 7). Species richness declined in all but two of the fourteen sites while eight changes (all declines in mean species count) were statistically significant (Table 5). The two pinewood survey sites remained stable. The only sites to have shown small but non-significant increases were Priestfield and Wellhanger Copse. Not surprisingly such a strong and convergent signal across sites was also reflected in a significant reduction in mean richness at the GB level ie. analysing all plots together (Figure 4).

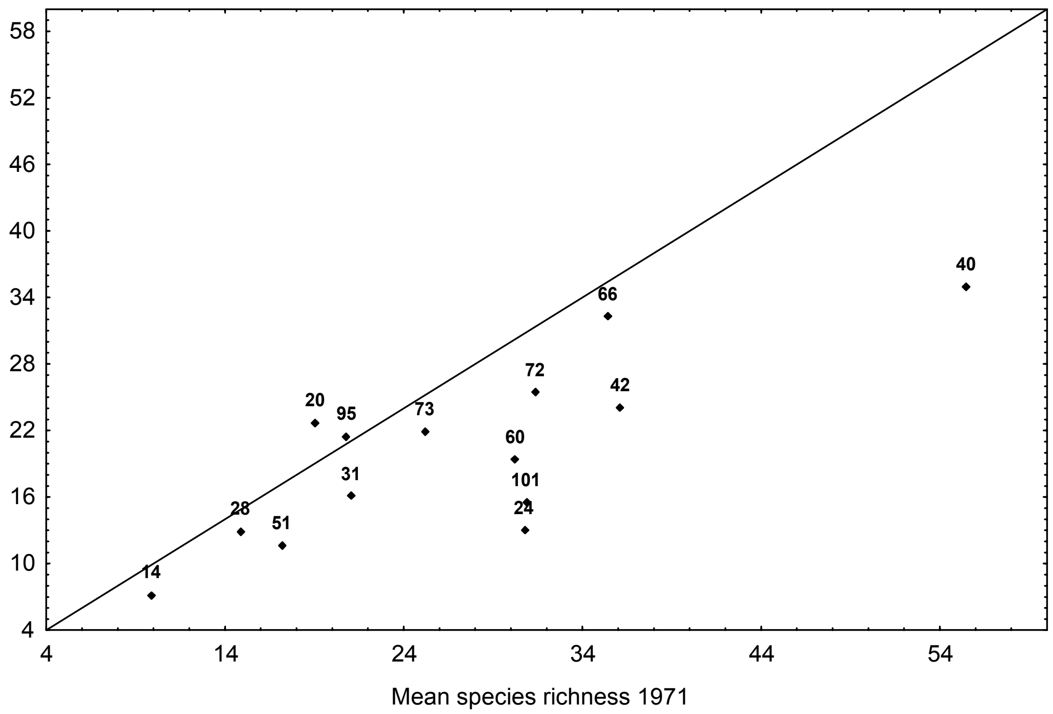


Figure 7 Scatter plot showing the change in mean species richness on each of 14 pilot sites surveyed in 1971 and 2000.

16 plots were located on each site except Hill Wood where 8 plots that recorded complete removal of broadleaved woodland were excluded from the analysis. Site codes are as follows: 101, Oakers; 14, Bird's Marsh; 20, Wellhanger Copse; 24, Hill Wood; 28, Spital; 31, Balsham Wood; 40, Mill Wood; 42, Callender; 51, Cil-Hen-Ros; 60, Eaves Wood; 66, Glan Morlies; 72, Hall Brow; 73, Great Knott; 95, Priestfield.

3.4.4 Competitor score

The proportion of species exhibiting relatively competitive traits increased on nine out of fourteen sites. Eight increases and two decreases were statistically significant. The two sites showing reduced competitor scores were Oakers and Priestfield (Table 5).

3.4.5 Ruderal score

The proportion of ruderal plants, ie. those more typical of increasingly open and periodically disturbed conditions, decreased significantly at the GB all-sites level (Figure 4). Decreases also appeared to be more characteristic of the lowland zones 1 and 2. Analysis of individual sites showed remarkable convergence with twelve out of fourteen reductions, six of which were statistically significant (Table 5).

Stress-tolerator score

Changes in the proportion of stress-tolerators in plots were variable across the pilot sample. Exactly half the sites saw increased scores while six statistically significant changes were evenly balanced between increases or decreases (Table 5).

3.5 Soil pH in 1971 and 2000

3.5.1 Changes across all plots

Soil pH increased between 1971 and 2000, especially in the more acidic soils. A t-test for dependant samples indicated there was a significant increase in soil pH over the last 29 years; mean change = + 0.27 pH over all soils (Table 6). However the direction of change was not consistent across all soils, as highlighted in Table 6 and Figure 9. Increases in soil pH have mainly occurred where the 1971 soil pH was less than 6 with this increase being most pronounced in the most acidic soils. In soils where the 1971 pH was greater than pH 6, the majority of soils have, in fact, decreased in pH (Table 6). Although there was no significance to the absolute change from t-test analyses, the influence of a 'regression to the mean' cannot be discounted.

These results are however consistent with those recently obtained from the Countryside Survey 2000 soil re-sampling that examined changes from 1978 to 1998/9 (see Haines-Young *et al* 2000), and also re-sampling data obtained by SSLRC from the National Soil Inventory and ADAS from the Regional Soil Sampling Scheme (both of which are dominated by agricultural soils) (Loveland and Chambers, pers. comm.).

Site level changes in soil pH

Mean soil pH from 1971 and 2000 for each site is presented in Figure 10. Out of 16 sites, 13 showed an increase in soil pH over the period. Within sites t-test analyses showed that these changes were significant for sites 3, 20, 24,42, 73 and 95 (Table 7). Analyses of site easting and/or northing indicated no significant relationship with location. Further analyses with site location (e.g. altitude) may provide more insight since, of the three sites where pH decreased, two are in Wales and the remaining is the most northerly sample while the three sites where SOM increased most are in southern locations. Within site heterogeneity is clearly significant in sites 20, 24 and 42 (Figure 10). This may reflect management changes (e.g. site 60 Eaves Wood) or other environmental differences (e.g. shallow soils at site 42 Callender). It is noticeable that sites with the most base-rich soils (sites 20, 24) showed an increase in soil pH although the trend across all woodlands was for decline in pH by base rich soils. However, examination of change in within site values for soil pH showed that changes were consistent with the overall tendency for increased pH within more acid areas. This phenomenon of differential responses within sites relating to initial soil properties is apparent across all sites, as highlighted by the significant results from pH class analyses (Table 6).

Table 6 Statistics for soils re-sampled in 2000 by pH class for the 1971 soil pH

Soil pH class	Sample N	Mean change in soil pH	s.e.	Decrease in soil pH (sample N)	Increase in soil pH (sample N)	T-test significance
=3.5<4	36	0.80	0.07	35	1	<0.005
=4<4.5	60	0.39	0.07	48	12	<0.005
=4.5<5	39	0.31	0.10	27	12	<0.005
=5<5.5	35	0.42	0.18	20	15	<0.05
=5.5<6	25	0.34	0.20	15	10	n.s.
=6<6.5	19	0.06	0.11	10	9	n.s.
=6.5<7.0	17	-0.23	0.17	7	10	n.s.
=7.0<8	22	-0.72	0.24	8	14	<0.01
all	253	0.27	0.05	170	83	<0.05

Table 7 Statistics for soils re-sampled in 2000 by site

Site	Change in fresh soil pH	pH (N)	T-test significance between means	Change in SOM	SOM (N)	T-test significance between means
3	0.49	16	<0.005			n.s.
14	0.15	16	n.s.	9.46	16	n.s.
20	0.84	16	<0.01	0.12	16	n.s.
21	0.17	16	n.s.			n.s.
24	0.66	16	<0.005	3.73	16	<0.01
28	0.41	16	n.s.	2.63	16	n.s.
31	0.16	16	n.s.	-1.07	16	n.s.
40	0.13	16	n.s.	3.13	16	n.s.
42	1.03	16	<0.005	-2.04	16	n.s.
51	-0.15	16	n.s.	4.76	16	<0.005
60	0.11	16	n.s.	-4.25	16	n.s.
66	-0.25	15	n.s.	1.23	15	n.s.
72	0.20	16	n.s.	-4.51	16	n.s.
73	0.33	15	<0.005	11.27	16	<0.01
95	0.26	15	<0.05	0.22	16	n.s.
101	-0.21	16	n.s.	-1.67	16	n.s.

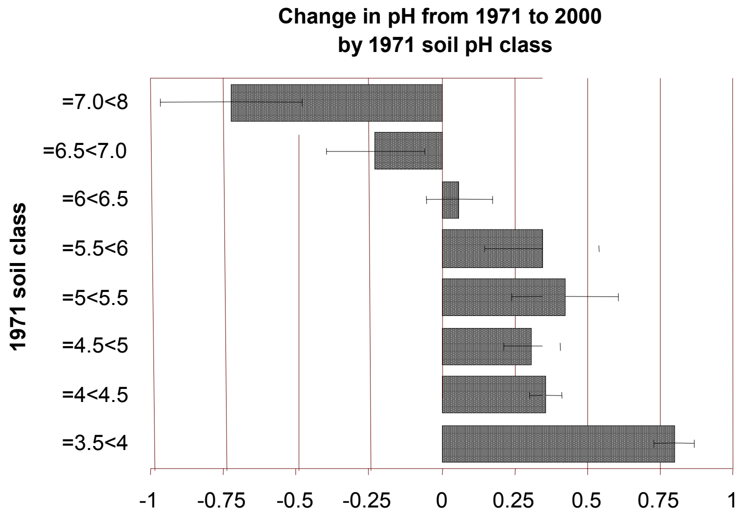


Figure 8 Change in pH from 1971 to 2000 by 1971 soil pH class.

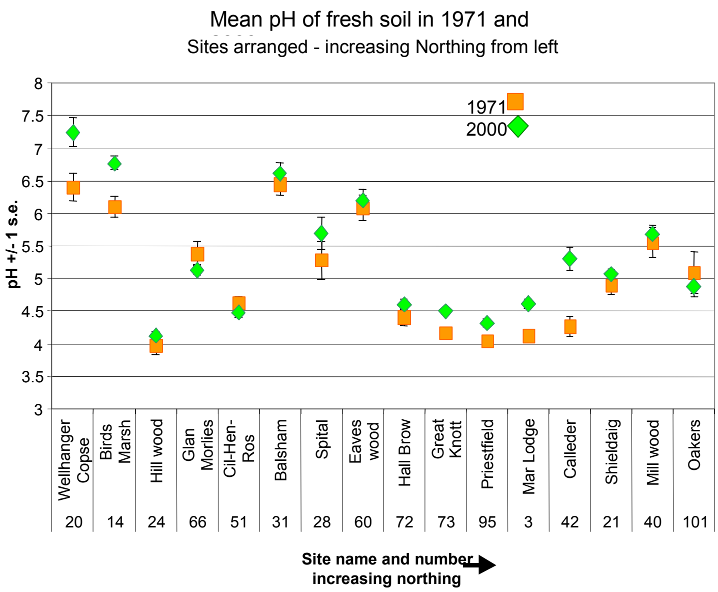


Figure 9 Mean pH of fresh soil in 1971 and 2000.

Sites arranged by northing from left to right.

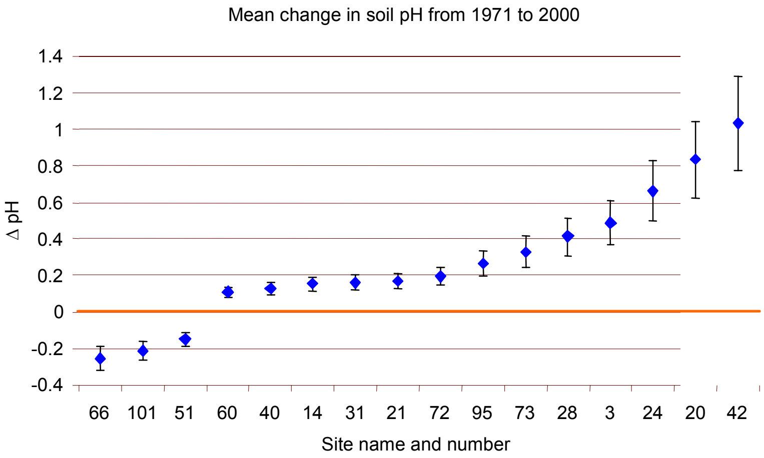


Figure 10 Mean change in soil pH from 1971 to 2000.

3.6 Soil organic matter content in 1971 and 2000

3.6.1 Change in soil organic matter content across all woodland plots

Figure 11 shows the change in Soil Organic Matter (SOM) between paired samples from 1971 to 2000 plotted against the original soil organic matter from 1971. No significant differences were apparent between 1971 and 2000 in the overall dataset. However, when the data are summarised by 1971 SOM class (Figure 12), a decline in SOM in the more organic soils and an increase in SOM in the least organic soils are apparent. The relative number of soil samples where SOM has either increased or decreased is detailed in Table 8. The results suggest that soils below 30% organic matter content have tended to increase in soil organic matter content and those above 30% have declined in SOM.

Table 8 Statistics for soil organic matter content of soils re-sampled in 2000, by 1971 soil organic matter (SOM) class

1971 SOM class	Sample N per class	Mean change in SOM from 1971 to 2000	s.e.	Decrease in SOM (N)	Increase in SOM (N)	T-test P
<10	69	8.36	1.76	57	12	<0.005
=10<15	68	3.62	1.51	39	29	<0.05
=15<20	33	1.48	1.65	14	19	n.s.
=20<30	24	7.67	3.81	14	10	n.s.
=30<100	29	-23.75	4.59	3	26	<0.005
all	223	1.64	1.24	127	96	n.s.

3.6.2 Site level changes in soil organic matter content

Mean soil organic matter from 1971 and 2000 for each site are presented in Figure 14. Results indicate that mean site changes in SOM range from +11 to -5% over the last 29 years. Out of 14 sites (no data from Shieldaig and Mar) 7 showed an increase in SOM over the period, 5 sites declined and 2 showed no change. Within site analysis showed that these changes were significant for sites 24, 51 and 73 (Table 7). Analyses of site SOM by easting and/or northing (see Figure 13) indicated no significant relationship with location. Within site heterogeneity was clearly significant in sites 60, 42 and 14 and, to a lesser extent, 101 and 73. This may reflect management changes (e.g. site 60) or other environmental differences (e.g. shallow soils). Change data were rather variable at the plot and site level and consequently no significant changes were detected in zonal or GB all-sites tests (Figure 5 & Table 5). Again the site data seemed to mask the overall trend in SOM change over the time period since changes in SOM grouped by 1971 SOM class were highly significant. Again, as in soil pH, soils within sites may be responding differently depending on their initial properties. In addition this pattern is also likely to be partly attributable to a 'regression to the mean' artefact (A. Scott pers.comm.). This does not however, apply to t-test results.

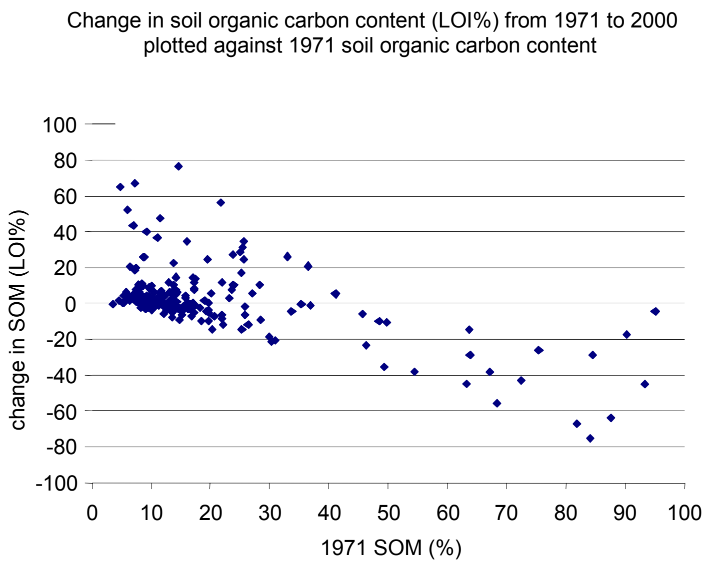


Figure 11 Change in soil organic matter content (LOI%) from 1971 to 2000 plotted against soil organic carbon content.

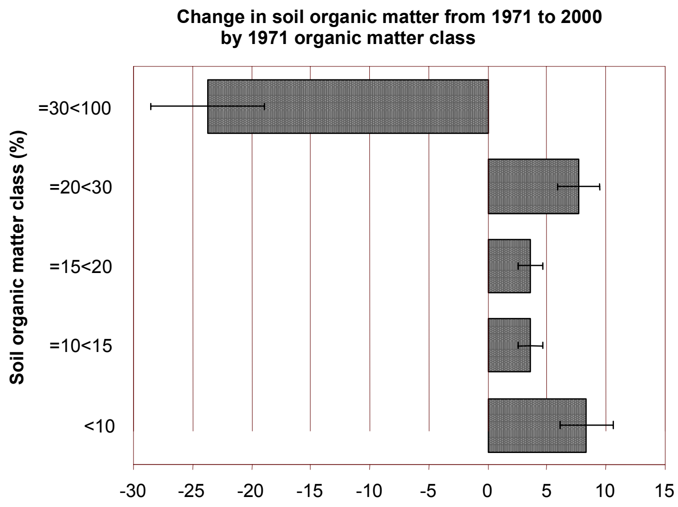


Figure 12   Change in soil organic matter from 1971 to 2000 by SOM class.

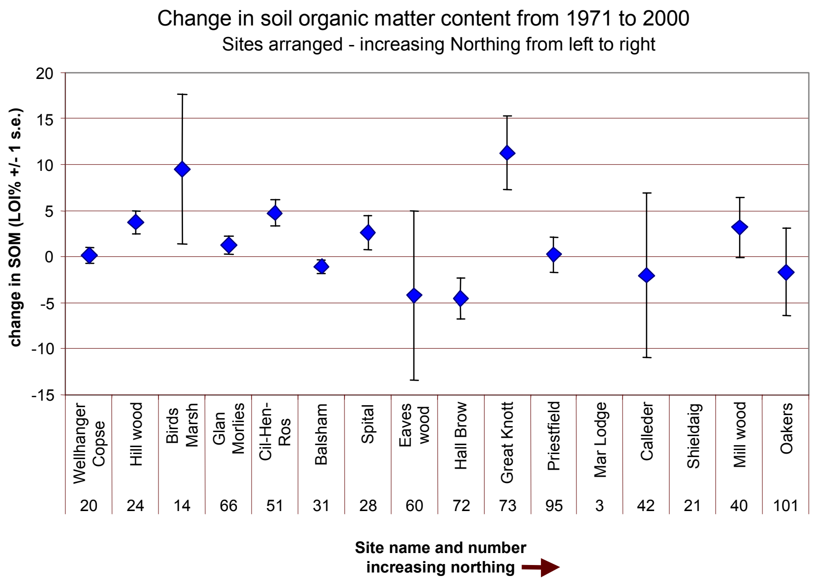


Figure 13   Sites arranged by northing from left to right.

(No data for the two pinewood sites).

Relationships between soil pH and organic matter content

There was no significant relationship detectable between the change in soil pH and soil organic matter content from 1971 to 2000 using all plot data or across sites. However, changes in soil pH by soil organic matter class (Figure 14) were significant across soil organic matter classes (Table 9) with the most organic soils showing the greatest increases in pH. Similar analyses for soil organic matter content by soil pH class (Figure 15) showed no significant changes within pH class. High within-site variation for both soil pH and SOM was only shown in one woodland (site 42, Callender), a site with shallow, sparse soils. Further analyses is required to examine relationships of SOM to management and location etc.

Table 9 Mean change in soil pH from 1971 to 2000 by soil organic matter class

SOM class	N	Mean change in fresh soil pH	s.d.	T-test significance between means
<10	69	0.10	1.03	n.s.
=10<15	67	0.32	0.96	<0.005
=15<20	32	0.20	0.54	<0.05
=20<30	24	0.34	0.54	<0.005
=30<100	29	0.52	0.78	<0.001

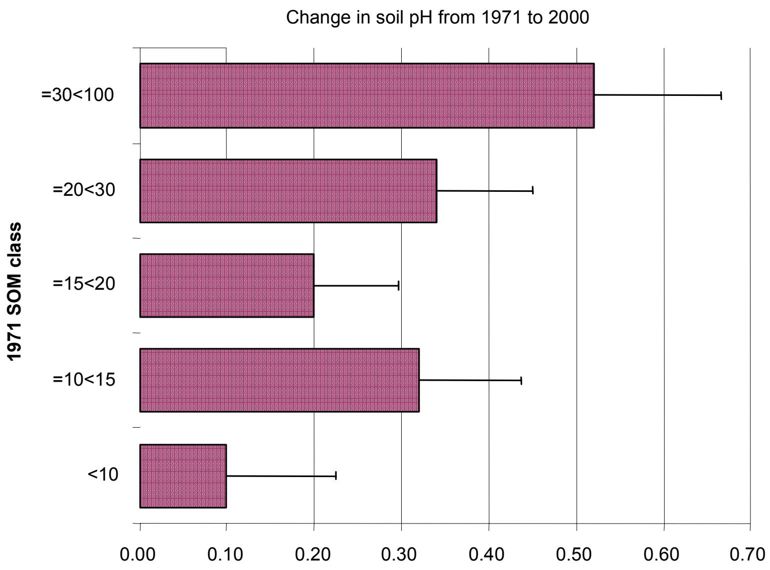


Figure 14 Change in soil pH from 1971 to 2000 by SOM class in 1971.

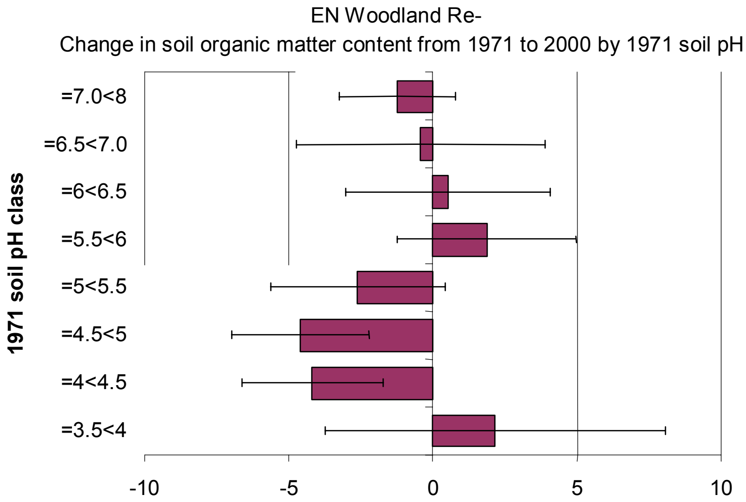


Figure 15 Change in SOM from 1971 to 2000 by 1971 soil pH class.

3.7 Relationship between change in soil pH and mean Ellenberg pH value

A positive correlation (Spearman r=0.278, n=216, p<0.001) was detected between soil pH and the cover weighted mean Ellenberg value that conveys changes in plant species composition along an implied pH gradient (Fig 16). While a time lag in the response of the vegetation would be expected, it seems that the thirty year survey interval is sufficient to have allowed detection of the positive relationship. The potential for vegetation response will also have been locally constrained by the available pool of species present. In this respect using a cover-weighted score will have added sensitivity and lessened the local pool constraint since responses to changing conditions could be expressed by change in abundance within plots rather than relying solely on appearance and disappearance.

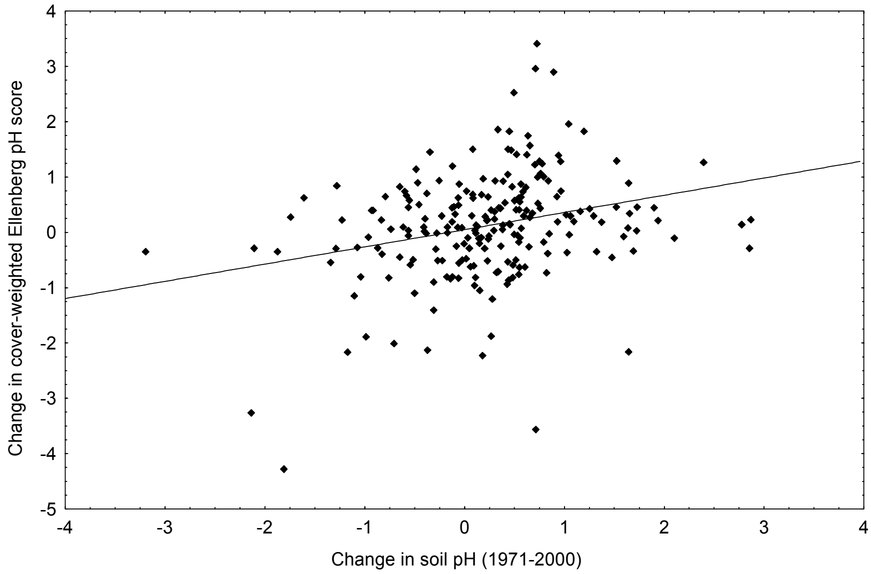


Figure 16 Relationship between change in mean cover-weighted Ellenberg pH value versus change in soil pH.

3.8 Changes in skewness of the dbh derived age-class distribution curve

This variable summarises the sequential difference in numbers of stems counted in each adjacent dbh class across ALL species in each year. A mean decrease indicates that the age-class distribution curve became less skewed to the left over time indicating fewer numbers of stems in the younger age-classes and relatively greater numbers of individuals in older classes. Eight out of thirteen sites showed a reduction in value (Table 5). No change data were available for Oakers in the absence of 1971 dbh records. Of the eight statistically significant site level tests, six conveyed decreased slopes. However high variability from plot to plot and between sites undoubtedly contributed to a lack of significance at the GB all-sites level although the 95% confidence interval suggested that there was a greater likelihood that broadleaved woods had, in general, shifted toward an older age-class profile with fewer juvenile stems (Fig 5). Indeed when count of stems in the youngest age-classes 1,2 and 3 were analysed, statistically significant reductions in stem numbers were seen at the GB all-sites level but also across the three upland sites in England & Wales and the two upland sites in Scotland (Fig 5).

3.9 Cover of potential field layer dominants

Changes in mean cover of field layer dominants excluded tree and shrub species whose density changes were tracked by the dbh curve variable as well as changes in total count of stems in the first three dbh classes. The tests here focussed on mean cover change in each plot summed over eleven potential woodland field layer dominants. These were *Deschampsia cespitosa, D. flexuosa, Hedera helix, Holcus mollis, Mercurialis perennis, Pteridium aquilinum, Rubus fruticosus* agg., *Urtica dioica, Vaccinium myrtillus* and *Rhododendron* spp. Tests of cover change in each individual species are reported below. Here, cover was averaged over all species to increase the chance of detecting a cross-site signal that would take into account different floristic starting points and therefore differences in the likely identity of potential dominants on each site.

Results showed that cover of potential dominants increased at ten out of fourteen sites and of the seven statistically significant changes, six were linked to increased mean cover the only significant decrease being Eaves at Wood (Table 5). Despite considerable variation between plots, a statistically significant increase in average cover was found at the GB all sites level (Fig 5).

Tests of change in cover of a selection of individual species were also carried out including the potentially dominant plants listed above (Table 10).

Table 10 Change in mean cover of selected plant species across all sites

All records were used including presences recorded at 1%-4% cover and records for scattered individuals at <1% cover which were coded arbitrarily as 0.5% in the plot data.

Species	Expected change	% occurrence (out of 224 in 1971)		Direction
Anthriscus sylvestris	Increase could indicate edge effects and fragmentation	5	ns	-
Arrthenatherum elatius	"	10	ns	-
Brachypodium sylvaticum	Increase maybe linked to deer grazing	33	ns	no change
Chamerion angustifolium	Increase following disturbance, burning, canopy clearance	9	ns	-
Deschampsia cespitosa	Increase following grazing or/and N input	35	*	-
D. flexuosa	Increase following grazing or/and N input	30	**	-
Galium aparine	Increase following N input and disturbance	28	ns	+
Hedera helix	Increase favoured by shading	49	ns	+
Holcus lanatus	Increased following grazing, N input	35	ns	+
H.mollis	Increase following grazing or/and N input	35	***	-
Hyacinthoides non-scripta	Decrease following grazing. Increase following canopy clearance	42	ns	-
Mercurialis perennis	Decrease following grazing	51	*	-
Plantago lanceolata	Increase favoured by repeated disturbance	6	*	-
Poa trivialis	Increase following N input or/and grazing	45	ns	-
Pteridium aquilinum	Increase following lack of management in more open areas	52	*	+
Rubus fruticosus agg.	Increase following lack of management	82	*	+
Urtica dioica	Increase following N input	45	ns	+
Vaccinium myrtillus	Increase in acid woods favoured by shading	17	ns	+

Statistically significant changes are most consistent with increased nutrient availability and lack of management. Interestingly, an increase in grass species that would be expected to reflect increased grazing pressure within sites was not observed. However, cross-site patterns were obscured by some notable between-site differences (see Site Reports). For example the massive decline in *Mercurialis perennis* and significant increase in *Brachypodium sylvaticum* on Eaves Wood was consistent with anecdotal evidence for a dramatic recent increase in deer numbers in the locale.

The most consistent parallel change between sites was shown by *Rubus fruticosus* agg, which increased substantially in mean cover across nine of the thirteen sites on which it was recorded. *Hedera helix* also increased across nine out of its twelve sites. The increase in *Rubus* is again at odds with expectations under increased grazing pressure (eg Kirby & Thomas 2000) although studies that have reported the effects of increased deer grazing have been mostly based on sites in southern and eastern England. Since only two of the pilot sites were located in this region, grazing impacts on woodland vegetation are likely to be absent or at best, weakly represented in these data.

3.10 Frequency of Ancient Woodland Indicator species

Out of nineteen statistically significant changes in frequency, seventeen species decreased and only two increased (Table 11). The increase in *Melica uniflora* was attributable to changes on Eaves Wood only following the creation of a mosiac of open areas of limestone pavement within the site (see Site Statements; Appendix 1).

Table 11 Changes in frequency of strict Ancient Woodland Indicator species between 1971 and 2000 across fourteen woodland sites with sixteen plots in each

Number of records are given as perecentages.

Ancient Woodland Indicator[1]	Chi-square	Sig	Dir	Records in 1971 (n=216)	Records in 2000 (n=216)	Countryside[2] Survey X plots in 1998 (n=131)	Countryside Survey Y plots in 1998 (n=362)
Viola riviniana/reichenbiana	11.0	***	-	52	36	30	14
Oxalis acetosella	5.0	*	-	42	36	29	12
Lysimachia nemorum	16.7	***	-	25	13	6	2
Luzula pilosa	4.9	*	-	25	17	5	1
Carex sylvatica	5.2	*	-	24	13	10	2
Athyrium filix-femina	13.4	***	-	22	10	8	5
Primula vulgaris	6.6	*	-	20	9	9	4
Fragaria vesca	5.3	*	-	17	10	5	1
Potentilla sterilis[3]	4.4	*	-	16	9	4	2
Polypodium vulgare sens.lat.	15.1	***	-	11	3	1	0
Tamus communis	4.3	*	-	9	3	5	1
Moehringia trinervia	9.4	**	-	8	1	2	0
Campanula trachelium	10.1	**	-	6	0	0	0
Geranium sylvaticum	4.1	*	-	5	1	0	0
Convallaria majalis	5.1	*	-	3	0	1	0
Carex pendula	4.2	*	-	3	0	2	1
Melica uniflora	4.3	*	+	3	7	2	2
Viola odorata	4.2	*	+	0	3	2	1

Excluding Ancient Woodland indicators with less than six records, 31 species decreased in frequency and 17 increased overall. Two species showed no change over the 29 year period.

[1] *Campanula trachelium, Conopodium majus* and *Anenome nemorosa* were omitted. The former because of possible confusion with *C.latifolia* and the last two because of possible seasonal effects.
[2] Only plots in the Broadleaved, Mixed and Yew woodland Broad Habitat.
[3]Declined in Countryside Survey woodland plots between 1990 and 1998.

3.11 Partitioning floristic variation in space and time

All multivariate analyses were run on presence/absence plot data for the fourteen broadleaved sites excluding a) the eight Hill Wood plots that recorded replacement of woodland with improved grassland and b) two outliers in Bird's Marsh wood that were completely dominated by *Prunus laurocerasus* in both 1971 and 2000. Because of the absence of 1971 dbh data for Oakers, this site was excluded from CCA analyses when dbh data were entered as explanatory variables. The two Pinewood sites were excluded and analysed separately reflecting the marked difference in their floristic composition compared to the broadleaved sites.

Between site variation ie. variation due to differences between whole sites rather than individual plots irrespective of site, was quantified by specifying site as a covariable (ter Braak 1988). The same approach was used to partition variation due to time only (Fig 17). At first site the amount of variation accounted for by explanatory variables, site and time appears to leave a disagreeably large residual value. However, large residual variation in such data is not so surprising for a number of reasons. Firstly, it would be wrong to unfavourably contrast the size of the residual variation with the error variance routinely achieved in analysis of designed experiments or other ANOVA type analyses using a small number of response variables. In both cases response variables usually number 1 to maybe 20 (eg Scheiner 1993), whereas with species by quadrat matrices each species is itself a response variable. The ratio of noise to redundancy may often be very large as a result. Hence recovered relationships are often set against a background of high unexplained variation. Indeed most of the CCA runs in this investigation were based on about 400 species responses. Secondly, higher residual variation would be expected following random location of plots in sites ie. no deliberate targeting of homogenous stands.

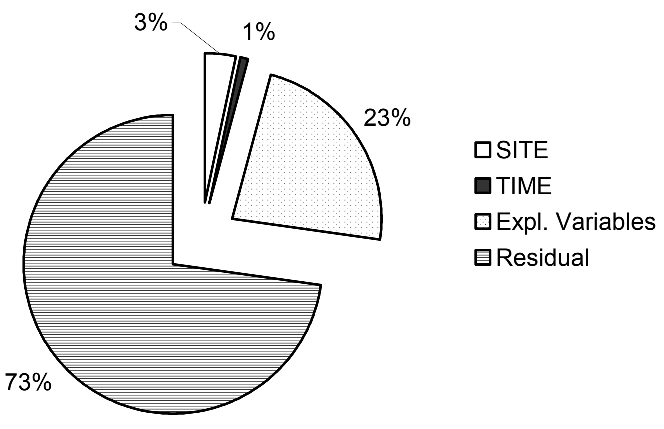


Figure 17   Partitioning of the variation in field layer plant species by plot data for fourteen broadleaved woodland sites recorded in 1971 and again in 2000.

3.12 Partitioning floristic variation in terms of explanatory variables

Spatial variation between sites and plots (time excluded as a covariable)

The set of explanatory variables that best explained floristic differences between plots across all sites were the following:

- Mean Ellenberg fertility score per plot (cover weighted).
- ITE Land Class axis 1 score for each site.
- Mean Ellenberg pH score per plot (cover weighted).
- Easting.

When vegetation derived indices ie. Ellenberg scores and CSR scores were omitted the following minimum variables explained the largest amount of spatial variation in the data:

- Northing.
- soil pH.
- Easting.
- Cover of *Urtica dioica.*
- Number of stems in the three smallest dbh classes.

Both models essentially reflect climatic gradients across Britain that are also related to altitude and linked to substrate fertility and pH, as well as the coincidental scarcity of extensive calcareous substrates in the uplands compared to lowland Britain. The ITE Land Class axis 1 score closely tracks the climatic upland/lowland continuum (Bunce et.al. 1996) while the apparent explanatory power of small stem density (variable 5) probably reflects the higher productivity and canopy species richness in lowland compared to upland woods which tend to be more open with lower densities of juvenile stems. In addition, upland woods are also more have a history of sheep grazing.

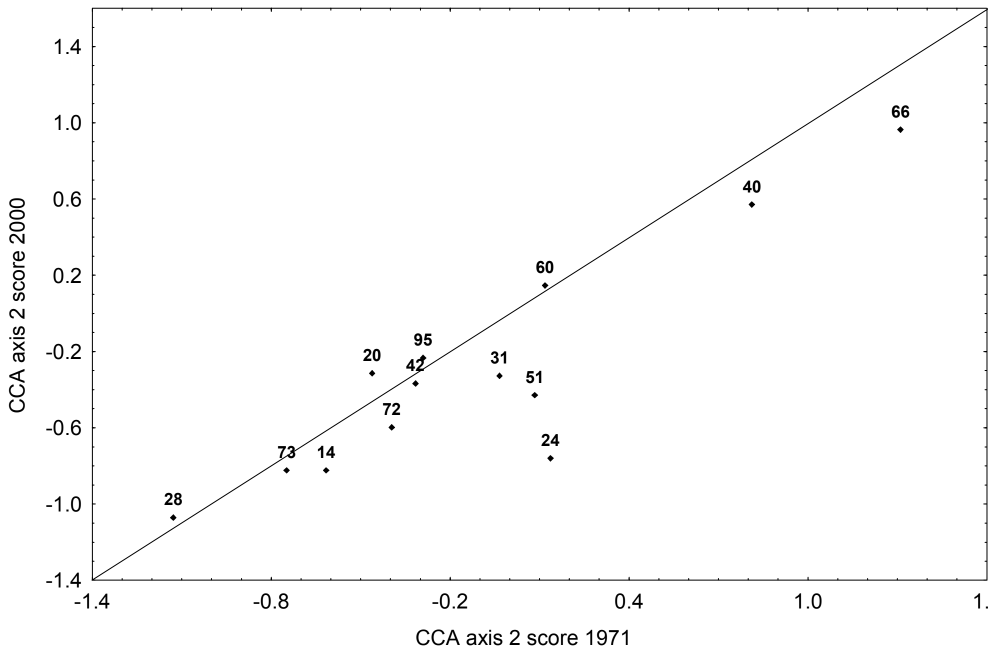
Variation in time and space (site excluded as a covariable)

When variation due to the location of each site was excluded a minimum number of explanatory variables were derived and the correlation with time examined to establish gradients in plot conditions along which plots may have moved between 1971 and 2000. The variables that best explained the constrained gradients ie. ordination scores for plots predicted by available explanatory variables, again highlighted the importance of regional gradients in the field layer records. The best fitting variables were:

- Mean Ellenberg fertility score per plot (cover weighted).
- Ellenberg light * Ellenberg pH (interaction term).
- Land Class axis 1 score for each site.
- Easting.
- Proportion of ruderal contribution.

Time was tenth most important variable selected from a total of 33 variables and was significant by permutation test at $p=0.005$. Time correlated most strongly with ordination axis 2 in turn most highly correlated with a) the contribution of ruderal strategies to field layer species composition (tendency for higher ruderal contribution in 1971), b) with soil pH (tendency for higher pH in 2000) and c) with the interaction between mean Ellenberg light score and mean Ellenberg pH (Fig 18). Even though the variation accounted for by temporal change was small relative to the other sources of variation in the data, these explanatory variables suggested that shifts along gradients of shade and soil pH had occurred over time. Ordination axis 1 also appeared to be strongly correlated with a pH gradient in the vegetation and also with mean Ellenberg fertility.

a)



b)

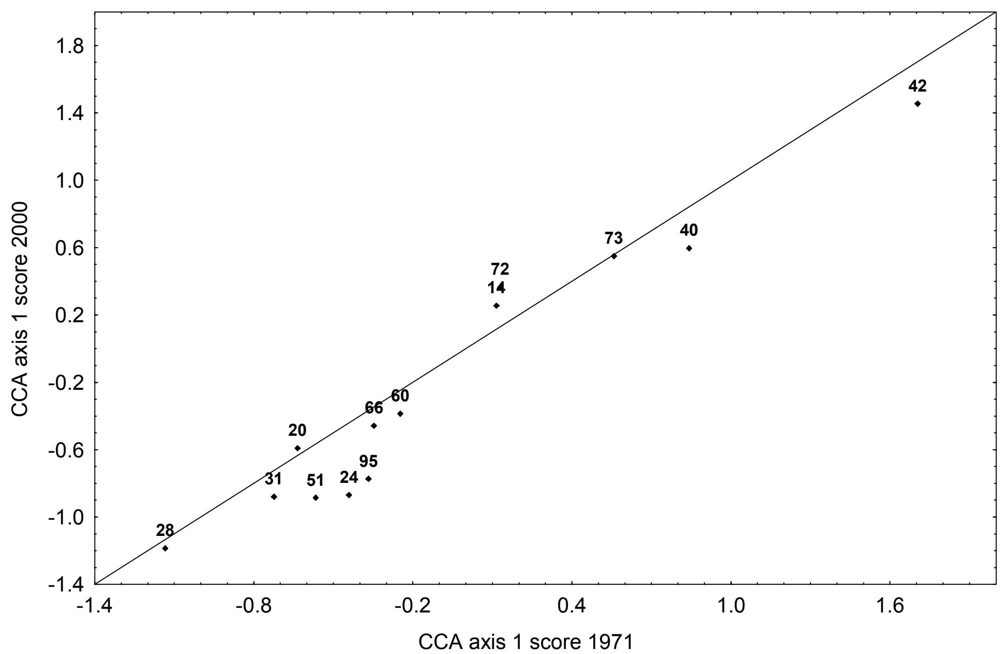


Figure 18 Variation over time in ordination scores for the first two constrained CCA axes.

Mean plot scores for each site in each year are shown. Plot scores represent the final best fit between explanatory variables and field layer species data for each plot. a) Axis 2 was best correlated with pH and disturbance. b) Axis 1 appeared to be most highly correlated with fertility and pH gradients. Overall, vegetation change between 1971 and 2000 across the 14 pilot sites suggested increased shading and a shift toward higher pH conditions. Note that the directional changes over time are consistent between sites even though correlated with starting point in 1971 and despite large differences in mean axis scores between sites.

3.13 Which variables best predicted the change in species richness?

Changes in field layer species composition over time occurred alongside widespread reduction in mean species richness within plots. Changes in species composition appeared to be linked to shifts in soil pH, increases in abundance of species favoured by more fertile conditions and an increase in shade. Taking into account scale and starting point, the change to more shaded and more fertile conditions was theoretically likely to be positively associated with the observed drop in mean richness (eg Waide *et al* 1999). The relative importance of these condition changes was assessed by a standard multiple regression of the independent variables used in the CCA analyses onto *change in* species richness.

The variables that best explained change in species richness are shown below in order of their partial correlation coefficient. This conveys the fit between richness change and each variable *in the absence* of all other variables.

Table 12 Multiple regression results for the dependent variable, change in species richness between 1971 and 2000

Independent variable	partial correlation	ANOVA	df	F	p
Change in Ellenberg light score	0.30	Regression SS	36	4.75	***
Northing	-0.18	Residual SS	158		
dbh curve in '71	-0.18				
Change in proportion of Ruderal strategy	0.17				
Change in proportion of Competitive strategy	-0.16				
Variance accounted for	52%				

The results confirm the importance of change in shade/disturbance at ground level. Decreases in Ellenberg light score, decreases in the proportion of ruderal plants and increases in the proportion of competitive plants are all associated with decreased species richness. All the variables apart from dbh curve in 1971 are not statistically independent of the actual change in richness but suggest the varying importance of change in plot conditions. dbh data are independent since woody species did not contribute to species counts in plots. The relationship between species richness change and the skewness of the dbh curve in 1971 is however, not absolutely straightforward. Plots that had relatively lower counts of younger compared to older stems either lost or gained species. However, plots with the highest numbers of younger stems tended to mostly lose species richness (Fig 19).

A logical constraint on the size of species reductions is the number of species in each plot to start with. While there is not such a constraint on increasing richness, a plot cannot obviously lose more species than were originally present. Indeed the number of species lost per plot did appear to be proportional to the initial total (Fig 20). Differences in initial richness were actually correlated with northing – richer plots being more northern in 1971. After fitting change in richness to species richness in 1971 the residual values were in fact, uncorrelated with northing (Spearman r=0.07, n=216, p=0.33). This does not alter the fact that more northerly sites tended to have richer field layers than more southern sites.

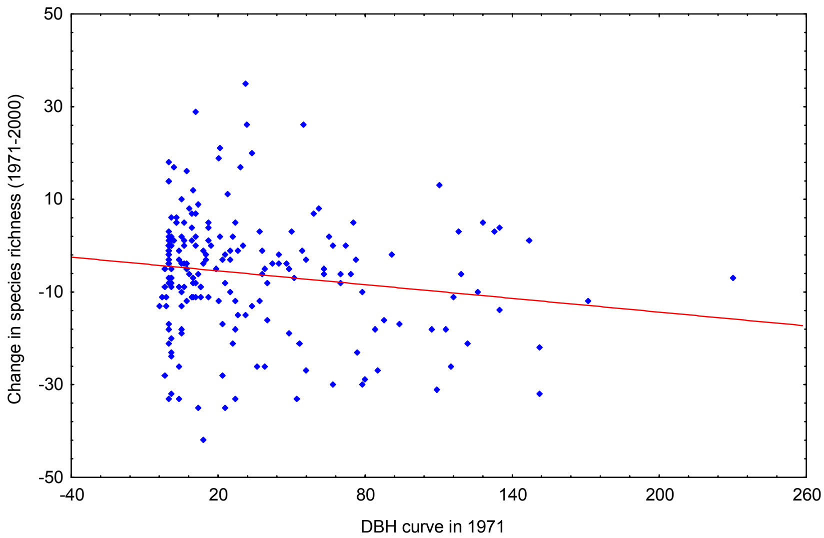


Figure 19 Relationship between the dbh distribution curve across all woody species per plot in 1971 versus change in field layer species richnes between 1971 and 2000.

The higher the dbh curve number the greater the relative abundance of stems in younger cohorts.

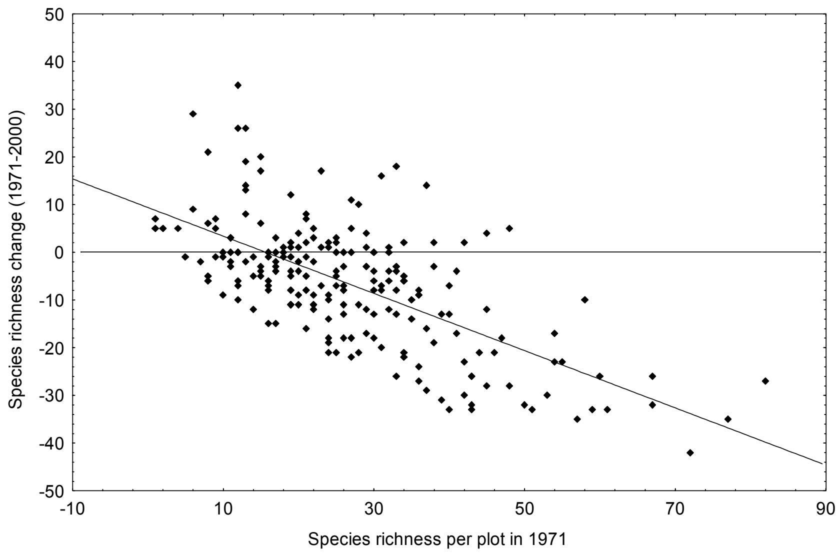


Figure 20 Species richness change between 1971 and 2000 versus initial plot richness in 1971.#

3.13.1 The role of potentially dominant field layer species

Changes in cover of potential dominants differed greatly between plots and sites. On some sites change in combined cover of *Urtica dioica, Pteridium aquilinum* and *Rubus fruticosus* agg., was associated with reduced field layer richness but on other sites this was not the case (Fig 21). The positive relationships seen at Wellhanger copse and Priestfield may reflect the widespread canopy removal that was a particular feature of these two sites and the common increase of both potentially dominant species as well as more subordinate, less aggressive plants from low abundances. A similar pattern shown by changes in abundance of *Rubus fruticosus* agg. in southern English woods was also seen described by Kirby (1998)

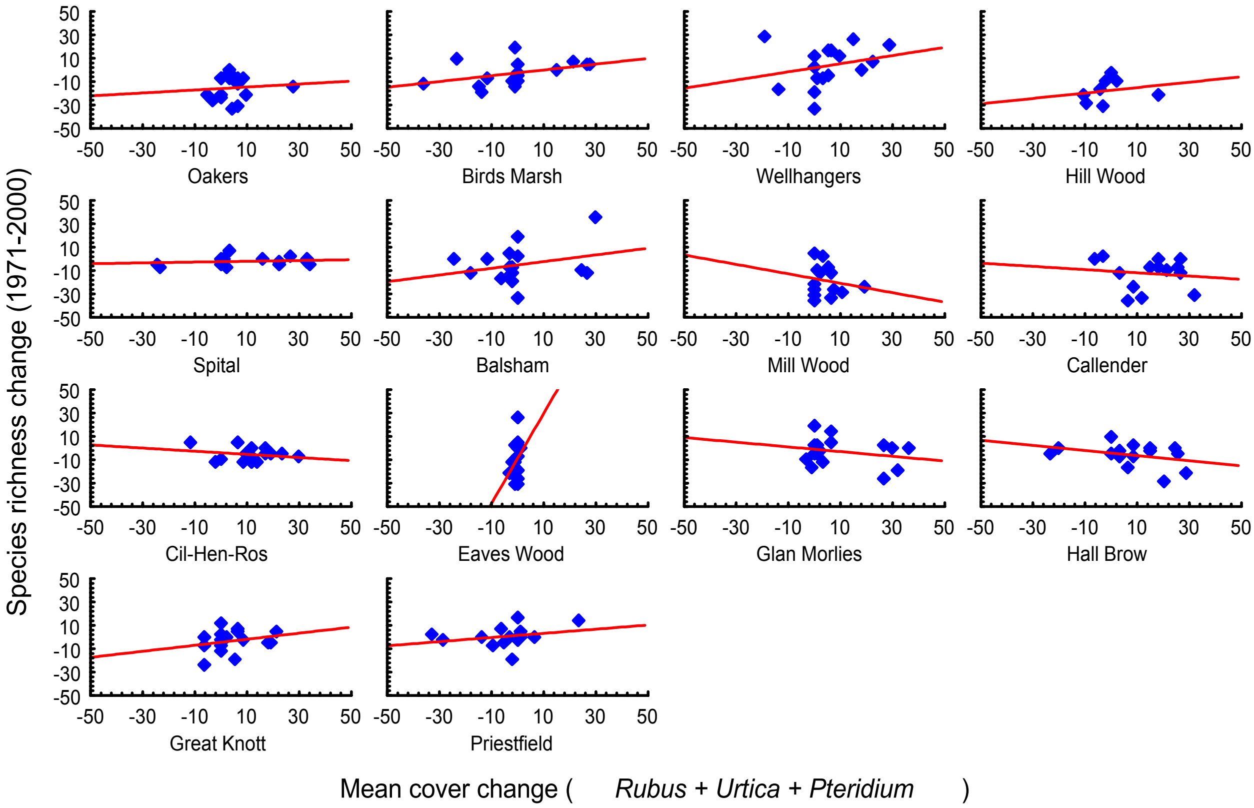


Figure 21 Change in mean cover of three potential field layer dominants combined, versus species richness change per plot between 1971 and 2000.

4. Discussion

4.1 What were the key changes seen across the 16 pilot sites between 1971 and 2000?

The most striking changes to have occurred were undoubtedly the cross-site decline in mean plant species richness and general increase in soil pH. The tendency for more acid soils to increase most in pH and for more basic soils to decrease most, also parallels the national cross-Broad Habitat pattern already reported for the interval 1978 to 1998 based on Countryside Survey soil samples (Haines-Young *et al* 2000).

In addition the loss in SOM from the more organic soils was a remarkable and potentially rather important finding. More detailed analyses of these data is necessary to rule out misinterpretation due to sampling artefacts. Any complete resurvey of all 103 native woodland sites would of course yield a much larger dataset and a greater ability to confirm the patterns detected in the pilot survey.

There was also a widespread ageing of mixed tree populations across most sites characterised by a reduction in abundance of stems in the youngest dbh classes and a net shift in favour of stems between 25-50cm in diameter. This change was associated with a general increase in shade and reduction in field layer disturbance implied by variable changes in the proportion of competitive and stress-tolerant species but a clear, cross-site reduction in the contribution of more ruderal plants.

A greater number of reductions in species frequency between plots across sites occurred than increases. In terms of Ellenberg values and established growth strategies, the declining plants were not biased toward any particular range of conditions. However Ancient woodland Indicator species experienced a far greater proportion of declines than increases compared to non-indicators. Changes in cover were different: species that increased in cover were more likely to be taller, more competitive or shade-tolerant, typical of higher pH situations and less typical of open and disturbed conditions. These general patterns were detectable despite considerable variation between plots and between sites.

The decline in species richness and tendency for species compositional changes to imply greater shade are also consistent with recent changes observed in vegetation plots located in the Broadleaved Broad Habitat in 1990 and 1998 (Haines-Young et.al. 2000). Countryside Survey found smaller magnitude changes in Scotland but, in this study, more northern sites tended to start more species rich in 1971 and lose proportionately more species than more southern sites. The two native pinewoods were different and showed negligible change in mean species richness. The evidence from the pilot analysis therefore seems to refute this notion of greater stability in upland Britain. However these differences should not be over-interpreted since comparisons need to be made with more rigorously on a ‘like-with-like’ basis in terms of woodland type as well as statistical power.

In terms of field layer floristic change, the two native Scots Pine sites were relatively stable over the twenty nine year period albeit with a small indication of increased shading and reduced occurrence of plant species that started at low frequency in 1971.

4.2 What were the most likely causes of change?

The drivers of the changes in soil pH and SOM cannot be identified from this survey. However, since these data follow a national trend identified by other large scale surveys (eg Countryside Survey), it is likely that pH and SOM changes are, at least in part, occurring as a result of a national-scale driver. The most obvious in terms of pH change is reduction in acidification from atmospheric deposition (NEGTAP 2001). However, other environmental changes may also be important, especially climate change (eg Price *et al* 1999).

The relatively high loss in SOM from the more organic soils was unexpected and is potentially very important. However, these initial values should be converted into quantitative estimates, using bulk density measurements, before the full implications of these changes can be determined in terms of potential Carbon loss from woodlands.

The general reduction in mean species richness within plots was correlated with an apparent lack of disturbance on most sites as tree populations that comprised many more juveniles in 1971 aged over the twenty nine year period. This is perhaps not so surprising since the effect of canopy closure and disturbance on plant species richness in woodlands is well known. The interesting aspect from the pilot study is the prevalence of the change across plots and sites. This pattern maybe associated with recovery from much more open conditions that prevailed earlier in the 20th century following war-time timber and underwood extraction from many sites across Britain.

The two sites that had experienced major canopy disturbance stood out in that species richness increased. Indeed Priestfield, where canopy removal had affected the majority of plot locations, was the only site to have shown a significant increase in younger stems, an increase in the proportion of ruderals in the field layer and increasing mean plant species richness. Whether such extensive disturbance as a proportion of the site is or was desirable is another issue.

Although canopy removal is known to have a positive, medium-term effect on field layer species richness, soil changes could influence the quality of such gaps in the future. If one of the consequences of soil change is a gradual increase in nutrient availability then managed canopy disturbance intended to promote local increases in species richness within sites may have to contend with the vigorous response of field layer competitors whose consolidation and spread would be enhanced. Interactions with grazing pressure in different parts of GB are clearly important here and grazing was not clearly identified as a widespread impact on sample sites. Indeed the increase in *Rubus* cover across most sites is at odds with recent intensive studies on specific sites that reported decreases in *Rubus* cover linked to increased grazing pressure (Kirby & Thomas 2000; Crampton *et al* 1998; Mountford & Peterken 1998). Nor did we detect the typical increases in grass abundance noted in these studies. On one site the apparent collapse in *Mercurialis perennis* and parallel increase in the grass *Brachypodium sylvaticum* seemed to be linked to recent increases in deer numbers while the unchanging scarcity of *Pinus sylvestris* seedlings at Mar seemed most likely to be attributable to unabated deer grazing intensity. Recent changes in management at Mar may not have had time to elicit a response while the large size of this site also meant that changes in established exclosures simply did not coincide with the pilot sample plots.

4.3 What are the benefits of surveying a larger number of sites ?

The pilot site survey has shown how between-site and within-site variation can be taken into account in an analysis of change in vegetation, soil and tree population age. However some obvious gaps in our ability to detect regional changes in woodlands appeared from a limited study of only sixteen sites. The most obvious was grazing and its effects on species richness, species composition and changes in abundance of potential dominants like *Rubus fruticosus* agg. With more sites would come more redundancy thus reducing the influence of noise in the data. More sites would also bring in clearer coverage of probable regional relationships between woodland dynamics and drivers such as the October 1987 storm. With only sixteen sites, such relationships were only present as outliers and as such, are intractable when it comes to quantifying the range of variation in responses and interactions with other drivers of change. For example, absence or presence of grazing in areas of high NOx deposition versus grazing levels in low deposition areas.

Also, just as the sixteen plots in each site form the basis for inferring change across the whole site, the larger the number of sites surveyed the more accurately and realistically will inferences from cross-site studies apply to the wider population of woodlands of potential conservation interest.

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Boxes

Appendices

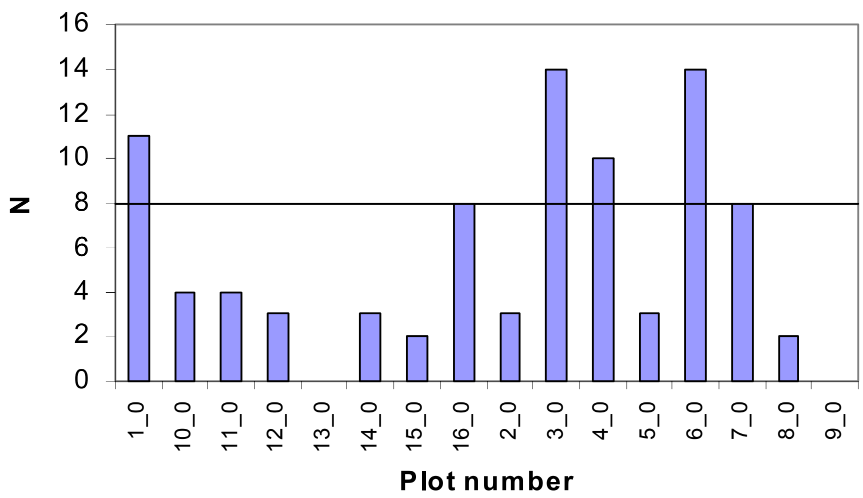
BOX 1 Quantifying the efficiency of plot relocation in 2000

The criterion used to assess the efficiency of plot relocation was based on the fact that paired plots ostensibly in the same location should be more similar in species composition than any other random pairing of 1971 and 2000 records in the same site. Even if the vegetation in one place had changed over time, accurate relocation should have resulted in lower variation in the range of differences between temporal pairs because of auto-correlation (von Ende 1993). If temporal pairs have actually been poorly relocated they are less likely to be correlated in time. Consequently the range of differences between 1971 and 2000 records will be higher translating into less similarity in species composition over time.

The degree of species compositional similarity between paired and unpaired plots was computed using the %DISTANCE macro in SAS for Windows version 8 (Kuo 1997). Similarity was conveyed by the Jaccard coefficient for presence/absence data.

The example below shows an assessment carried out for the 16 plots recorded in 1971 and in 2000 at Bird's Marsh wood. The y-axis gives the number of similarity coefficients between the 2000 record and all other unpaired 1971 records that were higher than the similarity between the true pair. On average, this number should be less than eight. Highly dissimilar but accurately located plot pairs could of course occur if vegetation change had been great but had left the plot more similar in general to 1971 plots. The graph shows that four paired plots appeared to be more dissimilar than expected. Either cause suggests that closer examination of these data maybe needed.

An overall test of the relative success of plot relocation could be carried out by comparing the variance between plot records for the ostensibly co-located temporal pair with variances across randomly selected temporal pairs (eg Phillipi *et al* 1997).



BOX 2 Summarising the shape of dbh based age-class distribution curves for each plot

Detailed dbh measurements were recorded in each sample plot in 1971 and 2000. Each tree species was recorded separately. These data can be used to convey changes in the age profile of individual tree species over time (see Appendix 7). However, in order to incorporate these data into analyses of change we needed to summarise change in plot based dbh curves between 1971 and 2000 in a way that would retain maximum information about changes in population structure. The added benefit of such a summary was the expectation that loss of fine detail would actually remove some of the sampling error due to plot relocation. For example the index is independent of the absolute counts in each class and is therefore not influenced by potentially large differences in those counts. What it focuses on are differences in the direction of the slope of the dbh curve. The index is able to track changes from a distribution skewed towards younger age classes toward a more bell-shaped distribution more typical of the stem-exclusion or thicket stage of forest development (see Peterken 1996; Kirby 1988).

dbh counts were summarised as the sum of differences between counts for adjacent classes as follows:

dbh curve = $\sum_{i=1}^{D} Ci - C(i+1)$

Where C*i* = stem count in either 1971 or 2000 for dbh class *i.* An example is given below for stem counts of *Fagus sylvatica* in Birds Marsh wood across all plots. The interpretation of change is that a reduction in adjacent summed differences indicates net reductions in stem numbers from the youngest age-classes and relative gains to older classes.

		dbh	**Count in 1971**	**Count in 2000**
		1	29	2
dbh curve 71 =	4	2	25	1
		3	0	1
dbh curve 2000 =	1	4	0	2
		5	0	3
		6	0	1
		7	0	1
		9	0	1

BOX 3 Changes in species richness and species composition following the replacement of lowland broadleaved woodland with improved grassland

Hill Wood is situated south of Chippenham in north Wiltshire. The floristic profile recorded by the total 16 sample plots in 1971 places it in the National Vegetation Classification unit W8c, the *Deschampsia cespitosa* sub-community of the *Fraxinus excelsior-Acer campestre-Mercurialis perennis* woodland. It also falls into site type 2 of the Bunce (1989) classification. Between the original 1971 survey and recording for the pilot project in 2000, about half the woodland on the 35 ha site was removed and replaced with agriculturally improved *Lolium perenne* dominated grassland. The table below records the species composition in 1971 and again in 2000 of the eight plots that recorded the change in habitat. The change in species richness is remarkable if not surprising. The change in species composition represents a profound shift away from a diverse species mixture including specialised stress-tolerant woodland taxa as well as more competitive larger perennials, trees and shrubs. A number of typical woodland bryophyte species have also now gone from the recorded plots.

The numbers in the table indicate mean percentage cover across the eight plots. A '+' indicates cover at less than 1%.

Plant species	Mean cover 1971	Mean cover 2000
Rubus fruticosus agg.	14	
Mercurialis perennis	11	
Lamiastrum galeobdolon	9	
Rosa seedling/sp	9	
Deschampsia cespitosa	7	
Galium odoratum	6	
Hedera helix	4	
Urtica dioica	3	
Circaea lutetiana	3	
Brachypodium sylvaticum	3	
Lathyrus pratensis	2	
Festuca gigantea	2	
Filipendula ulmaria	1	
Lonicera periclymenum	1	
Carex sylvatica	1	
Ajuga reptans	1	
Silene dioica	1	
Viola riviniana/reichenbiana	1	
Fraxinus excelsior	1	+
Dryopteris filix-mas	1	
Geum urbanum	1	
Crataegus monogyna	1	
Angelica sylvestris	+	
Arum maculatum	+	
Eurhynchium sp.	+	
Primula vulgaris	+	
Veronica montana	+	
Dryopteris dilatata/carthusiana	+	
Acer campestre	+	
Geranium robertianum	+	
Glechoma hederacea	+	

Plant species	Mean cover 1971	Mean cover 2000
Rumex conglomeratus	+	
Vicia sepium	+	
Arctium agg.	+	
Corylus avellana	+	
Galium aparine	+	
Hyacinthoides non-scripta	+	
Plagiomnium undulatum	+	
Quercus seedling/sp	+	
Tamus communis	+	
Betula seedling/sp	+	
Cardamine hirsuta/flexuosa	+	
Galium palustre	+	
Prunus spinosa	+	
Ulmus glabra	+	
Thamnobryum alopecurum	+	
Luzula pilosa	+	
Sambucus nigra	+	
Poa trivialis	+	2
Fissidens sp.	+	
Ligustrum vulgare	+	
Thuidium tamariscinum	+	
Agrostis stolonifera	+	
Callitriche seedling/sp	+	
Carex remota	+	
Dactylorhiza fuchsii	+	
Paris quadrifolia	+	
Plagiochila sp	+	
Pteridium aquilinum	+	
Stellaria holostea	+	
Ulmus procera	+	
Veronica chamaedrys	+	
Viola hirta	+	
Alnus glutinosa	+	
Brachythecium sp.	+	
Cornus sanguinea	+	
Hypnum cupressiforme sens.lat.	+	
Ilex aquifolium	+	
Lophocolea heterophylla	+	
Mnium hornum	+	
Salix caprea	+	
Sinapis arvensis/alba		+
Elytrigia repens		+
Plantago major		+
Matricaria discoidea		+
Cirsium arvense		+
Sonchus asper		+
Ranunculus repens		+
Rumex crispus		+
Rumex obtusifolius		+
Taraxacum agg.		1
Dactylis glomerata		1
Trifolium pratense		13
Trifolium repens		23
Lolium perenne		46

BOX 4 Dates of site survey in 1971 and 2000

Differences in number of days between the 1971 and 2000 survey dates varied. While none of the sites were surveyed in Spring in one year and in late Summer in another, some sites did differ by as much as 42 days. The 2000 survey dates were generally later than those in 1971. Coincidentally, the group of sites on which *Anenome nemorosa* was recorded in either year, had some of the largest day differences. For this reason the decline in *A.nemorosa* detected in the pilot resurvey is omitted from the results in the body of the report (pg. 36).

Table 1. Months during which surveying was carried out.

Site	Site Name	1971	2000
3	Mar Lodge	July	Aug
14	Birds Marsh	Sept	Aug
20	Wellhanger Copse	Aug	?
21	Shieldaig	Aug	Sept
24	Hill wood	Aug	Aug
28	Spital	Sept	Aug
31	Balsham	July	Aug
40	Mill wood	July	Aug
42	Callender	July	Sept
51	Cil-Hen-Ros	July	July
60	Eaves wood	Aug	Sept
66	Glan Morlies	June	July
72	Hall Brow	Sept	Sept
73	Great Knott	Sept	Sept
95	Priestfield	Aug	Aug
101	Oakers	?	?

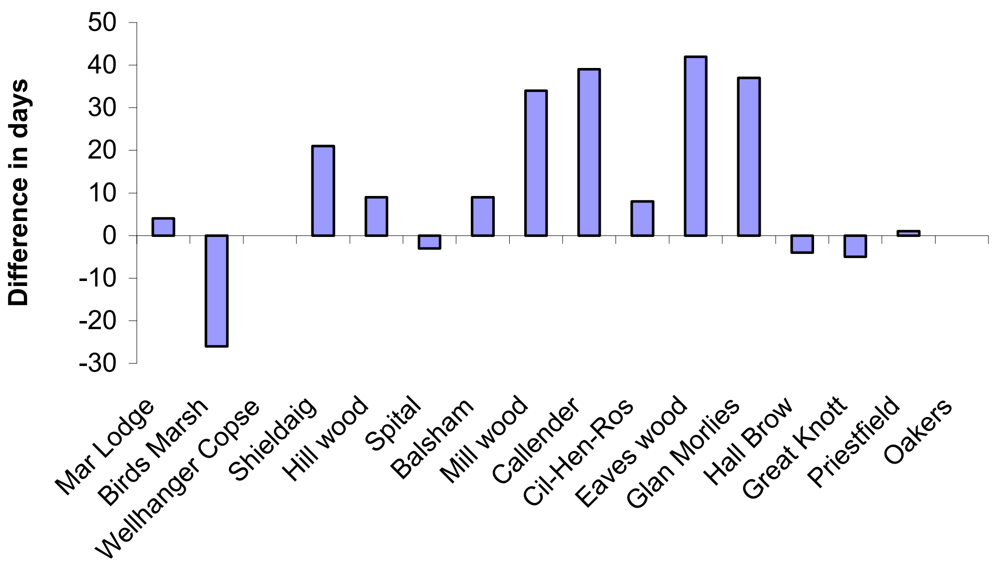


Figure 1. Difference in days between 1971 and 2000 survey dates. Negative values indicate that the 1971 survey was later than the 2000.

Appendix 1 Site Statements

Callender

Position in the landscape

The wood is in two sections:

i. Below the road (5 plots)
Directly adjacent to River Spey.
Steep slope and c. 50 m level ground.
River forms lower boundary, fertile grass upper.

ii. Above the road (11 plots)
Mainly a steep, often boulder-covered slope.
Some flush lines and open ground.
Fertile grass below wood, open moorland above.

Management description and habitats

- Estate owned
- Woodland open with low basal area.
- No evidence of recent management of either blocks.
- Birch trees looked moribund.
- Large oaks in lower section looked originally as if planted.
- New (within 3 years) fence in upper section with no obvious purpose.
- Local management for game but no evidence for this objective in the site.
- The steep slopes make access difficult which may be why the wood is not utilised for game at the present time.

Tree composition and change

- Over 90% of stems recorded at both dates were birch.
- Otherwise there was some rowen and a few oak, alder and birch cherry.
- There was no understorey escept for a few hazel recorded in 2000.
- The loss of stems of birch from almost all classes between 1971 and 2000 suggests natural mortality followed by windblow, although there could have been some local harvesting.
- The number of saplings had greatly declined and from observation these were mainly old multiple stems.
- The number of dead stems has also declined, virtualy to zero confirming the above comments.

Ground vegetation and change

- Dominated in frequency by widespread calcifuges especially *Calluna*, *Pteridium*, *Vaccinium myrtillus*, *Festuca ovina* and *Galium saxatile*.
- Few ancient woodland indicators present – mainly species from open grasslands and moorlands.
- With the exception of *Pteridium*, virtually all these species have declined.
- The increase in canopy of *Pteridium* (almost 40%) provides the probable explanation
- Many other species also show decline over the period.
- There is a significant overall loss of species.
- The following species have increased: *Pteridium aquilinum* (13-14). The following species have decreased: *Agrostis canina* (10-7); *Agrostis capillaris* (10-7); *Deschampsia flexuosa* (13-10); *Galium saxatile* (13-10); *Viola riviniana* (14-11); *Calluna vulgaris* (10-8); *Axthoxanthum odoratum* (12-7); *Blechnum spicant* (12-7); *Veronica officianalis* (10-5); *Potentilla erecta* (14-8); *Vaccinium myrtillis* (10-4); *Festuca ovina* (13-6).
- The average ground cover has almost doubled with *Calluna* (7-8) and *Deschampsia* (4-5), *Carex echinata* and *Pteridium* (14-52) all increasing whereas no species have declined.

Conclusion

- The site is representative of open birchwood in the north of Scotland.
- Little recruitment of trees is taking place and the tree population is declining
- The dense *Pteridium* cover means that regeneration is unlikely. There is also deer grazing.
- Such woods are likely to continue to decline in tree cover under present conditions.

Balsham

Position in the landscape

- The wood is on more-or-less level ground.
- Surrounded by a bank and ditch and is therefore probably of medieval origin.
- The wood is surrounded by arable land is close to a small village.

Management description and habitats

- Estate owned.
- The wood consists of different blocks with contrasting management histories.
- Some compartments have been recently felled and replanted with broadleaved trees or left to regrow (6 plots). Exotics have also been removed.
- Other compartments (9 plots) are mature woodland of various ages / structure.

- Wide rides, both old and new are present through the wood.
- The wood is in estate ownership and is managed primarily for game, with a long term management plan. There is also a policy of conversion to hardwoods.

Tree composition and change

- Ash shows a typical self-thinning profile with increase in larger size classes and decline in small stems.
- Oak shows stable position, with evidence of removal of large stems.
- Pine, widespread in 1971 now removed except for two stems.
- Sycamore shows increase in large size classes otherwise stable.
- Wychelm quite widespread in 1971 now completely absent.
- Small recovering of suckering elm saplings.
- Small recruitment of beech but loss of hawthorn.
- Understorey of hazel almost identical in 1971 and 2000 reflecting stable matrix of management.
- No ash saplings recorded in 1971 with many recorded in 2000.
- Smaller dead stems stable, larger show small increase, reflecting competition in older stands.

Ground vegetation and change

- Ground flora consists of widespread species in lowland woods with *Mercurialis, Glechoma, Urtica* and *Rubus* most frequent.
- These species have hardly declined in frequency.
- But overall species richness has declined by 19%.
- There are many ancient woodland indicators, some of which have decline slightly.
- Some species are present typical of recenlty coppiced areas.
- In terms of cover, *Mercurialis* has increases slightly against the overall trend.
- By contrast, *Rubus* and *Urtica* have declined.
- The decline in *Scilla* is probably a seasonal effect.
- Overall however, the situation is stable reflected in the maintenance of species numbers.
- Only one species has increased in frequency: Glechoma hederacea (9-10). One species, *Rubus* has stayed the same and the following species have declined: *Hyacinthoides non-scripta* (10-9); *Mercurialis* (15-14); *Urtica dioica* (11-10); *Poa trivialis* (12-10); *Primula elatior* (10-5); *Circaea lutetiana* (14-6); *Geum urbanum* (13-4).
- The following species have decreased in cover: *Hyacinthoides non-scripta* (11.6 – 1.1); *Primula elatior* (5.3 – 0.2) and *Urtica dioica* (14.3 – 1.9) whereas *Mercurialis* (20.4 – 37.3) and *Rubus* (5.4 – 19.3) increased in cover.

Conclusion

- The contrasts in management have maintained a matrix of different conditions of successional stages favouring a range of species and habitats.
- This type of management reflects the traditional practices in such woods over many centuries – especially following the removal of most exotics.
- The bank and ditch system perhaps protect the wood against external influences, in conjunction with its shape also giving minimal boundaries.

Birds Marsh

Position in the landscape

The southern part of the wood is on more-or-less level ground surrounded by crops – maize and oats. The northern part of the wood slopes gently down to some fields of old permanent pastures. Much of the wood is surrounded by a bank and ditch, suggesting medieaval origin.

Management description and habitats

Estate owned.
Three plots were in relatively undisturbed old oak woodland.
Seven plots were in rhododendron thickets with large old trees above of oak and pine.
Two plots were in laurel thickets.
Four plots were in felled and replanted woodland.
Some clearings had been cut in the laurel, which was coppicing vigorously.
Other open areas from fellings were dense *Rubus* clumps.
Paths were maintained for public access and were intensively used.

Tree composition and change

- The number of birch trees in the second size class had increased 1971-2000, reflecting opening up of the wood.
- Birch saplings had declined by 50%.
- Laurel had almost doubled the number of stems in all but one size class.
- *Rhododendron* was abundant but stable.
- Larger ash decline, saplings down by 5 times.
- Holly had increased 7 times in the lowest size class, but all other classes had also increased.
- Small beech in 1971 had expanded into larger classes.
- Sycamore showed a decline through all size classes but especially the small.
- Many oaks had gone, presumably from felling.
- Fewer dead stems of trees.
- Disappearance of dead saplings and shrubs.

Ground vegetation and change

- Only *Rubus* reaches a high frequency.
- Overall species richness has declined by 29%.
- The other species are all infrequent but even these low numbers have generally declined, especially bryophytes, even relatively shade-tolerant species.
- *Dryopteris dilatata* have declined by 50%.
- Covers are also low and stable.
- These changes suggest increasing shade from shrubs although the low initial figures make it difficult to detect significant change.
- No species increased in frequency and *Rubus* (14-13) and *Dryopteris dilatata* (13-6) have declined.
- *Pteridium* declined in cover from 11.5 to 0.5 but *Rubus* increased from 14.1 to 21.8.

Conclusion

- In 1971 laurel and rhododendron already heavily shaded the wood but this has probably increased.
- Some evidence of regeneration in felled areas both natural and planted.
- If the shrubs continue to expand, the wood is likely to gradually lose any natural structure.
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Cil-Hen-Rhos

Position in the landscape

- On steep slope facing north-east.
- Small stream at the bottom of slope with narrow alluvial strip.
- Intensive grassland above, at one end and below. Scrub and woodland at the other end.

Management description and habitats

- One private owner.
- No evidence of recent management – confirmed by owners.
- Very overgrown track, suggesting an old extraction route.

Tree composition and change

- Major increase in holly, both trees and saplings.
- Hawthorn has increased in size from saplings to trees although saplings maintained.
- Hazel shows major increase in all sizes.
- Beech – low frequency, stable.

- Wychelm – low frequency but disappeared.
- Sycamore – abundant in all size classes but large size classes, in particular, showed major increases. Saplings up five times as many as in 1971.
- Oak – relatively stable but some evidence of increasing size.
- Ash – dominant tree, all medium/large size classes increase but some evidence that large trees have died and disappeared. Large trees were seen blown over. Saplings have increased by 3 times.
- All stems – strong recruitment of saplings and shrubs.
- Dead – increase in large dead stems.

Ground vegetation and change

- Mainly species from neutral / mildly acid soils
- Veronica montana (10-6); Circaea lutetiana (11-4); Silene dioica (10-5); have declined but Rubus fruticosus (16-16), Dryopteris filix-mas (16-16) and D. dilatata (16-16) are stable whereas Hedera helix (11-16) and Hyacanthoides non-scripta (7-16) increased.
- Overall species richness has declined by 33%.
- *Rubus* has increased from 49.7 to 84.1% in cover. *Dryopteris dilatata* has also increased from 4.8 to 10.8%.

Conclusion

- This wood provides a good example of a tree population maturing without interference towards a more natural state.
- The ground vegetation has become less diverse due probably, to an increase in shade both from the canopy and the *Rubus.*

Eaves Wood

Position in the landscape

- A gently sloping site with the trees mainly growing out of limestone pavement.
- The north of the site is bounded by a large quarry.
- Otherwise other broadleaved woodland, permanet grassland and housing.

Management description and habitats

- Owner with conservation management objectives.
- Site is a SSSI
- Four plots were in old coppice.
- 12 plots had been felled, thinned or cleared to varying degrees.
- Some wide tracks have been cleared through the wood.

- A series of footpaths are present, much used by the public.

Tree composition and change

- Birch trees increases in a range of classes from 0 to 16.
- Birch saplings virtually disappeared 80-2.
- Holly saplings and trees increased from low base.
- Hawthorn increased in size classes but saplings declined.
- Sycamore trees largely removed but saplings have also almost disappeared.
- Pine removed except for isolated species.
- Oak – larger size classes increased, saplings declined.
- Ash trees quite stable but only 10% of saplings now present.
- Hazel very abundant – small stems down by 50%, larger stems increased.
- Overall only 10% of saplings still regenerating.
- Evidence of removal of lower size classes but some larger classes have increased.
- Virtually all dead stem classes have declined.

Ground vegetation and change

- Species rich limestone woodland
- Most species of calcareous/neutral soil types
- Many ancient woodland indicators
- Increased frequency: *Brachypodium sylvaticum* (11-12).
- Decreased: Tercrium scorodonia (11-1); Rosa (16-3); Mercurialis perennis (16-0); Lonicera (11-7); Fragaria vesca (14-12); Dryopteris filix-mas (10-6).
- Nationally scarce *Carex digitata* seen in a number of plots
- The most frequent species have declined
- Overall species richness has declined by 36%.
- The loss of *Mercurialis* and *Dryopteris* suggests deer grazing – supported by local anecdotal information.
- Many other species have also declined although with the degree of disturbance they may have been expected to increase.
- *Brachypodium sylvaticum* (1.6 – 5.8); *Agrostis capillaris* (5.4 – 11.6) *and Agrostis stolonifera* (3.5 – 11.3) all increased in cover, no species declined – consistent with grazing pressure.
- Brachypodium sylvaticum Conclusion
- A highly disturbed site with evidence of selective removal of certain tree species.
- The regeneration capacity appears to have declined – probably due to deer grazing.
- Although some species may have declined because of grazing pressure, other changes are more difficult to describe although local shading from yew could be a factor.

Great Knott

Position in the landscape

- Lower slopes gentle but upper slopes have some steeper sections with silurian slate outcropping.
- Lower boundary is road adjacent to permanent pasture.
- Two thirds of remaining boundary is woodland, some felled.
- Other boundary is permanent pasture.

Management description and habitats

- Owner with conservation management objectives.
- Most of the wood is stored coppice.
- Some clearings have been made, with fenced areas within which regeneration, mainly of Birch and willow is taking place.
- There are waymarked paths for public access.
- Some large pine trees felled.
- Small areas of plantation c. 30 years at the upper edge of the wood.
- Small plantation of *Nothofagus*.

Tree composition and change

- Birch trees and saplings have virtually disappeared – the extent of loss suggessts management rather than natural process.
- Hazel declined by 75%.
- Introduction of *Nothofagus* spp. by planting.
- Increase in pine due to planting.
- Oak predominantes with loss of smaller size classes, probably by management and increase in the larger categories.
- The latter process is identical over the whole site because of the dominance of oak.
- Few dead stems were recorded at either site.

Ground vegetation and change

- Stable: Deschampsia flexuosa (15-15); Galium saxatile (14-14); Pteridium aquilinum (15-15)
- Decreased: Anthoxanthum odoratum (10-8); Dryopteris dilatata (15-13); Dryopteris filix-mas (10-5); Holcus lanatus (10-2); Lonicera periclymenum (10-6); Luzula pilosa (10-4); Oxalis acetosella (16-13); Rubus fruticosus (13-11); Teucrium scorodonia (12-4).
- Mainly species of mildly acid or very acid soils.

- Most frequent species are declining although three are stable.
- Overall species richness has declined by 13%.
- Otherwise a balance of gains and losses although the bryophytes seem to have shown a marked decline.
- Some changes could be due to deer grazing together with increased shade in undisturbed areas.
- *Vaccinium myrtillis* (2.2 – 15.4); *Agrostis capillaris* (2.2. – 10.3); and *Pteridium* (14.3 – 25.5) have all increased increased in cover whereas *Deschampsia flexuosa* (49.4 – 18.9) and *Holcus lanatus* (5.3 – 0.6) have declined.

Conclusion

- Removal of certain size classes together with clearance has modified the structure of the wood.
- Quite strong evidence of deer grazing causing decline of some species.
- Mosaic of patches may mean that different parts of the wood are following different trends and therefore difficult to identify overall pattern.

Hall Brow

Position in the landscape

- Compex series of slopes down to streams both in and outside wood. Some quite steep slopes and small rocky outcrops.
- Upper and southern boundary of wood grades into open ground with scattered trees.
- Northern boundary is deciduous woodland.
- Otherwise the wood is bounded by permanent pasture although a track between the trees and grassland in one section.

Management description and habitats

- Owner with conservation management objectives.
- Most of the wood is stored, singled coppice.
- Overgrown tracks, charcoal burner huts and walls are present in the wood showing long history of exploitation.
- One clearing has been made with a fenced area planted with beech.
- Large glades are present in the upper section, usually with dense bracken.

Tree composition and change

- Birch trees and saplings have virtually disappeared.
- As with Great Knott, the extent of loss suggests management rather than a natural progression.

- Minor decline in hawthorn but beech and ash similar.
- Sycamore shows small decline from low base.
- Overall increase in the larger size class and major loss of smaller – extent of this suggests management.
- Saplings show a major decline overall and shrubs have almost disappeared.
- The overall pattern is dominated by the decline in smaller oak stems.
- Dead stems have almost disappeared suggesting maturation of the site population of trees.

Ground vegetation and change

- Increased: Pteridium aquilinum (11-16); Agrostis capillaris (13-14).
- Deceased: Anthoxanthum odoratum (15-14); Deschampsia flexuosa (16-15); Digitalis purpurea (12-11); Oxalis acetosella (16-14); Teucrium scorodonia (13-10); Dryopteris dilatata (16-12); Galium saxatile (14-10); Lonicera pericymenum (16-12); Luzula pilosa (12-8); Dryopteris filix-mas (10-5); Rubus fruticosus (13-7).
- Deceased: *Anthoxanthum odoratum.* Mainly species of mildly acid soils.
- Most frequent species are declining.
- Overall species richness has declined by 19%.
- As with Great Knott, the bryophytes have also declined overall.
- These changes could be consistent with an increase in cover of bracken, dense shade and possibly deer grazing.
- *Pteridium* has thus increased (18.0 – 40.1) as have *Agrostis capillaris* (2.2 – 15.3) and *Deschampsia flexuosa* (3.5 – 8.5) whereas *Anthoxanthum* has declined (11.1 – 5.4).

Conclusion

- The change in size class pattern is probably mainly due to maturation of the stand but this could have been amplified by removal.
- Strong evidence of increase in bracken cover could be causing loss of ground flora species, in conjunction with shading – most of the wood is now quite dense.
- The small cleared area would have had a minor influence in the overall total.

Priestfield

Position in the landscape

- Compex series of slopes down to streams both in and outside wood. Some quite steep The bottom 20% slopes down steeply to a river and has two small streams present.
- The river and more deciduous woodland form the lower boundary.
- Two other sides are adjacent to permanent grassland.
- The other side has newly planted trees in about a fifty metre strip adjacent to permanent grassland.

Management description and habitats

- One private owner.
- Nine plots have been carefully felled and are now singled coppice.
- Four plots are overgrown plantation of exotic species *c*15 years when many large trees were felled.
- Four plots are relatively undisturbed on the steep ground above the river.
- There is public access by footpaths and also horse riding.
- Some very large trees still remain on the edge of the wood and the lower section.
- An old railway line runs through the middle of the wood.

Tree composition and change

- Birch saplings and trees have both greatly increased, presumably because of disturbance.
- Holly has greatly increased (400% saplings) but also in the middle size classes of trees.
- Hawthorn has declined a bit from a low base.
- The larger size classes of ash and beech have disappeared – presumably because of the felling.
- Larch has been planted in the wood whereas it was absent previously.
- Many small oak are present as saplings and trees and the larger size classes have also increased, presumably due to planting.
- Overall saplings, young trees and hazel have all expanded extensively with only the very large size classes disappeared.
- The number of small dead saplings and trees have greatly increased probably from competition.

Ground vegetation and change

- Increased: Dryopteris dilatata (12-16); Lonicera pericymenum (10-14); Dryopterii filix-mas (7-10); Rubus fruticosus (10-15); Oxalis acetosella (14-15); Stellaria holostea (9-10).
- Decreased: Deschampsia caspitosa (10-9); Pteridium aquilinum (13-6); Holcus mollis (11-9).
- Exceptionally, this site has more species expanding than declining, presumably because of the extensive disturbance.
- Also, more species have increased than declined.
- Species are from mildly acid to neutral soil types.
- Species richness has increased by 23%.
- The collapse of the bryophyte species frequency is difficult to explain.

- *Dryopteris dilatata* (3.2 – 5.4); *Dryopteris filix-mas* (3.2 – 4.9); *Oxalis acetosella* (3.1 – 5.7); *Rubus* (1.9 – 7.8) have all increased in cover whereas *Pteridium* (24.8 – 4.5) is the only species to decline.

Conclusion

- This wood showed the greatest evidence of the effects of removal of large trees and disturbance.
- Exceptionally, for the pilot series, it showed widespread increases in species frequency, presumably because of the opening up of the canopy.
- This points to the increase in shade being the most important factor in species decline elsewhere.
- Some large individuals present in the wood indicate the policy importance of protecting the few old trees that remain.

Hill Wood

Position in the landscape

- The wood is on almost level ground with calcareous clay soils.
- One third of the boundary is occupied by crops.
- One third, permanent pasture.
- One third, short-term grassland.

Management description and habitats

- One private owner.
- Half of the woodland was cleared in the mid-1970s for agriculture and is now short-term grassland used for organic farming.
- The rest of the site is mainly ancient woodland although there is a small plantation of poplars and a few exotics in one section.

Tree composition and change

- Apart from the poplar plantation, the tree population has remained stable.

Vegetation composition and change

- To be completed.

Conclusion

- To be completed.
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Wellhanger Copse

Position in the landscape

- A stable slope to the north, otherwise level or gently sloping.
- About half the boundary is adjacent to crops although there is usually a narrow band of trees and a track between the fields and the wood.
- Otherwise the wood is against a complex mixture of old fields, scrub, housing and some grassland.

Management description and habitats

- Owner with conservation management objectives.
- The upper part of the wood was blown down in the great gale of 1987 but the northern slopes were protected – about four plots.
- About four plots were in old plantations of various species.
- Piles of old cut stems were present througout the wood but all large stems had been removed – some areas had been left – about three plots.
- Fenced pheasant pens were present in the wood – no plots fell within them.
- Some cleared areas had been planted with beech and oak – about five plots.
- Three plots were in areas which had probably been felled and had laurel growing vigorously.
- Wide rides were maintained through the wood.
- An old railway line ran across the centre of the wood.

Tree composition and change

- Birch and hawthorn have dissappeared from the site – could be management or windblow.
- Hazel stems have declined by about 40%, especially concentrated in the smaller classes.
- Saplings have increased fivefold reflecting disturbance.
- Laurel has greatly expanded from zero and represents a real threat to the woodland flora.
- All large beech have disappeared – presumably from the gale although some are left around the periphery. The planted stems are counted in the total for saplings. The smaller stems from 1971 have moved into the larger categories.
- Sycamore saplings have declined but the successful stems have moved into the larger size classes. Either this species was not affected by the gale or it was in a different part of the wood.
- Larch has been felled out.
- Oak has moved into the larger size classes but recruitment is from planting.

- Although ash saplings have increased the smaller trees have declined massively – either by windblow or management, or a combination.
- As a whole, the site shows a major loss of basal area, in numbers in the smaller classes and size in the larger.
- Dead wood has almost disappeared.

Vegetation composition and change

- Increased: G*lechoma* (6-11).
  Stable: *Rubus* (12-12).
  Decreased: *Mercurialis perennis* (14-13); *Rhinanthus minor* (11-8); *Hedera* (13-9) and *Viola* (10-6).
- Although the common species are declining, overall more species are expanding than declining in the site as a whole.
- Overall species richness has increased by 19%.
- This suggests the impact of disturbance has benefited more species than not.
- Most species are from calcareous or neutral soils and the species that are expanding most are typical of open conditions or woodland edges.
- *Hedera helix* has increased (3.5 – 6.1) as has *Rubus* (13.4 – 19.3) but *Mercurialis* has declined (43.5 – 36.0).

Conclusion

- This is a highly managed site that has also suffered a major disturbance.
- Patterns of change in the tree structure are therefore complex with succession, planting, clearance and mature stands present in the same site.
- As with Priestfield, the non-renewable resource consists of the old trees which are few and threatened by management – the structure of the site will continue to be a mosaic of patches.
- The mosaic of patches has apparently led to the maintenace of diversity and is probably close to the historical cultural pattern – confirming the short-term benefits of harvesting.
-

Glan Morlies

Position in the landscape

- A complex site along the bank of a river with contrasts in slope, drainage and aspect.
- Some spurs of woodland extend away from the river out into the farmland.
- There are combinations of sharp fenced boundaries, merging direct and open woodland.
- Most of the wood is bounded by well managed permanent grassland.
- A proportion of the wood is bounded by rushy pasture which is probably becoming progressively less grazed.

Management description and habitats

- Four private owners.
- There are strong contrasts in management in the wood.
- Four plots are in undisturbed woodland.
- Two plots are in open grazed beech and alder woodland.
- Three plots are in old fields, now scrubbing up.
- One plot is in overgrown willow.
- One plot was in overgrown Douglas fir c. 15 years.
- One plot was in a field.
- Three plots were in young but unthinned plantations.

Tree composition and change

- The hazel population was stable.
- Holly and sycamore had increased a litte from almost zero.
- Beech was low and stable.
- Oak was almost unchanged but with relatively few trrees, some large but no regeneration.
- There was an increase in ash saplings but apart from a small decline in two smaller classes, the situation was stable.
- The overall site pattern shows some decline but reflects the mosaic of patches in the site overall due probably to felling in some parts of the wood.
- Dead stems have greatly declined – again probably reflecting felling and lack of competition.

Vegetation composition and change

- Increased: Chysophlenium oppositifolium (5-11); Dryopteris dilatata (7-12); Geranium robertianum (10-13); Veronica montana (7-10); Hedera helix (10-12); Ranunculus repens (10-12); Oxalis acetosella (9-10); Rubus fruticosus (14-15).
- Stable: *Viola riviniana* (10-10).
- Decreased: Lonicera (10-9); Lysimachia (11-10); Circaea lutetiana (12-10); Prunella (13-5).
- The ground vegetation in this wood shows an equal balance between gains and losses both in the most frequent speies and in the balance of total individual species.
- As with Wellhanger Copse and Priestfield, this probably represents the different stages of succession that the patches in the wood are currently at.
- There is no obvious pattern between the species that are declining and increasing – again reflecting the complexity of management-related patterns from plot to plot.
- Overall species richness has only declined by 9%.

- The wood is diverse with species representative of many soil conditions from wet shaded to open fields, and mature woodland, again reflecting the wide range of ground conditions present.
- *Rubus* (2.4 – 31.2); *Lolium perenne* (3.8 – 5.1); *Agrostis canina* (5.4 – 11.6) and *Agrostis stolonifera* have all increased whereas only *Holcus mollis* (5.0 – 0.3) has declined.

Conclusion

- This wood shows a mosaic of patches at different successive stages, with the tree population therefore in flux and no overall pattern.
- The highly variable ground conditions favour many species.
- The site has therefore maintained a diverse structure and species composition, showing disturbance to be beneficial in the short-term.

Spital Wood

Position in the landscape

- The upper part of the wood is in a narrow strip about 100 m wide along the edge of a dry watercourse.
- The lower part extends away from the watercourse into a more gently sloping valley side.
- The wood is surrounded by intensive arable crops and there was circumstantial evidence that the run-off is affecting the ground vegetation because of the high edge to area relationship and local increase in *Urtica dioica*.
- Some edges of the wood have a bank and ditch with an overgrown hedge on the bank suggesting an ancient origin.

Management description and habitats

- Estate owned.
- The upper 100 m of the wood has a small pheasant pen (one plot).
- The central section of the wood consists of collapsed elm, both English and suckering, some of which is re-growing – five plots.
- Of the two lower sections, about four plots consist of relatively undisturbed woodland.
- Two plots were in a plantation of about 20 years.
- The remaining plots are in what appears to be overgrown secondary woodland.
- For a small site there is therefore a range of conditions.

Tree composition and change

- Hawthorn saplings have declined but there is a major increase in all larger size classes – maybe as a result of disturbance and subsequent development.
- Suckering elm saplings and trees have greatly declined but have still maintained a significant number of stems in the smaller classes indicating regeneration from suckers despite the elm disease.
- By contrast, the wychelm has virtually disappeared, presumably because it cannot regenerate from suckers.
- The hazel population has matured losing small size classes.
- Sycamore has declined greatly – perhaps because it cannot compete with the vigorous ground vegetation following the opening of the canopy.
- The few larch trees have matured.
- Small oaks have virtually disappeared otherwise the population has matured.
- Ash saplings and small trees have matured into larger size classes.
- The overall pattern is dominated by the change in elm, with a massive decline of dead stems.

Ground vegetation and change

- Increased: Hyacanthoides non-scriptus (9-100); Poa trivialis (13-15); Rubus fruticosus ((10-12).
- Decreased: Hedera helix (10-8); Mercurialis perennis (15-13);
- Lamiastrum galeobodolon (15-12); Milium effusum (11-7); Silene dioica (16-11).
- More species have declined than increased both in the most common species and in terms of numbers.
- Overall species richness has declined by 13%.
- The central area of the wood – the main cause for the massive increase in Urtica and the losses are probably in this area.
- Different parts of the wood could therefore be following different trajectories.
- There has been a great increase in cover of three species: *Urtica* (2.2 – 28.0); *Rubus* (11.0 – 18.5) and *Mercurialis perennis* (11.5 – 12.8) with a decline of *Lamiastrum* from (19.6 – 1.5).

Conclusion

- The lower part of the wood is relatively stable, partly because it is not affected by the elm disease and partly because it is wider and buffered against agricultural run.
- The upper part of the wood (apart from the pheasant pen) is massively affected by Dutch elm and is now virtually pure *Urtica* and *Rubus* due to light increase.
- The site shows the complexity of change at a local level albeit different parts of the wood can follow different trajectories.
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Oakers Wood [the 1971 data for the tree population is not available]

Position in the landscape

- The wood is situated on almost level land.
- It is bounded on two sides by banks / ditches, probably an ancient boundary against the heathland which would have been traditionally grazed.
- On one side the wood is bounded by crops.
- One one side by heathland, in the process of being invaded by birch.
- One one side by a mixture of heatland, trees, scrub, a small field and a house.
- On the fourth side by a road adjacent to woodland.

Management description and habitats

- One private owner.
- The current position is that it has been unmanaged for a considerable time, at least before the last survey.
- The bank / ditch boundaries suggest that it is an ancient wood, as do the banks / ditches running through the wood.
- Some planting, probably victoria, of sweet chestnuts has taken place.
- The northern edge of the wood has probably been derived from colonisation of heathland – the soils are podzolic and quite different from elsewhere in the wood.

Tree composition and change

- Birch shows a typical pattern of a maturing population with no evidence of recruitment – presumably disturbance is necessary for birch regeneration at this site.
- There is a vigorous population of hazel with many young stems.
- Although there is no evidence from 1971 to support it, it seems likely from observation that Rhododendron is expanding – confirmed by the increase from one to four in the ground vegetation.
- Oak shows an exceptionally evenly balanced series of size classes suggesting maturation from an initial coppiced base.
- Ash has many saplings but otherwise shows a relatively narrow range of size classes at the lower end of the range.
- Overall there is a wide range of classes but with relatively few large trees – suggesting a felling perhaps in the second war followed by lack of interference.
- Apart from hazel, there are few dead stems suggesting that competiton is not yet taking place.

Ground vegetation and change

- Stable: Hedera helix (14-14); Pteridium aquilinum (10-10) ; Rubus (14-14).

- Decreased: Lonicera (12-10); Viola (11-9); Dryopteris (12-6); Potentilla sterilis (11-4);
- Poa trivialis (11-1); Prunella vulgaris (10-0); Veronica chamaedrys (10-0).
- The balance is greatly towards declining species.
- Species that declined most are largely typical of more open situations.
- Overall, only a quarter of species were increasing whereas three quarters were declining.
- Overall species richness declined by 50%, the highest perecentage drop of any of the pilot sites.
- The overwhelming evidence is of decline through increase in shade – if it was not for the opposite trend in Wellhanger Copse and Priestfield, this could have been put down to observer bias. Furthermore, the species such as Primula could Arctium could hardly be mistaken.
- As in the other sites, Rubus is expanding its cover (1.7 – 17.5) at the expense of minor species, Agrostis canina, Dactylis, Mercurialis and Pterdium which have almost disappeared.

Conclusion

- The rhododendron expansion is a real threat to the native species in this wood.
- The tree population shows evidence of development from a possible felling 50-60 years ago but because the trees are widely spaced there is little competition.
- The decline in diversity in the ground vegetation seems to be linked with a combination of increase in shade and a lack of disturbance.
- It could well be many years before natural processes reverse this trend.

Mar Lodge

Position in the landscape

- The blocks of woodland cover several square kilometres and may be divided into two broad groups.
- The first group is of three main stands of trees, two in the upper reaches of Glen Quoich and the other nearer the forest lodge.
- The other group is diverse varying from small dense stands to open forest with isolated old pines and scattered birch.
- The site covers a wide range of altitudes from about 250 to almost 700 metres but apart from flush lines, the soils are similar.

Management description and habitats

- Owner with conservation management objectives.
- The site has long been managed as a deer forest and deer are present throughout.

- There is a fenced and planted area adjacent to the River Dee in the lower section of the forest, which is in the process of being opened up.
- There is a small fenced plot (which was noted in 1971) in the area near the forest lodge which shows abundant regeneration.
- Comparing notes with 1971, the site seems remarkedly stable and was considered then as an open site of mature trees with no regeneration.

Tree composition and change

- Birch saplings have increased but in a limited area only adjacent to one previously fenced plot – otherwise the situation is unchanged.
- Although more pines were recorded in 2000, this is due to sampling differences and when taken in conjunction with other sites, the situation is stable. There is no evidence of recruitment.

Vegetation composition and change

- There is some evidence of a loss of species coincident with a corresponding increase in cover of *Calluna* and some evidence of *Vaccinium.*
- Four species have declined in frequency and three have increased, well balanced in comparison with most sites.
- In general however, the situation is in comparison with other woods – extremely stable.
- Calluna (40.0 – 48.8); *Vaccinium myrtillus* (16.3 – 20.5) and *Vaccinium vitis-idea* (3.0 – 5.8) have increased in cover whereas *Deschampsia flexuosa* has declined.

Conclusion

- The vegetation has changed little between 1971 and 2000.
- In the short-term this is not a problem but as is well documented, the long-term continuity of the population of pine trees is threatened because there is no evidence of new recruitment in the sample plots.
- The dispersed nature of the stands of pine resulted in difficulties in plot re-location related to the trees but this has not affected the overall conclusion since field layer vegetation varies little from plot to plot.
- Most Scottish pinewoods have limited diversity and the value lies in the trees – differing from other sites in the survey.
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Shieldaig

Position in the landscape

- The site consists of three blocks.

- Overlooking Loch Torridan there is a birchwood next to the Loch shore adjacent to a steep cliff with scattered pine above.
- On the east side of Loch Shieldaig is the main area of forest but it is fragmented with unwooded tracts interspersed between the main pine stands.
- On the west side of Loch Shieldaig is an area of scattered pine, also included in the site map.
- There is therefore a great degree of variability in the site from cliffs to almost level land by the loch and includes cliffs with skeletal soils to brown earths and peats.

Management description and habitats

- Estate owned.
- The site has historically been open to sheep and deer grazing, with no control.
- There was a major fire in the late sixties which had a major impact on the site.
- The high profile of the site has led to a steadily increased status of protection both from disturbance and stock.
- A series of new fences are now in place through the site although red deer and sheep are still present – but probably in much lower numbers than previously.
- Observation during the survey showed that there was extensive regeneration between blocks of woodland marked on the original maps. Because the sample plots were placed in these blocks much of this regeneration was inevitably missed in the current survey.

Tree composition and change

- The birch population has increased both in numbers and intermediate size classes.
- The pine population is relatively stable in terms of the old trees, but there is regeneration taking place as shown in the lowest size class increases.

Vegetation composition and change

- The species are from mildly acid to very acid soils as well as form acid peats.
- Species are mainly from pen habitats with few woodland plants.
- Species richness has declined by about 15%.
- The vegetation is typical of a western pinewood with open boggy areas between the trees.
- Increased: Calluna vulgaris (15-16); Vaccinium myrtillis (11-13); Deschampsia flexuosa (9-12).
- Stable: *Potentilla erecta* (12-12).
- Decreased: Molinia caerulea (12-11); Blechnum spicant (15-12); Agrostis canina (12-7); Succisa pratensis (11-4).
- Even balance between increases and declines of the most frequent species.
- Almost equal numbers of species have declined as have increased.

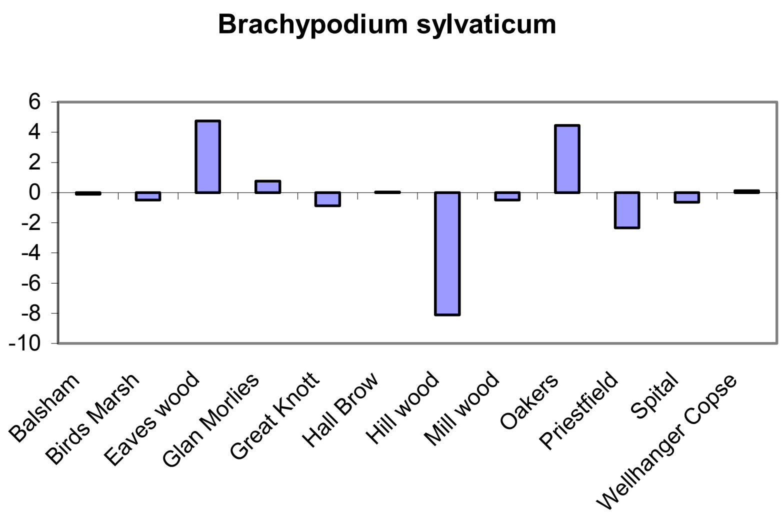
- The site is relatively stable overall but heterogeneity present suggests that different sections may be following contrasting trajectories.
- The cover of *Calluna* has declined very much (46.3 – 19.3) perhaps because of over-maturity, *Erica cinerea* (5.8 – 0.7) and *Molinia* (23.8 – 12.3) also declined whereas *Vaccinium myrtillus* increased (4.6 – 15.6) and *Pteridium* remaining stable, at about 14%.

Conclusion

- Vigorous regeneration is taking place over much of the site but is inadquately represented in the tree data because the plots were located according to Steven and Carlisle's map of the old stands of pine.
- The site is therefore dynamic in terms of its tree population but the overall composition of the vegetation is relatively stable although the cover of species has changed over time and probably will continue to do so.

Appendix 3 Changes in percentage cover of potential field layer dominants by site

Site Name	BRC names	Site	Mcover 71	Mcover 00
Mar Lodge	*Agrostis canina sens.lat.*	3	0.3	1.2
Mar Lodge	*Agrostis capillaris*	3	0.4	1.0
Mar Lodge	*Calluna vulgaris*	3	40.0	48.8
Mar Lodge	*Deschampsia flexuosa*	3	8.4	2.0
Mar Lodge	*Empetrum nigrum*	3	0.8	1.4
Mar Lodge	*Festuca arundinacea*	3	0.0	1.6
Mar Lodge	*Festuca vivipara*	3	1.4	0.6
Mar Lodge	*Hylocomium splendens*	3	0.0	12.3
Mar Lodge	*Molinia caerulea*	3	3.1	3.8
Mar Lodge	*Pleurozium schreberi*	3	0.0	4.5
Mar Lodge	*Rhytidiadelphus loreus*	3	0.0	5.4
Mar Lodge	*Sphagnum* sp.	3	0.0	1.3
Mar Lodge	*Vaccinium myrtillus*	3	16.3	20.5
Mar Lodge	*Vaccinium vitis-idaea*	3	3.0	5.8
Birds Marsh	*Dryopteris dilatata/carthusiana*	14	1.4	0.6
Birds Marsh	*Mercurialis perennis*	14	3.8	0.0
Birds Marsh	*Prunus laurocerasus*	14	0.0	10.6
Birds Marsh	*Pteridium aquilinum*	14	11.7	0.5
Birds Marsh	*Rhododendron spp.*	14	0.1	6.3
Birds Marsh	*Rubus fruticosus agg.*	14	14.1	21.8
Birds Marsh	*Urtica dioica*	14	0.3	1.6
Wellhanger Copse	*Circaea lutetiana*	20	1.7	0.3
Wellhanger Copse	*Eupatorium cannabinum*	20	0.0	1.0
Wellhanger Copse	*Eurhynchium* sp.	20	0.3	1.0
Wellhanger Copse	*Geranium dissectum*	20	1.3	0.0
Wellhanger Copse	*Glechoma hederacea*	20	0.5	1.7
Wellhanger Copse	*Hedera helix*	20	3.5	6.1
Wellhanger Copse	*Lamiastrum galeobdolon*	20	3.8	0.4
Wellhanger Copse	*Lophozia ventricosa*	20	0.0	5.6
Wellhanger Copse	*Mercurialis perennis*	20	43.5	36.0
Wellhanger Copse	*Poa trivialis*	20	4.0	0.4
Wellhanger Copse	*Pteridium aquilinum*	20	0.1	3.5
Wellhanger Copse	*Rubus fruticosus* agg.	20	13.4	19.3
Wellhanger Copse	*Urtica dioica*	20	2.2	8.4
Wellhanger Copse	*Veronica chamaedrys*	20	1.6	0.3
Shieldaig	*Agrostis canina sens.lat.*	21	2.3	1.1
Shieldaig	*Agrostis capillaris*	21	0.0	1.4
Shieldaig	*Betula seedling/sp*	21	1.4	0.2
Shieldaig	*Blechnum spicant*	21	1.8	0.4
Shieldaig	*Calluna vulgaris*	21	46.3	19.3
Shieldaig	*Carex echinata*	21	0.3	1.1
Shieldaig	*Deschampsia flexuosa*	21	3.6	1.0
Shieldaig	*Empetrum nigrum*	21	1.9	0.0
Shieldaig	*Erica ciliaris*	21	1.3	0.0
Shieldaig	*Erica cinerea*	21	5.8	0.7
Shieldaig	*Erica tetralix*	21	2.5	5.1
Shieldaig	*Eriophorum vaginatum*	21	3.1	0.0
Shieldaig	*Hylocomium splendens*	21	0.0	5.0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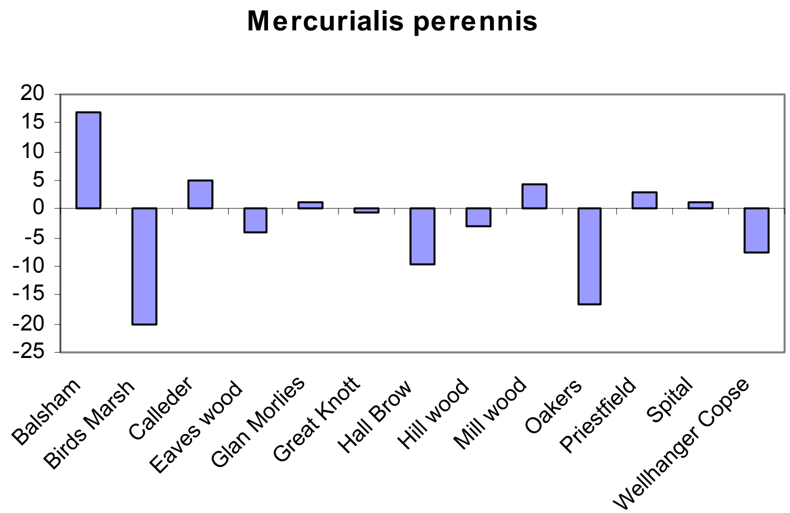
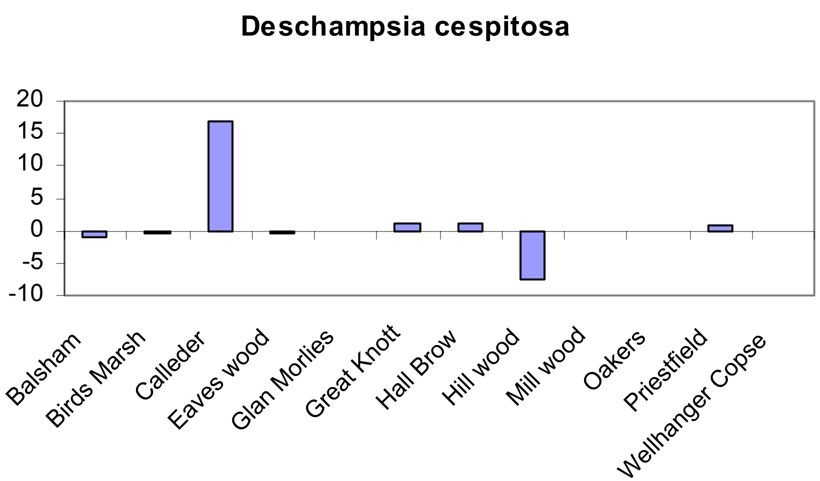
4
2
0
-2
-4
-6
-8
-10
Balsham
Birds Marsh
Eaves wood
Glan Morlies
Great Knott
Hall Brow
Hill wood
Mill wood
Oakers
Priestfield
Spital
Wellhanger Copse


Mercurialis perennis
20
15
10
5
0
-5
-10
-15
-20
-25
Balsham
Birds Marsh
Calleder
Eaves wood
Glan Morlies
Great Knott
Hall Brow
Hill wood
Mill wood
Oakers
Priestfield
Spital
Wellhanger Copse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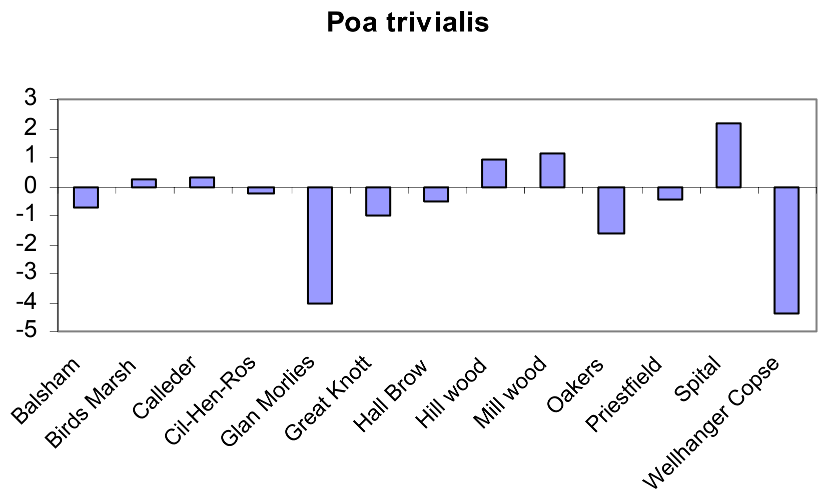
20
15
10
5
0
-5
-10
Balsham
Birds Marsh
Calleder
Eaves wood
Glan Morlies
Great Knott
Hall Brow
Hill wood
Mill wood
Oakers
Priestfield
Wellhanger Copse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3
2
1
0
-1
-2
-3
-4
-5
Balsham
Birds Marsh
Calleder
Cil-Hen-Ros
Glan Morlies
Great Knott
Hall Brow
Hill wood
Mill wood
Oakers
Priestfield
Spital
Wellhanger Copse

Appendix 5 Distribution of 103 1971 woodland survey sites by ITE Land Class and four landscape types across Britain

Table 1. 1971 woodland survey sites and their representation across Land Classes in GB

Landscape type	Land class	Number of woodland sites
P	1	17
A	2	13
A	3	6
A	4	0
P	5	3
P	6	2
P	7	1
P	8	0
A	9	10
P	10	3
A	11	5
A	12	0
P	13	0
A	14	1
P	15	9
P	16	5
M	17	5
M	18	1
M	19	2
M	20	3
U	21	2
U	22	0
U	23	0
U	24	1
A	25	3
A	26	1
P	27	7
M	28	3
U	29	0
U	30	0
M	31	0
U	32	0
TOTAL		**103**

Table 2. Number of 1971 woodland survey sites in each of four landscape types across Britain in comparison with the estimated area of broadleaved woodland in each

	Arable	Marginal Upland	Pastoral	Upland
No. of woodland sites	37	14	46	3
Percentage area of woodland (Barr *et al* 1993)	38	19	36	7

Appendix 6 Species Frequency Tables for each site

Balsham Wood

SPECIES	1971	2000	Diff
Fraxinus excelsior	16	16	0
Corylus avellana	13	14	1
Acer campestre	11	10	-1
Quercus seedling/sp	11	8	-3
Crataegus monogyna	5	9	4
Sambucus nigra	5	8	3
Acer pseudoplatanus	4	5	1
Ulmus glabra	4	0	-4
Viburnum opulus	3	2	-1
Pinus sylvestris	3	1	-2
Populus tremula	2	2	0
Prunus spinosa	1	5	4
Euonymus europaeus	1	2	1
Ligustrum vulgare	1	0	-1
Salix seedling/sp	1	0	-1
Salix caprea	0	4	4
Carpinus betulus	0	2	2
Ulex sp.	0	2	2
Fagus sylvatica	0	1	1
Malus domestica	0	1	1
Prunus padus	0	1	1
Rhamnus cathartica	0	1	1
Geranium robertianum	0	3	3
Veronica montana	0	3	3
Carex sylvatica	4	6	2
Cirsium vulgare	0	2	2
Cornus sanguinea	3	5	2
Hedera helix	1	3	2
Lapsana communis	0	2	2
Paris quadrifolia	0	2	2
Agrostis gigantea	0	1	1
Alchemilla sp.	0	1	1
Carex paniculata	0	1	1
Carex remota	0	1	1
Cirsium palustre	2	3	1
Clematis vitalba	0	1	1
Danthonia decumbens	0	1	1
Dryopteris filix-mas	2	3	1
Galium aparine	2	3	1
Glechoma hederacea	9	10	1
Heracleum sphondylium	1	2	1
Hypericum pulchrum	0	1	1

SPECIES	1971	2000	Diff
Lamium purpureum	0	1	1
Lysimachia nummularia	0	1	1
Milium effusum	0	1	1
Odontites vernus	0	1	1
Plantago major	0	1	1
Polygonum nodosum	0	1	1
Potentilla reptans	1	2	1
Prunella vulgaris	1	2	1
Ribes sp.	0	1	1
Rosa seedling/sp	7	8	1
Senecio jacobaea	0	1	1
Taraxacum agg.	0	1	1
Veronica chamaedrys	2	3	1
Veronica serpyllifolia	0	1	1
Arum maculatum	3	3	0
Brachypodium sylvaticum	2	2	0
Dipsacus fullonum	1	1	0
Epilobium hirsutum	2	2	0
Festuca gigantea	1	1	0
Luzula pilosa	2	2	0
Mnium hornum	1	1	0
Myosotis seedling/sp	1	1	0
Primula vulgaris	2	2	0
Rubus fruticosus agg.	12	12	0
Stachys sylvatica	1	1	0
Angelica sylvestris	2	1	-1
Cerastium fontanum	1	0	-1
Chamerion angustifolium	3	2	-1
Cirsium arvense	1	0	-1
Convolvulus arvensis	1	0	-1
Dactylis glomerata	1	0	-1
Dactylorhiza fuchsii	1	0	-1
Dryopteris dilatata/carthusiana	1	0	-1
Epilobium montanum	6	5	-1
Eurhynchium sp.	16	15	-1
Hyacinthoides non-scripta	10	9	-1
Hypericum hirsutum	1	0	-1
Juncus conglomeratus	1	0	-1
Lathyrus pratensis	1	0	-1
Lysimachia nemorum	1	0	-1
Mercurialis perennis	15	14	-1
Orchis mascula	1	0	-1
Potentilla sterilis	5	4	-1
Pteridium aquilinum	1	0	-1
Rubus idaeus	1	0	-1

SPECIES	1971	2000	Diff
Rumex conglomeratus	3	2	-1
Scrophularia nodosa	2	1	-1
Scutellaria galericulata	1	0	-1
Solanum dulcamara	2	1	-1
Stellaria holostea	1	0	-1
Tamus communis	4	3	-1
Urtica dioica	11	10	-1
Vicia sepium	1	0	-1
Ajuga reptans	5	3	-2
Arctium agg.	4	2	-2
Filipendula ulmaria	5	3	-2
Juncus effusus	2	0	-2
Lonicera periclymenum	5	3	-2
Lophocolea sp.	2	0	-2
Poa trivialis	12	10	-2
Ranunculus repens	3	1	-2
Thamnobryum alopecurum	3	1	-2
Agrostis stolonifera	4	1	-3
Bryonia dioica	3	0	-3
Deschampsia cespitosa	6	3	-3
Holcus lanatus	3	0	-3
Thuidium tamariscinum	3	0	-3
Carex pendula	4	0	-4
Viola riviniana/reichenbiana	9	5	-4
Primula elatior	10	5	-5
Fragaria vesca	8	2	-6
Sanicula europaea	7	1	-6
Brachythecium sp.	10	3	-7
Plagiomnium undulatum	9	2	-7
Circaea lutetiana	14	6	-8
Fissidens sp.	11	2	-9
Geum urbanum	13	4	-9

Bird's Marsh

SPECIES	1971	2000	Diff
Acer pseudoplatanus	11	13	2
Fraxinus excelsior	9	5	-4
Quercus seedling/sp	8	11	3
Rhododendron spp.	5	5	0
Sambucus nigra	4	2	-2
Fagus sylvatica	3	5	2
Crataegus monogyna	3	2	-1
Ilex aquifolium	3	2	-1
Betula seedling/sp	2	7	5
Corylus avellana	2	2	0
Picea abies	1	0	-1
Ulmus glabra	1	0	-1
Pinus sylvestris	0	3	3
Prunus laurocerasus	0	2	2
Alnus glutinosa	0	1	1
Pinus nigra	0	1	1
Salix caprea	0	1	1

SPECIES	1971	2000	Diff
Ulmus procera	0	1	1
Chamerion angustifolium	2	4	2
Dicranella heteromalla	1	3	2
Solanum dulcamara	0	2	2
Daphne laureola	5	6	1
Geranium robertianum	1	2	1
Lonicera periclymenum	1	2	1
Carex remota	0	1	1
Cirsium arvense	0	1	1
Cirsium vulgare	0	1	1
Diplophyllum albicans	0	1	1
Epilobium hirsutum	0	1	1
Epilobium obscurum	0	1	1
Festuca rubra agg.	0	1	1
Galium palustre	0	1	1
Glechoma hederacea	0	1	1
Holcus lanatus	0	1	1
Polygonum nodosum	0	1	1
Prunella vulgaris	0	1	1
Rosa seedling/sp	0	1	1
Rumex conglomeratus	0	1	1
Rumex obtusifolius	0	1	1
Scrophularia nodosa	0	1	1
Veronica serpyllifolia	0	1	1
Viola riviniana/reichenbiana	0	1	1
Digitalis purpurea	2	2	0
Epilobium montanum	2	2	0
Urtica dioica	2	2	0
Agrostis stolonifera	1	1	0
Brachypodium sylvaticum	1	1	0
Cardamine hirsuta/flexuosa	1	1	0
Poa trivialis	1	1	0
Senecio jacobaea	1	1	0
Veronica montana	1	1	0
Rubus fruticosus agg.	14	13	-1
Eurhynchium sp.	9	8	-1
Pteridium aquilinum	7	6	-1
Atrichum sp.	5	4	-1
Geum urbanum	2	1	-1
Mercurialis perennis	2	1	-1
Plantago major	2	1	-1
Agrostis capillaris	1	0	-1
Athyrium filix-femina	1	0	-1
Azalea spp.	1	0	-1
Callitriche seedling/sp	1	0	-1
Deschampsia cespitosa	1	0	-1
Festuca gigantea	1	0	-1
Holcus mollis	1	0	-1
Juncus effusus	1	0	-1
Lophocolea sp.	1	0	-1
Melica uniflora	1	0	-1
Plagiomnium undulatum	1	0	-1
Robinia pseudoacacia	1	0	-1
Rubus idaeus	1	0	-1

SPECIES	1971	2000	Diff
Stellaria holostea	1	0	-1
Stellaria media	1	0	-1
Tamus communis	1	0	-1
Taraxacum agg.	1	0	-1
Vicia sepium	1	0	-1
Hedera helix	4	2	-2
Fissidens sp.	3	1	-2
Hypnum cupressiforme sens.lat.	3	1	-2
Poa annua	3	1	-2
Ranunculus repens	3	1	-2
Brachythecium sp.	2	0	-2
Carex sylvatica	2	0	-2
Pellia sp.	2	0	-2
Persicaria hydropiper	2	0	-2
Plagiochila sp	2	0	-2
Polytrichum sp.	2	0	-2
Hyacinthoides non-scripta	4	1	-3
Mnium hornum	7	3	-4
Circaea lutetiana	6	2	-4
Ajuga reptans	4	0	-4
Thuidium tamariscinum	4	0	-4
Dryopteris filix-mas	6	1	-5
Dryopteris dilatata/carthusiana	13	6	-7

Callender

SPECIES	1971	2000	Diff
Betula seedling/sp	16	14	-2
Sorbus aucuparia	16	9	-7
Quercus seedling/sp	3	2	-1
Acer pseudoplatanus	3	0	-3
Alnus glutinosa	2	2	0
Corylus avellana	2	1	-1
Prunus padus	2	1	-1
Fraxinus excelsior	1	3	2
Salix seedling/sp	1	0	-1
Larix sp.	0	1	1
Salix caprea	0	1	1
Rhytidiadelphus loreus	0	7	7
Pleurozium schreberi	5	11	6
Brachythecium sp.	2	5	3
Cirsium palustre	6	9	3
Galium aparine	0	3	3
Hypericum sp.	0	3	3
Poa trivialis	0	3	3
Racomitrium lanuginosum	0	3	3
Urtica dioica	1	4	3
Aulacomnium palustre	0	2	2
Campylopus sp.	0	2	2
Carex flacca	0	2	2
Carex pilulifera	0	2	2
Carex pulicaris	0	2	2

SPECIES	1971	2000	Diff
Dicranum scoparium	5	7	2
Juncus bulbosus	0	2	2
Juncus conglomeratus	0	2	2
Oreopteris limbosperma	0	2	2
Atrichum sp.	0	1	1
Carex binervis	0	1	1
Carex panicea	1	2	1
Carex sylvatica	0	1	1
Crepis paludosa	0	1	1
Deschampsia cespitosa	2	3	1
Dicranella sp	0	1	1
Drepanocladus revolvens	0	1	1
Eleocharis quinqueflora	0	1	1
Epilobium palustre	0	1	1
Epilobium tetragon/obscurum	0	1	1
Euphrasia officinalis agg.	0	1	1
Glechoma hederacea	0	1	1
Hieracium 'indeterminate'	0	1	1
Holcus mollis	7	8	1
Juniperus communis	1	2	1
Mercurialis perennis	0	1	1
Myosotis seedling/sp	0	1	1
Philonotis sp.	0	1	1
Pteridium aquilinum	13	14	1
Salix repens agg.	0	1	1
Stachys sylvatica	2	3	1
Stellaria uliginosa	0	1	1
Thuidium tamariscinum	7	8	1
Vaccinium uliginosum	0	1	1
Carex echinata	3	3	0
Carex nigra	3	3	0
Chrysosplenium oppositifolium	3	3	0
Danthonia decumbens	1	1	0
Equisetum sylvaticum	1	1	0
Galium palustre	1	1	0
Juncus effusus	4	4	0
Oxalis acetosella	8	8	0
Plantago lanceolata	1	1	0
Primula vulgaris	2	2	0
Sphagnum sp.	3	3	0
Stellaria holostea	2	2	0
Achillea ptarmica	1	0	-1
Arctostaphylos uva-ursi	1	0	-1
Campanula rotundifolia	2	1	-1
Cardamine pratensis	2	1	-1
Drosera rotundifolia	2	1	-1
Dryopteris dilatata/carthusiana	5	4	-1
Erica tetralix	3	2	-1
Eriophorum angustifolium	3	2	-1
Eupatorium cannabinum	1	0	-1

SPECIES	1971	2000	Diff
Filipendula ulmaria	1	0	-1
Geum urbanum	1	0	-1
Gymnadenia conopsea	1	0	-1
Holcus lanatus	8	7	-1
Hypochoeris spp.	1	0	-1
Juncus articulatus/acutiflora	1	0	-1
Juncus squarrosus	2	1	-1
Lonicera periclymenum	1	0	-1
Luzula pilosa	9	8	-1
Lysimachia nemorum	3	2	-1
Melampyrum pratense	1	0	-1
Molinia caerulea	4	3	-1
Myrica gale	1	0	-1
Narthecium ossifragum	3	2	-1
Pellia sp.	1	0	-1
Plagiochila sp	1	0	-1
Plagiomnium undulatum	1	0	-1
Polygala oxyptera	4	3	-1
Ranunculus acris	1	0	-1
Ranunculus flammula	1	0	-1
Rosa seedling/sp	1	0	-1
Rubus saxatilis	1	0	-1
Rumex obtusifolius	1	0	-1
Senecio jacobaea	2	1	-1
Trichophorum cespitosum	2	1	-1
Tussilago farfara	1	0	-1
Cardamine hirsuta/flexuosa	2	0	-2
Cerastium fontanum	2	0	-2
Conopodium majus	2	0	-2
Dactylorhiza fuchsii	2	0	-2
Dicranella heteromalla	2	0	-2
Digitalis purpurea	2	0	-2
Empetrum nigrum	2	0	-2
Eurhynchium sp.	6	4	-2
Hypnum cupressiforme sens.lat.	4	2	-2
Nardus stricta	5	3	-2
Pedicularis sylvatica	2	0	-2
Polypodium vulgare sens.lat.	7	5	-2
Prunella vulgaris	5	3	-2
Rubus idaeus	2	0	-2
Rumex acetosella	2	0	-2
Taraxacum agg.	2	0	-2
Agrostis canina sens.lat.	10	7	-3
Agrostis capillaris	10	7	-3
Ajuga reptans	5	2	-3
Angelica sylvestris	3	0	-3
Athyrium filix-femina	3	0	-3
Deschampsia flexuosa	13	10	-3
Equisetum arvense	3	0	-3
Galium saxatile	13	10	-3

SPECIES	1971	2000	Diff
Lapsana communis	3	0	-3
Lathyrus linifolius	6	3	-3
Lotus corniculatus	3	0	-3
Mnium hornum	3	0	-3
Ranunculus repens	5	2	-3
Rhytidiadelphus squarrosus	6	3	-3
Thymus polytrichus	3	0	-3
Valeriana officinalis	3	0	-3
Viola palustris	4	1	-3
Viola riviniana/reichenbiana	14	11	-3
Calluna vulgaris	12	8	-4
Epilobium montanum	5	1	-4
Erica cinerea	9	5	-4
Polytrichum sp.	5	1	-4
Teucrium scorodonia	9	5	-4
Anthoxanthum odoratum	12	7	-5
Blechnum spicant	12	7	-5
Pseudoscleropodium purum	12	7	-5
Veronica officinalis	10	5	-5
Dryopteris filix-mas	6	0	-6
Hylocomium splendens	11	5	-6
Potentilla erecta	14	8	-6
Succisa pratensis	9	3	-6
Vaccinium myrtillus	10	4	-6
Vaccinium vitis-idaea	6	0	-6
Festuca ovina agg.	13	6	-7
Hypericum pulchrum	8	1	-7
Trientalis europaea	9	2	-7
Veronica chamaedrys	8	1	-7
Luzula campestris/multiflora	12	4	-8
Anemone nemorosa	9	0	-9
Rhytidiadelphus triquetrus	13	3	-10

Cil-Hen-Ros

SPECIES	1971	2000	Diff
Acer pseudoplatanus	15	16	1
Fraxinus excelsior	15	15	0
Corylus avellana	7	13	6
Fagus sylvatica	2	3	1
Ilex aquifolium	1	6	5
Sambucus nigra	1	2	1
Alnus glutinosa	1	0	-1
Betula seedling/sp	1	0	-1
Prunus spinosa	1	0	-1
Sorbus aucuparia	0	2	2
Hyacinthoides non-scripta	7	16	9
Atrichum sp.	0	5	5
Crataegus monogyna	5	10	5

SPECIES	1971	2000	Diff
Hedera helix	11	16	5
Carex pulicaris/serotina	0	1	1
Dryopteris filix-mas	15	16	1
Eurhynchium sp.	15	16	1
Moehringia trinervia	0	1	1
Quercus seedling/sp	9	10	1
Rhytidiadelphus loreus	0	1	1
Ribes sp.	1	2	1
Senecio vulgaris	0	1	1
Thamnobryum alopecurum	0	1	1
Viola palustris	0	1	1
Agrostis capillaris	1	1	0
Dryopteris dilatata/carthusiana	16	16	0
Lonicera periclymenum	2	2	0
Pellia sp.	2	2	0
Poa trivialis	1	1	0
Rubus fruticosus agg.	16	16	0
Anthoxanthum odoratum	1	0	-1
Brachythecium sp.	2	1	-1
Cardamine hirsuta/flexuosa	4	3	-1
Dicranella heteromalla	1	0	-1
Fissidens sp.	1	0	-1
Fragaria vesca	1	0	-1
Galeopsis tetrahit agg.	1	0	-1
Geranium robertianum	7	6	-1
Hypericum pulchrum	1	0	-1
Lophocolea sp.	2	1	-1
Mnium hornum	4	3	-1
Phalaris arundinacea	1	0	-1
Plagiochila sp	2	1	-1
Polytrichum sp.	2	1	-1
Ranunculus repens	1	0	-1
Rhytidiadelphus squarrosus	1	0	-1
Ribes uva-crispa	1	0	-1
Scrophularia auriculata	1	0	-1
Sphagnum sp.	1	0	-1
Teucrium scorodonia	1	0	-1
Glechoma hederacea	2	0	-2
Holcus mollis	2	0	-2
Lapsana communis	2	0	-2
Listera ovata	2	0	-2
Ulmus glabra	2	0	-2
Hypnum cupressiforme sens.lat.	3	0	-3
Plagiomnium undulatum	6	3	-3
Thuidium tamariscinum	10	7	-3
Blechnum spicant	5	1	-4
Chrysosplenium oppositifolium	6	2	-4
Galium aparine	4	0	-4
Geum urbanum	6	2	-4
Viola riviniana/reichenbiana	4	0	-4
Digitalis purpurea	5	0	-5
Pteridium aquilinum	5	0	-5
Rumex conglomeratus	5	0	-5
Silene dioica	10	5	-5
Urtica dioica	5	0	-5
Veronica montana	10	5	-5
Epilobium montanum	6	0	-6
Lysimachia nemorum	7	1	-6
Salix seedling/sp	6	0	-6
Circaea lutetiana	11	4	-7
Oxalis acetosella	9	2	-7
Athyrium filix-femina	13	3	-10

Eaves Wood

SPECIES	1971	2000	Diff
Fraxinus excelsior	16	15	-1
Quercus seedling/sp	14	14	0
Corylus avellana	14	13	-1
Taxus baccata	13	13	0
Crataegus monogyna	12	10	-2
Acer pseudoplatanus	11	6	-5
Betula seedling/sp	9	7	-2
Sorbus aucuparia	9	7	-2
Ilex aquifolium	8	11	3
Ligustrum vulgare	8	6	-2
Pinus sylvestris	8	4	-4
Fagus sylvatica	5	1	-4
Larix sp.	4	3	-1
Tilia sp.	4	2	-2
Prunus spinosa	3	6	3
Salix seedling/sp	3	0	-3
Ulmus glabra	2	4	2
Euonymus europaeus	2	2	0
Prunus padus	2	1	-1
Sambucus nigra	2	0	-2
Cornus sanguinea	1	2	1
Prunus avium	1	1	0
Pinus sp./seedling	1	0	-1
Malus domestica	0	1	1
Malus sylvestris	0	1	1
Salix caprea	0	1	1
Sorbus lancastriensis	0	1	1
Sorbus sp.	0	1	1
Ctenidium molluscum	0	7	7
Cotoneaster sp.	0	6	6
Rhytidiadelphus triquetrus	0	6	6
Carex digitata	0	5	5

SPECIES	1971	2000	Diff	SPECIES	1971	2000	Diff
Melica uniflora	4	9	5	*Athyrium filix-femina*	1	0	-1
Senecio jacobaea	2	7	5	*Calluna vulgaris*	1	0	-1
Fissidens sp.	0	4	4	*Campanula rotundifolia*	1	0	-1
Hedera helix	5	9	4	*Cardamine hirsuta/flexuosa*	1	0	-1
Carex flacca	3	6	3	*Centaurea nigra*	1	0	-1
Geranium sanguineum	0	3	3	*Centaurium erythraea*	1	0	-1
Neckera crispa	0	3	3	*Cirsium palustre*	1	0	-1
Rosa pimpinellifolia	0	3	3	*Conopodium majus*	1	0	-1
Sesleria caerulea	1	4	3	*Deschampsia cespitosa*	1	0	-1
Tortella tortuosa	0	3	3	*Epipactis helleborine*	1	0	-1
Brachythecium sp.	0	2	2	*Festuca ovina agg.*	4	3	-1
Carex sylvatica	5	7	2	*Filipendula ulmaria*	1	0	-1
Inula conyzae	0	2	2	*Galium aparine*	1	0	-1
Lotus corniculatus	0	2	2	*Geranium sylvaticum*	1	0	-1
Tortula sp.	0	2	2	*Hieracium 'indeterminate'*	1	0	-1
Brachypodium sylvaticum	11	12	1	*Holcus mollis*	1	0	-1
Calliergon cuspidatum	0	1	1	*Moehringia trinervia*	1	0	-1
Campylopus sp.	0	1	1	*Mycelis muralis*	1	0	-1
Carex caryophyllea	0	1	1	*Plantago major*	1	0	-1
Carex seedling/sp	0	1	1	*Pleurozium schreberi*	2	1	-1
Chamerion angustifolium	0	1	1	*Poa annua*	1	0	-1
Cynosurus cristatus	0	1	1	*Primula veris*	1	0	-1
Galium odoratum	0	1	1	*Primula vulgaris*	5	4	-1
Helictotrichon pubescens	0	1	1	*Pseudoscleropodium purum*	6	5	-1
Humulus lupulus	0	1	1	*Ranunculus acris*	1	0	-1
Leontodon autumnalis	0	1	1	*Ranunculus repens*	1	0	-1
Polytrichum sp.	4	5	1	*Rubus fruticosus agg.*	16	15	-1
Rubus caesius	0	1	1	*Rubus idaeus*	4	3	-1
Scabiosa columbaria	0	1	1	*Stachys sylvatica*	1	0	-1
Stachys officinalis	0	1	1	*Stellaria graminea*	1	0	-1
Thymus polytrichus	0	1	1	*Succisa pratensis*	1	0	-1
Veronica arvensis	0	1	1	*Thamnobryum alopecurum*	1	0	-1
Viola hirta	0	1	1	*Trifolium pratense*	1	0	-1
Agrostis capillaris	4	4	0	*Trifolium repens*	1	0	-1
Cirsium vulgare	1	1	0	*Tussilago farfara*	1	0	-1
Filipendula vulgaris	3	3	0	*Urtica dioica*	1	0	-1
Galium sterneri	2	2	0	*Veronica agrestis*	1	0	-1
Glechoma hederacea	1	1	0	*Asplenium trichomanes*	4	2	-2
Helianthemum nummularium	2	2	0	*Bromopsis ramosa*	2	0	-2
Hypericum pulchrum	1	1	0	*Dactylis glomerata*	4	2	-2
Pteridium aquilinum	4	4	0	*Daphne mezereum*	2	0	-2
Rhamnus cathartica	1	1	0	*Eurhynchium sp.*	12	10	-2
Rhytidiadelphus loreus	1	1	0	*Fragaria vesca*	14	12	-2
Ribes uva-crispa	1	1	0	*Geranium robertianum*	4	2	-2
Agrostis canina sens.lat.	1	0	-1	*Holcus lanatus*	2	0	-2
Alchemilla sp.	1	0	-1	*Hypericum perforatum*	2	0	-2
Anthoxanthum odoratum	1	0	-1	*Lotus pedunculatus*	2	0	-2
Arctium agg.	1	0	-1	*Melica nutans*	2	0	-2
Arrhenatherum elatius	1	0	-1	*Polygonatum odoratum*	2	0	-2
Asplenium ruta-muraria	2	1	-1	*Potentilla erecta*	6	4	-2

SPECIES	1971	2000	Diff
Ribes sp.	2	0	-2
Taraxacum agg.	5	3	-2
Arum maculatum	3	0	-3
Circaea lutetiana	3	0	-3
Dicranum majus	3	0	-3
Dicranum scoparium	4	1	-3
Dryopteris dilatata/carthusiana	6	3	-3
Phyllitis scolopendrium	9	6	-3
Potentilla sterilis	9	6	-3
Prunella vulgaris	5	2	-3
Rhytidiadelphus squarrosus	3	0	-3
Viola riviniana/reichenbiana	16	13	-3
Ajuga reptans	4	0	-4
Dryopteris filix-mas	10	6	-4
Lonicera periclymenum	11	7	-4
Lophocolea sp.	4	0	-4
Poa pratensis sens.lat.	4	0	-4
Polypodium vulgare sens.lat.	4	0	-4
Tamus communis	4	0	-4
Veronica officinalis	5	1	-4
Anemone nemorosa	5	0	-5
Geum urbanum	6	1	-5
Hyacinthoides non-scripta	5	0	-5
Plagiomnium undulatum	5	0	-5
Agrostis stolonifera	6	0	-6
Plagiochila sp	6	0	-6
Convallaria majalis	7	0	-7
Festuca rubra agg.	9	2	-7
Epilobium montanum	8	0	-8
Rosa seedling/sp	12	3	-9
Solidago virgaurea	9	0	-9
Hypnum cupressiforme sens.lat.	12	2	-10
Teucrium scorodonia	11	1	-10
Thuidium tamariscinum	14	3	-11
Mercurialis perennis	16	0	-16

Glan Morlies

SPECIES	1971	2000	Diff
Fraxinus excelsior	10	13	3
Corylus avellana	7	11	4
Alnus glutinosa	7	10	3
Quercus seedling/sp	5	10	5
Acer pseudoplatanus	5	7	2
Salix seedling/sp	5	4	-1
Crataegus monogyna	4	8	4
Fagus sylvatica	3	2	-1
Ilex aquifolium	2	5	3
Prunus spinosa	1	0	-1
Salix caprea	0	3	3

SPECIES	1971	2000	Diff
Betula seedling/sp	0	2	2
Pseudotsuga spp.	0	2	2
Ulex sp.	0	2	2
Picea abies	0	1	1
Prunus avium	0	1	1
Ulex minor	0	1	1
Pellia sp.	3	11	8
Atrichum sp.	2	9	7
Carex remota	0	6	6
Chrysosplenium oppositifolium	5	11	6
Dryopteris dilatata/carthusiana	7	12	5
Festuca gigantea	0	5	5
Calliergon cuspidatum	3	7	4
Carex seedling/sp	0	4	4
Agrostis capillaris	10	13	3
Dryopteris filix-mas	3	6	3
Geranium robertianum	7	10	3
Juncus effusus	5	8	3
Mercurialis perennis	1	4	3
Potentilla sterilis	2	5	3
Rumex sanguineus	0	3	3
Veronica montana	7	10	3
Agrostis stolonifera	6	8	2
Alopecurus geniculatus	0	2	2
Blechnum spicant	3	5	2
Brachypodium sylvaticum	0	2	2
Diplophyllum albicans	0	2	2
Epilobium montanum	6	8	2
Euphrasia officinalis agg.	0	2	2
Geum rivale	0	2	2
Hedera helix	10	12	2
Holcus lanatus	8	10	2
Hookeria lucens	0	2	2
Juncus bufonius sens.lat.	0	2	2
Polytrichum sp.	4	6	2
Ranunculus repens	10	12	2
Thamnobryum alopecurum	0	2	2
Alliaria petiolata	0	1	1
Anemone nemorosa	0	1	1
Apium graveolens	0	1	1
Brachythecium sp.	2	3	1
Callitriche seedling/sp	0	1	1
Cardamine pratensis	0	1	1
Ctenidium molluscum	0	1	1
Deschampsia cespitosa	1	2	1
Epilobium parviflorum	2	3	1
Festuca rubra agg.	0	1	1
Filipendula ulmaria	5	6	1
Fissidens sp.	2	3	1

SPECIES	1971	2000	Diff
Galeopsis tetrahit agg.	0	1	1
Galium palustre	5	6	1
Glechoma hederacea	2	3	1
Holcus mollis	6	7	1
Marchantia spp.	0	1	1
Mnium hornum	3	4	1
Molinia caerulea	0	1	1
Oenanthe crocata	1	2	1
Oxalis acetosella	9	10	1
Pedicularis sylvatica	0	1	1
Poa pratensis sens.lat.	1	2	1
Potentilla reptans	0	1	1
Primula vulgaris	0	1	1
Rhytidiadelphus loreus	0	1	1
Rhytidiadelphus squarrosus	2	3	1
Rubus fruticosus agg.	14	15	1
Rubus idaeus	0	1	1
Scutellaria galericulata	0	1	1
Senecio aquaticus	6	7	1
Senecio jacobaea	0	1	1
Senecio vulgaris	0	1	1
Stellaria media	0	1	1
Stellaria uliginosa	3	4	1
Taraxacum agg.	1	2	1
Thalictrum minus	0	1	1
Thuidium tamariscinum	8	9	1
Urtica dioica	5	6	1
Valeriana officinalis	0	1	1
Veronica beccabunga	2	3	1
Dicranella heteromalla	1	1	0
Epilobium palustre	1	1	0
Glyceria fluitans	6	6	0
Hypnum cupressiforme sens.lat.	1	1	0
Iris pseudacorus	1	1	0
Juncus bulbosus	1	1	0
Plagiomnium undulatum	5	5	0
Polygonum nodosum	1	1	0
Rumex obtusifolius	2	2	0
Sagina sp.	2	2	0
Stellaria holostea	1	1	0
Viola riviniana/reichenbiana	10	10	0
Achillea ptarmica	1	0	-1
Ajuga reptans	2	1	-1
Allium ursinum	1	0	-1
Angelica sylvestris	4	3	-1
Anthoxanthum odoratum	4	3	-1
Capsella bursa-pastoris	1	0	-1
Cirsium vulgare	1	0	-1
Conopodium majus	1	0	-1
Epilobium hirsutum	1	0	-1

SPECIES	1971	2000	Diff
Equisetum arvense	1	0	-1
Eurhynchium sp.	13	12	-1
Festuca ovina agg.	1	0	-1
Galium saxatile	1	0	-1
Geum rivale x urbanum (G. x intermedium)	1	0	-1
Heracleum sphondylium	1	0	-1
Hydrocotyle vulgaris	1	0	-1
Hypericum perforatum	1	0	-1
Hypochoeris spp.	2	1	-1
Juncus articulatus/acutiflora	3	2	-1
Leucanthemum vulgare	1	0	-1
Lolium multiflorum	1	0	-1
Lonicera periclymenum	10	9	-1
Lotus pedunculatus	4	3	-1
Lysimachia nemorum	11	10	-1
Matricaria discoidea	1	0	-1
Moehringia trinervia	1	0	-1
Persicaria maculosa	1	0	-1
Phyllitis scolopendrium	2	1	-1
Poa trivialis	5	4	-1
Polygonum aviculare agg.	1	0	-1
Potentilla erecta	3	2	-1
Pseudoscleropodium purum	1	0	-1
Pteridium aquilinum	1	0	-1
Pulicaria dysenterica	1	0	-1
Rumex acetosa	1	0	-1
Scrophularia vernalis	1	0	-1
Solanum dulcamara	1	0	-1
Sorbus aucuparia	1	0	-1
Stachys sylvatica	3	2	-1
Teucrium scorodonia	1	0	-1
Trifolium dubium	1	0	-1
Veronica serpyllifolia	3	2	-1
Achillea millefolium	2	0	-2
Anagallis tenella	2	0	-2
Bromus hordeaceus	2	0	-2
Carum verticillatum	2	0	-2
Circaea lutetiana	12	10	-2
Cirsium palustre	8	6	-2
Dactylis glomerata	4	2	-2
Digitalis purpurea	2	0	-2
Fragaria vesca	3	1	-2
Geranium dissectum	2	0	-2
Hyacinthoides non-scripta	4	2	-2
Hypericum pulchrum	2	0	-2
Hypericum tetrapterum	2	0	-2
Lolium perenne	6	4	-2
Lophocolea sp.	2	0	-2
Myosotis seedling/sp	2	0	-2

SPECIES	1971	2000	Diff
Plantago lanceolata	4	2	-2
Rosa seedling/sp	8	6	-2
Sanicula europaea	3	1	-2
Silene dioica	5	3	-2
Trifolium repens	5	3	-2
Arrhenatherum elatius	3	0	-3
Athyrium filix-femina	12	9	-3
Bellis perennis	4	1	-3
Cardamine hirsuta/flexuosa	6	3	-3
Cynosurus cristatus	6	3	-3
Geum urbanum	7	4	-3
Lotus corniculatus	3	0	-3
Lychnis flos-cuculi	3	0	-3
Mentha aquatica	3	0	-3
Persicaria hydropiper	3	0	-3
Pilosella officinarum	3	0	-3
Plagiochila sp	3	0	-3
Potentilla anserina	4	1	-3
Ranunculus acris	4	1	-3
Ranunculus flammula	4	1	-3
Carex sylvatica	6	2	-4
Centaurea nigra	4	0	-4
Cirsium arvense	5	1	-4
Dactylorhiza fuchsii	4	0	-4
Galium aparine	6	2	-4
Phleum pratense sens.lat.	4	0	-4
Plantago major	4	0	-4
Stachys officinalis	4	0	-4
Trifolium pratense	4	0	-4
Cerastium fontanum	7	2	-5
Poa annua	6	1	-5
Veronica chamaedrys	5	0	-5
Rumex conglomeratus	8	1	-7
Prunella vulgaris	13	5	-8

Great Knott

SPECIES	1971	2000	Diff
Quercus seedling/sp	15	16	1
Betula seedling/sp	15	6	-9
Sorbus aucuparia	8	5	-3
Corylus avellana	5	11	6
Ilex aquifolium	4	9	5
Pinus sylvestris	1	3	2
Larix sp.	1	2	1
Picea abies	1	1	0
Salix caprea	1	1	0
Salix seedling/sp	1	0	-1
Fagus sylvatica	0	8	8
Prunus padus	0	3	3
Acer pseudoplatanus	0	2	2
Fraxinus excelsior	0	2	2
Picea sitchensis	0	2	2
Alnus glutinosa	0	1	1
Nothofagus nervosa	0	1	1
Prunus avium	0	1	1
Rhytidiadelphus loreus	1	11	10
Agrostis capillaris	6	13	7
Carex pilulifera	0	5	5
Hyacinthoides non-scripta	0	5	5
Vaccinium myrtillus	8	13	5
Carex seedling/sp	0	3	3
Oreopteris limbosperma	0	3	3
Viola riviniana/reichenbiana	2	5	3
Atrichum sp.	1	3	2
Blechnum spicant	5	7	2
Holcus mollis	7	9	2
Hypericum pulchrum	0	2	2
Juncus effusus	3	5	2
Lysimachia nemorum	2	4	2
Polytrichum sp.	13	15	2
Athyrium filix-femina	1	2	1
Carex pallescens	0	1	1
Dactylis glomerata	1	2	1
Dicranum majus	4	5	1
Epilobium palustre	0	1	1
Erica cinerea	0	1	1
Festuca ovina agg.	0	1	1
Galium palustre	0	1	1
Geranium robertianum	0	1	1
Hedera helix	0	1	1
Juncus conglomeratus	0	1	1
Melica uniflora	0	1	1
Molinia caerulea	0	1	1
Rubus idaeus	0	1	1
Sphagnum sp.	1	2	1
Thuidium tamariscinum	2	3	1
Brachypodium sylvaticum	2	2	0
Calluna vulgaris	1	1	0
Cardamine hirsuta/flexuosa	2	2	0
Carex binervis	1	1	0
Cirsium palustre	2	2	0
Deschampsia flexuosa	15	15	0
Galium saxatile	14	14	0
Hylocomium splendens	1	1	0
Juncus articulatus/acutiflora	1	1	0
Pellia sp.	1	1	0
Plagiomnium undulatum	1	1	0
Pteridium aquilinum	15	15	0

SPECIES	1971	2000	Diff
Rumex acetosella	1	1	0
Ajuga reptans	3	2	-1
Carex pendula	1	0	-1
Cephalozia bicuspidata	1	0	-1
Circaea lutetiana	2	1	-1
Epilobium montanum	1	0	-1
Eurhynchium sp.	2	1	-1
Galium aparine	1	0	-1
Glechoma hederacea	1	0	-1
Gymnocarpium dryopteris	1	0	-1
Mercurialis perennis	1	0	-1
Moehringia trinervia	1	0	-1
Pleurozium schreberi	5	4	-1
Poa trivialis	1	0	-1
Ranunculus repens	1	0	-1
Rhytidiadelphus squarrosus	6	5	-1
Scrophularia nodosa	1	0	-1
Tetraphis pellucida	1	0	-1
Urtica dioica	1	0	-1
Agrostis stolonifera	2	0	-2
Anthoxanthum odoratum	10	8	-2
Brachythecium sp.	2	0	-2
Deschampsia cespitosa	6	4	-2
Dryopteris dilatata/carthusiana	15	13	-2
Hypnum cupressiforme sens.lat.	14	12	-2
Lepidozia reptans	2	0	-2
Potentilla erecta	4	2	-2
Rubus fruticosus agg.	13	11	-2
Ceratocapnos claviculata	3	0	-3
Dicranella heteromalla	5	2	-3
Digitalis purpurea	6	3	-3
Leucobryum glaucum	4	1	-3
Oxalis acetosella	16	13	-3
Polypodium vulgare sens.lat.	3	0	-3
Pseudoscleropodium purum	3	0	-3
Carex sylvatica	4	0	-4
Lonicera periclymenum	10	6	-4
Dryopteris filix-mas	10	5	-5
Plagiochila sp	8	1	-7
Teucrium scorodonia	12	5	-7
Agrostis canina sens.lat.	8	0	-8
Holcus lanatus	10	2	-8
Luzula pilosa	12	4	-8
Mnium hornum	14	5	-9
Lophocolea sp.	14	3	-11
Dicranum scoparium	15	2	-13

Hall Brow

SPECIES	1971	2000	Diff
Quercus seedling/sp	16	15	-1
Betula seedling/sp	15	13	-2
Sorbus aucuparia	14	9	-5
Corylus avellana	13	5	-8
Fraxinus excelsior	11	8	-3
Crataegus monogyna	7	5	-2
Acer pseudoplatanus	6	7	1
Salix caprea	4	0	-4
Fagus sylvatica	1	4	3
Malus sylvestris	1	0	-1
Populus tremula	1	0	-1
Prunus spinosa	1	0	-1
Dicranum majus	0	9	9
Pseudoscleropodium purum	0	8	8
Carex pilulifera	0	7	7
Brachythecium sp.	0	5	5
Pteridium aquilinum	11	16	5
Rhytidiadelphus squarrosus	1	6	5
Vaccinium myrtillus	3	8	5
Pleurozium schreberi	0	4	4
Rhytidiadelphus loreus	0	4	4
Deschampsia cespitosa	2	5	3
Hyacinthoides non-scripta	4	7	3
Ilex aquifolium	3	6	3
Thuidium tamariscinum	7	10	3
Carex binervis	0	2	2
Solidago virgaurea	0	2	2
Agrostis capillaris	13	14	1
Apium nodiflorum	0	1	1
Atrichum sp.	4	5	1
Blechnum spicant	3	4	1
Campylopus sp.	0	1	1
Cerastium fontanum	0	1	1
Chrysosplenium oppositifolium	1	2	1
Cirsium palustre	0	1	1
Elytrigia repens	0	1	1
Festuca gigantea	0	1	1
Fissidens sp.	0	1	1
Galium aparine	0	1	1
Holcus lanatus	6	7	1
Hylocomium splendens	0	1	1
Hypericum pulchrum	2	3	1
Lepidozia sp.	0	1	1
Pellia sp.	0	1	1
Phegopteris connectilis	0	1	1
Prunus padus	0	1	1
Rhytidiadelphus triquetrus	0	1	1
Solanum dulcamara	0	1	1
Stellaria uliginosa	0	1	1
Taxus baccata	1	2	1

SPECIES	1971	2000	Diff
Arum maculatum	1	1	0
Hypnum cupressiforme sens.lat.	7	7	0
Oreopteris limbosperma	3	3	0
Polytrichum sp.	14	14	0
Rumex conglomeratus	1	1	0
Agrostis stolonifera	2	1	-1
Anthoxanthum odoratum	15	14	-1
Arctium agg.	1	0	-1
Athyrium filix-femina	4	3	-1
Ceratocapnos claviculata	1	0	-1
Cytisus scoparius	1	0	-1
Deschampsia flexuosa	16	15	-1
Digitalis purpurea	12	11	-1
Equisetum sylvaticum	2	1	-1
Eurhynchium sp.	8	7	-1
Filipendula ulmaria	1	0	-1
Galium palustre	2	1	-1
Geranium robertianum	4	3	-1
Gymnocarpium dryopteris	2	1	-1
Hedera helix	1	0	-1
Holcus mollis	8	7	-1
Juncus effusus	3	2	-1
Lepidozia reptans	1	0	-1
Poa annua	1	0	-1
Poa pratensis sens.lat.	1	0	-1
Polypodium vulgare sens.lat.	1	0	-1
Primula vulgaris	1	0	-1
Ranunculus repens	3	2	-1
Rubus idaeus	2	1	-1
Rumex acetosella	1	0	-1
Scutellaria galericulata	1	0	-1
Silene dioica	2	1	-1
Stachys sylvatica	1	0	-1
Stellaria media	1	0	-1
Urtica dioica	2	1	-1
Alnus glutinosa	2	0	-2
Brachypodium sylvaticum	8	6	-2
Conopodium majus	2	0	-2
Epilobium montanum	2	0	-2
Leucobryum glaucum	2	0	-2
Meconopsis cambrica	2	0	-2
Mercurialis perennis	4	2	-2
Oxalis acetosella	16	14	-2
Plagiomnium undulatum	5	3	-2
Stellaria holostea	5	3	-2
Veronica chamaedrys	3	1	-2
Veronica officinalis	2	0	-2
Agrostis canina sens.lat.	3	0	-3
Ajuga reptans	3	0	-3
Dactylis glomerata	4	1	-3

SPECIES	1971	2000	Diff
Luzula campestris/multiflora	5	2	-3
Potentilla sterilis	3	0	-3
Scrophularia nodosa	4	1	-3
Teucrium scorodonia	13	10	-3
Viola riviniana/reichenbiana	8	5	-3
Cardamine hirsuta/flexuosa	4	0	-4
Dryopteris dilatata/carthusiana	16	12	-4
Galium saxatile	14	10	-4
Lonicera periclymenum	16	12	-4
Luzula pilosa	12	8	-4
Veronica montana	5	1	-4
Circaea lutetiana	7	2	-5
Dicranella heteromalla	5	0	-5
Dryopteris filix-mas	10	5	-5
Moehringia trinervia	5	0	-5
Poa trivialis	5	0	-5
Carex sylvatica	6	0	-6
Lophocolea sp.	9	3	-6
Rubus fruticosus agg.	13	7	-6
Lysimachia nemorum	9	2	-7
Dicranum scoparium	9	0	-9
Plagiochila sp	12	1	-11
Mnium hornum	16	3	-13

Hill Wood

SPECIES	1971	2000	Diff
Crataegus monogyna	15	6	-9
Fraxinus excelsior	15	9	-6
Betula seedling/sp	14	4	-10
Corylus avellana	14	6	-8
Quercus seedling/sp	13	3	-10
Ulmus procera	8	0	-8
Acer campestre	7	4	-3
Prunus spinosa	7	3	-4
Sambucus nigra	5	5	0
Ulmus glabra	5	0	-5
Salix caprea	4	0	-4
Cornus sanguinea	3	0	-3
Ilex aquifolium	1	0	-1
Ligustrum vulgare	1	0	-1
Rhododendron spp.	1	0	-1
Salix seedling/sp	1	0	-1
Viburnum opulus	1	0	-1
Acer pseudoplatanus	0	1	1
Euonymus europaeus	0	1	1
Fagus sylvatica	0	1	1
Larix sp.	0	1	1
Malus domestica	0	1	1
Picea abies	0	2	2

SPECIES	1971	2000	Diff
Populus nigra	0	1	1
Ulex sp.	0	2	2
Agrostis capillaris	1	0	-1
Agrostis stolonifera	2	0	-2
Ajuga reptans	13	2	-11
Allium ursinum	0	1	1
Alnus glutinosa	3	0	-3
Angelica sylvestris	11	0	-11
Arctium agg.	9	2	-7
Arum maculatum	13	3	-10
Athyrium filix-femina	1	0	-1
Brachypodium sylvaticum	12	1	-11
Brachythecium sp.	2	0	-2
Callitriche seedling/sp	1	0	-1
Cardamine hirsuta/flexuosa	5	0	-5
Carex pendula	1	0	-1
Carex remota	3	0	-3
Carex sylvatica	13	2	-11
Circaea lutetiana	16	2	-14
Cirsium arvense	0	2	2
Cirsium palustre	2	0	-2
Clematis vitalba	0	1	1
Dactylis glomerata	1	4	3
Dactylorhiza fuchsii	4	0	-4
Deschampsia cespitosa	14	1	-13
Dryopteris dilatata/carthusiana	10	0	-10
Dryopteris filix-mas	15	3	-12
Elytrigia repens	0	1	1
Epilobium montanum	6	0	-6
Eurhynchium sp.	16	6	-10
Festuca gigantea	9	1	-8
Filipendula ulmaria	5	0	-5
Fissidens sp.	3	0	-3
Fragaria vesca	1	0	-1
Galium aparine	10	1	-9
Galium odoratum	10	2	-8
Galium palustre	8	0	-8
Geranium robertianum	9	3	-6
Geum urbanum	13	4	-9
Glechoma hederacea	11	4	-7
Hedera helix	9	7	-2
Heracleum sphondylium	1	0	-1
Holcus mollis	1	0	-1
Hyacinthoides non-scripta	4	2	-2
Hypnum cupressiforme sens.lat.	2	0	-2
Juncus conglomeratus	1	0	-1
Juncus effusus	2	0	-2
Lamiastrum galeobdolon	9	5	-4
Lathyrus pratensis	1	0	-1

SPECIES	1971	2000	Diff
Listera ovata	1	0	-1
Lolium perenne	0	8	8
Lonicera periclymenum	11	1	-10
Lophocolea heterophylla	2	0	-2
Luzula pilosa	2	0	-2
Lysimachia nemorum	1	0	-1
Matricaria discoidea	0	2	2
Mercurialis perennis	15	7	-8
Mnium hornum	1	0	-1
Orchis mascula	1	0	-1
Paris quadrifolia	1	0	-1
Pellia sp.	1	0	-1
Plagiochila sp	2	0	-2
Plagiomnium undulatum	14	1	-13
Plantago major	0	1	1
Poa trivialis	8	11	3
Primula vulgaris	10	0	-10
Prunella vulgaris	1	0	-1
Pteridium aquilinum	1	0	-1
Ranunculus acris	3	0	-3
Ranunculus repens	0	3	3
Rhytidiadelphus triquetrus	1	0	-1
Ribes sp.	0	1	1
Ribes uva-crispa	0	1	1
Rosa seedling/sp	15	2	-13
Rubus caesius	0	1	1
Rubus fruticosus agg.	15	8	-7
Rumex conglomeratus	10	1	-9
Rumex crispus	0	3	3
Rumex obtusifolius	0	3	3
Sanicula europaea	0	1	1
Silene dioica	7	0	-7
Silene dioicaxlatifolia	1	0	-1
Sinapis arvensis/alba	0	1	1
Sonchus asper	0	2	2
Stachys sylvatica	2	0	-2
Stellaria graminea	1	0	-1
Stellaria holostea	1	0	-1
Tamus communis	7	2	-5
Taraxacum agg.	2	5	3
Thamnobryum alopecurum	6	2	-4
Thuidium tamariscinum	8	0	-8
Trifolium pratense	0	5	5
Trifolium repens	0	3	3
Urtica dioica	13	3	-10
Veronica chamaedrys	1	0	-1
Veronica montana	6	1	-5
Vicia sepium	4	1	-3
Viola hirta	1	0	-1
Viola riviniana/reichenbiana	9	1	-8

Mar Lodge

SPECIES	1971	2000	Diff
Betula seedling/sp	6	4	-2
Sorbus aucuparia	3	3	0
Pinus sylvestris	3	10	7
Salix seedling/sp	1	0	-1
Melampyrum pratense	13	4	-9
Blechnum spicant	10	3	-7
Hypnum cupressiforme sens.lat.	11	4	-7
Aulacomnium palustre	6	0	-6
Sphagnum sp.	13	7	-6
Erica tetralix	9	4	-5
Lophocolea sp.	5	0	-5
Narthecium ossifragum	6	1	-5
Dicranum majus	5	1	-4
Rhytidiadelphus loreus	11	7	-4
Trientalis europaea	5	1	-4
Carex echinata	5	2	-3
Carex pulicaris	3	0	-3
Polygala serpyllifolia	3	0	-3
Pseudoscleropodium purum	5	2	-3
Carex viridula subsp.oedocarpa	2	0	-2
Dicranum scoparium	10	8	-2
Dryopteris dilatata/carthusiana	2	0	-2
Empetrum nigrum	7	5	-2
Listera cordata	2	0	-2
Luzula campestris/multiflora	7	5	-2
Luzula pilosa	7	5	-2
Oxalis acetosella	3	1	-2
Potentilla erecta	13	11	-2
Rhytidiadelphus squarrosus	2	0	-2
Atrichum undulatum	1	0	-1
Cerastium fontanum	1	0	-1
Cirsium palustre	1	0	-1
Erica cinerea	2	1	-1
Eriophorum angustifolium	1	0	-1
Eriophorum vaginatum	1	0	-1
Euphrasia officinalis agg.	1	0	-1
Gentianella campestris	1	0	-1
Juncus bulbosus	1	0	-1
Juncus conglomeratus	1	0	-1
Leucobryum glaucum	2	1	-1
Mnium hornum	1	0	-1
Pellia epiphylla	1	0	-1
Pinguicula vulgaris	1	0	-1
Poa annua	1	0	-1
Prunella vulgaris	1	0	-1

SPECIES	1971	2000	Diff
Pteridium aquilinum	1	0	-1
Ranunculus flammula	1	0	-1
Taraxacum agg.	1	0	-1
Thalictrum alpinum	1	0	-1
Vaccinium myrtillus	15	14	-1
Agrostis capillaris	5	5	0
Carex nigra	3	3	0
Juncus effusus	2	2	0
Plantago lanceolata	1	1	0
Pleurozium schreberi	16	16	0
Vaccinium vitis-idaea	16	16	0
Agrostis canina sens.lat.	5	6	1
Anemone nemorosa	0	1	1
Calluna vulgaris	15	16	1
Campylopus sp.	2	3	1
Deschampsia cespitosa	0	1	1
Deschampsia flexuosa	14	15	1
Festuca arundinacea	0	1	1
Festuca ovina agg.	1	2	1
Galium saxatile	8	9	1
Holcus mollis	0	1	1
Hypochaeris radicata	0	1	1
Juncus squarrosus	7	8	1
Lolium perenne	0	1	1
Lotus corniculatus	0	1	1
Pilosella officinarum	0	1	1
Ptilium crista-castrensis	0	1	1
Rhinanthus minor	0	1	1
Rumex acetosa	0	1	1
Succisa pratensis	1	2	1
Trichophorum cespitosum	2	3	1
Viola riviniana/reichenbiana	2	3	1
Anthoxanthum odoratum	3	5	2
Campanula rotundifolia	0	2	2
Carex binervis	0	2	2
Carex panicea	2	4	2
Lathyrus linifolius	0	2	2
Nardus stricta	1	3	2
Pedicularis sylvatica	0	2	2
Viola palustris	0	2	2
Danthonia decumbens	0	3	3
Festuca vivipara	5	8	3
Hylocomium splendens	13	16	3
Carex pilulifera	0	4	4
Molinia caerulea	10	14	4
Polytrichum sp.	0	7	7
Rhytidiadelphus triquetrus	1	8	7

Mill Wood

SPECIES	1971	2000	Diff
Betula seedling/sp	16	15	-1
Sorbus aucuparia	11	8	-3
Corylus avellana	10	7	-3
Crataegus monogyna	6	2	-4
Cytisus scoparius	5	4	-1
Alnus glutinosa	3	3	0
Salix caprea	1	6	5
Fraxinus excelsior	1	3	2
Prunus spinosa	1	1	0
Ulex sp.	1	1	0
Aesculus hippocastanum	1	0	-1
Cornus sanguinea	1	0	-1
Sorbus sp.	1	0	-1
Prunus padus	0	2	2
Eurhynchium sp.	6	15	9
Agrostis stolonifera	1	6	5
Viola odorata	0	5	5
Galium aparine	4	8	4
Poa trivialis	1	5	4
Rhytidiadelphus loreus	0	4	4
Stellaria holostea	9	13	4
Carex sylvatica	0	3	3
Digitalis purpurea	3	6	3
Festuca arundinacea	1	4	3
Pleurozium schreberi	0	3	3
Silene dioica	3	6	3
Stachys sylvatica	3	6	3
Arrhenatherum elatius	5	7	2
Atrichum sp.	1	3	2
Cardamine amara	0	2	2
Carex flacca	0	2	2
Dryopteris dilatata/carthusiana	8	10	2
Luzula sylvatica	3	5	2
Oreopteris limbosperma	0	2	2
Stellaria graminea	1	3	2
Urtica dioica	3	5	2
Anthriscus sylvestris	2	3	1
Apium graveolens	0	1	1
Calamagrostis epigejos	0	1	1
Calliergon cuspidatum	1	2	1
Carex binervis	0	1	1
Carex pilulifera	0	1	1
Centaurea nigra	4	5	1
Equisetum sp.	0	1	1
Equisetum sylvaticum	0	1	1
Euphrasia officinalis agg.	0	1	1

SPECIES	1971	2000	Diff
Glyceria fluitans	2	3	1
Gymnocarpium dryopteris	0	1	1
Hypochaeris radicata	0	1	1
Linum catharticum	0	1	1
Lolium perenne	0	1	1
Lophozia ventricosa	0	1	1
Lotus corniculatus	0	1	1
Molinia caerulea	0	1	1
Pilosella officinarum	0	1	1
Sanicula europaea	3	4	1
Stellaria media	1	2	1
Stellaria nemorum	0	1	1
Bromopsis ramosa	1	1	0
Calluna vulgaris	1	1	0
Carex nigra	1	1	0
Cirsium vulgare	1	1	0
Dicranum scoparium	3	3	0
Hypnum cupressiforme sens.lat.	1	1	0
Juncus effusus	5	5	0
Poa pratensis sens.lat.	1	1	0
Potentilla anserina	1	1	0
Pteridium aquilinum	11	11	0
Rumex obtusifolius	6	6	0
Thuidium tamariscinum	10	10	0
Thymus polytrichus	1	1	0
Trifolium pratense	1	1	0
Tussilago farfara	1	1	0
Vaccinium myrtillus	2	2	0
Achillea ptarmica	1	0	-1
Agrostis gigantea	1	0	-1
Brachypodium sylvaticum	1	0	-1
Chrysosplenium oppositifolium	9	8	-1
Circaea lutetiana	1	0	-1
Crepis paludosa	5	4	-1
Dactylorhiza purpurella	1	0	-1
Erica cinerea	1	0	-1
Euphorbia agg.	1	0	-1
Galium palustre	2	1	-1
Galium verum	2	1	-1
Geum rivale	5	4	-1
Heracleum sphondylium	9	8	-1
Hieracium 'indeterminate'	2	1	-1
Hypericum perforatum	1	0	-1
Jasione montana	1	0	-1
Linaria vulgaris	1	0	-1
Lonicera periclymenum	1	0	-1
Lotus pedunculatus	1	0	-1
Lychnis flos-cuculi	1	0	-1
Melampyrum pratense	1	0	-1

SPECIES	1971	2000	Diff	SPECIES	1971	2000	Diff
Mentha aquatica	1	0	-1	*Dryopteris filix-mas*	10	7	-3
Petasites spp.	1	0	-1	*Holcus mollis*	16	13	-3
Phleum pratense sens.lat.	2	1	-1	*Hypochoeris spp.*	4	1	-3
Polygonum aviculare agg.	1	0	-1	*Lathyrus linifolius*	4	1	-3
Polytrichum sp.	1	0	-1	*Luzula pilosa*	6	3	-3
Populus tremula	1	0	-1	*Polypodium vulgare sens.lat.*	4	1	-3
Ranunculus flammula	1	0	-1	*Ranunculus acris*	5	2	-3
Ranunculus repens	14	13	-1	*Rosa seedling/sp*	3	0	-3
Rubus fruticosus agg.	2	1	-1	*Veronica serpyllifolia*	3	0	-3
Rubus saxatilis	2	1	-1	*Viola riviniana/reichenbiana*	12	9	-3
Rumex acetosa	7	6	-1	*Athyrium filix-femina*	5	1	-4
Rumex acetosella	3	2	-1	*Filipendula ulmaria*	9	5	-4
Senecio jacobaea	5	4	-1	*Fragaria vesca*	5	1	-4
Teucrium scorodonia	1	0	-1	*Hylocomium splendens*	5	1	-4
Thamnobryum alopecurum	1	0	-1	*Hypericum pulchrum*	6	2	-4
Valeriana officinalis	3	2	-1	*Luzula campestris/multiflora*	5	1	-4
Vicia sepium	2	1	-1	*Pellia sp.*	4	0	-4
Agrostis canina sens.lat.	8	6	-2	*Primula vulgaris*	10	6	-4
Blechnum spicant	10	8	-2	*Salix seedling/sp*	4	0	-4
Brachythecium sp.	3	1	-2	*Taraxacum agg.*	7	3	-4
Caltha palustris	3	1	-2	*Cirsium palustre*	9	4	-5
Dactylis glomerata	10	8	-2	*Deschampsia flexuosa*	12	7	-5
Festuca rubra agg.	10	8	-2	*Equisetum arvense*	5	0	-5
Galium odoratum	4	2	-2	*Galium saxatile*	11	6	-5
Geranium robertianum	10	8	-2	*Holcus lanatus*	15	10	-5
Juncus articulatus/acutiflora	3	1	-2	*Lathyrus pratensis*	7	2	-5
Juncus bulbosus	2	0	-2	*Rhinanthus minor*	5	0	-5
Lapsana communis	6	4	-2	*Veronica chamaedrys*	14	9	-5
Listera ovata	2	0	-2	*Geum urbanum*	10	4	-6
Mercurialis perennis	8	6	-2	*Lophocolea sp.*	7	1	-6
Mnium hornum	3	1	-2	*Prunella vulgaris*	9	3	-6
Oxalis acetosella	14	12	-2	*Angelica sylvestris*	12	5	-7
Paris quadrifolia	2	0	-2	*Geranium sylvaticum*	10	3	-7
Plagiomnium undulatum	10	8	-2	*Myosotis seedling/sp*	7	0	-7
Plantago lanceolata	6	4	-2	*Potentilla erecta*	12	5	-7
Plantago major	3	1	-2	*Pseudoscleropodium purum*	12	5	-7
Rubus idaeus	4	2	-2	*Succisa pratensis*	13	6	-7
Senecio aquaticus	2	0	-2	*Alchemilla sp.*	9	1	-8
Stellaria uliginosa	6	4	-2	*Anthoxanthum odoratum*	14	6	-8
Trifolium repens	4	2	-2	*Cerastium fontanum*	9	1	-8
Triticum aestivum	2	0	-2	*Epilobium montanum*	10	2	-8
Veronica beccabunga	2	0	-2	*Anemone nemorosa*	12	3	-9
Veronica montana	10	8	-2	*Cardamine hirsuta/flexuosa*	9	0	-9
Achillea millefolium	3	0	-3	*Conopodium majus*	12	3	-9
Agrostis capillaris	13	10	-3	*Rhytidiadelphus triquetrus*	10	1	-9
Ajuga reptans	9	6	-3	*Veronica officinalis*	9	0	-9
Bellis perennis	4	1	-3	*Plagiochila sp*	10	0	-10
Campanula rotundifolia	6	3	-3	*Rhytidiadelphus squarrosus*	12	2	-10
Cynosurus cristatus	4	1	-3	*Lysimachia nemorum*	14	3	-11
Deschampsia cespitosa	11	8	-3				

Oakers

SPECIES	1971	2000	Diff
Ilex aquifolium	5	15	10
Corylus avellana	3	12	9
Betula seedling/sp	3	10	7
Quercus seedling/sp	9	13	4
Crataegus monogyna	7	10	3
Rhododendron spp.	1	4	3
Fagus sylvatica	0	1	1
Viburnum opulus	0	1	1
Sorbus aucuparia	1	1	0
Acer pseudoplatanus	1	0	-1
Fraxinus excelsior	13	11	-2
Salix seedling/sp	2	0	-2
Ligustrum vulgare	6	1	-5
Polytrichum sp.	2	8	6
Dryopteris dilatata/carthusiana	4	9	5
Veronica montana	1	6	5
Brachypodium sylvaticum	6	8	2
Carex flacca	0	2	2
Euphorbia amygdaloides	2	4	2
Festuca gigantea	0	2	2
Geranium robertianum	2	4	2
Luzula pilosa	2	4	2
Molinia caerulea	0	2	2
Rosa seedling/sp	4	6	2
Sanicula europaea	0	2	2
Agrostis capillaris	4	5	1
Carex curta	0	1	1
Castanea sativa	1	2	1
Fragaria vesca	1	2	1
Lathyrus pratensis	0	1	1
Lotus corniculatus	0	1	1
Pleurozium schreberi	0	1	1
Scutellaria galericulata	0	1	1
Ajuga reptans	3	3	0
Blechnum spicant	2	2	0
Deschampsia cespitosa	1	1	0
Dicranella heteromalla	1	1	0
Glechoma hederacea	1	1	0
Hedera helix	14	14	0
Hyacinthoides non-scripta	7	7	0
Hypericum androsaemum	1	1	0
Melampyrum pratense	1	1	0
Mnium hornum	4	4	0
Pteridium aquilinum	10	10	0
Rubus fruticosus agg.	14	14	0
Thuidium tamariscinum	8	8	0
Anemone nemorosa	1	0	-1

SPECIES	1971	2000	Diff
Anthoxanthum odoratum	1	0	-1
Artemisia vulgaris	1	0	-1
Bellis perennis	1	0	-1
Calluna vulgaris	1	0	-1
Carex echinata	1	0	-1
Cerastium fontanum	1	0	-1
Cynosurus cristatus	1	0	-1
Dactylis glomerata	1	0	-1
Deschampsia flexuosa	1	0	-1
Dicranum scoparium	1	0	-1
Equisetum arvense	1	0	-1
Erica tetralix	1	0	-1
Geum urbanum	4	3	-1
Holcus mollis	1	0	-1
Hydrocotyle vulgaris	1	0	-1
Hypnum cupressiforme sens.lat.	2	1	-1
Inula conyzae	1	0	-1
Leucobryum glaucum	2	1	-1
Lolium perenne	1	0	-1
Lophocolea sp.	1	0	-1
Lycopus europaeus	1	0	-1
Medicago lupulina	1	0	-1
Mentha arvensis	1	0	-1
Myosotis seedling/sp	1	0	-1
Phyllitis scolopendrium	1	0	-1
Plagiochila sp	1	0	-1
Plantago major	1	0	-1
Pohlia nutans	1	0	-1
Pseudoscleropodium purum	3	2	-1
Pulicaria dysenterica	1	0	-1
Sphagnum sp.	1	0	-1
Stellaria graminea	1	0	-1
Stellaria holostea	1	0	-1
Stellaria media	1	0	-1
Symphytum sp.	1	0	-1
Trifolium repens	1	0	-1
Veronica serpyllifolia	1	0	-1
Vicia sepium	1	0	-1
Athyrium filix-femina	2	0	-2
Cardamine hirsuta/flexuosa	2	0	-2
Dactylorhiza fuchsii	2	0	-2
Digitalis purpurea	2	0	-2
Hypericum tetrapterum	2	0	-2
Hypochoeris spp.	2	0	-2
Juncus bulbosus	2	0	-2
Juncus effusus	7	5	-2
Lonicera periclymenum	12	10	-2
Lysimachia nemorum	5	3	-2
Oxalis acetosella	5	3	-2
Rhytidiadelphus squarrosus	2	0	-2

SPECIES	1971	2000	Diff
Tamus communis	2	0	-2
Thamnobryum alopecurum	2	0	-2
Viola riviniana/reichenbiana	11	9	-2
Agrostis canina sens.lat.	3	0	-3
Arrhenatherum elatius	3	0	-3
Arum maculatum	4	1	-3
Circaea lutetiana	7	4	-3
Conopodium majus	3	0	-3
Galium mollugo	3	0	-3
Galium palustre	3	0	-3
Lamiastrum galeobdolon	3	0	-3
Moehringia trinervia	3	0	-3
Plagiomnium undulatum	4	1	-3
Ranunculus repens	4	1	-3
Rumex conglomeratus	3	0	-3
Taraxacum agg.	3	0	-3
Urtica dioica	3	0	-3
Veronica officinalis	3	0	-3
Atrichum sp.	9	5	-4
Brachythecium sp.	4	0	-4
Carex sylvatica	6	2	-4
Epilobium montanum	4	0	-4
Galium aparine	5	1	-4
Polypodium vulgare sens.lat.	4	0	-4
Scutellaria minor	4	0	-4
Dryopteris filix-mas	11	6	-5
Luzula campestris/multiflora	5	0	-5
Mercurialis perennis	7	2	-5
Pulmonaria longifolia	5	0	-5
Ribes sp.	10	5	-5
Teucrium scorodonia	8	3	-5
Cirsium palustre	6	0	-6
Holcus lanatus	6	0	-6
Scrophularia nodosa	6	0	-6
Arctium agg.	7	0	-7
Eurhynchium sp.	13	6	-7
Potentilla erecta	9	2	-7
Potentilla sterilis	11	4	-7
Primula vulgaris	9	0	-9
Poa trivialis	11	1	-10
Prunella vulgaris	10	0	-10
Veronica chamaedrys	10	0	-10

Priestfield

SPECIES	1971	2000	Diff
Sorbus aucuparia	12	15	3
Fagus sylvatica	12	12	0
Quercus seedling/sp	11	13	2
Fraxinus excelsior	11	11	0
Ilex aquifolium	10	11	1
Betula seedling/sp	9	14	5
Acer pseudoplatanus	8	14	6
Crataegus monogyna	4	6	2
Corylus avellana	2	11	9
Viburnum opulus	2	2	0
Sambucus nigra	1	4	3
Pinus sylvestris	1	1	0
Salix caprea	1	1	0
Larix sp.	0	11	11
Pseudotsuga spp.	0	3	3
Prunus avium	0	2	2
Picea abies	0	1	1
Prunus padus	0	1	1
Agrostis capillaris	0	9	9
Dryopteris dilatata/carthusiana	12	16	4
Galium aparine	0	4	4
Geranium robertianum	1	5	4
Geum urbanum	1	5	4
Lonicera periclymenum	10	14	4
Mnium hornum	10	14	4
Rubus idaeus	2	6	4
Atrichum sp.	0	3	3
Bromopsis ramosa	0	3	3
Digitalis purpurea	2	5	3
Dryopteris filix-mas	7	10	3
Galium odoratum	0	3	3
Melica uniflora	1	4	3
Mercurialis perennis	1	4	3
Milium effusum	6	9	3
Eurhynchium sp.	11	13	2
Juncus effusus	0	2	2
Ribes sp.	1	3	2
Rubus fruticosus agg.	13	15	2
Stachys officinalis	0	2	2
Urtica dioica	2	4	2
Veronica montana	0	2	2
Ajuga reptans	1	2	1
Alliaria petiolata	0	1	1
Alnus glutinosa	0	1	1
Anchusa arvensis	0	1	1
Anthoxanthum odoratum	0	1	1
Arrhenatherum elatius	0	1	1
Carex seedling/sp	0	1	1
Cirsium arvense	0	1	1
Dactylis glomerata	0	1	1
Dicranella heteromalla	1	2	1
Drosera rotundifolia	0	1	1
Epilobium montanum	0	1	1

SPECIES	1971	2000	Diff
Heracleum sphondylium	0	1	1
Hyacinthoides non-scripta	1	2	1
Hylocomium splendens	0	1	1
Hypericum pulchrum	0	1	1
Lamium purpureum	0	1	1
Lapsana communis	0	1	1
Lolium multiflorum	0	1	1
Melampyrum pratense	0	1	1
Moehringia trinervia	0	1	1
Myosotis seedling/sp	0	1	1
Oxalis acetosella	14	15	1
Polygala oxyptera	0	1	1
Rumex obtusifolius	0	1	1
Sanicula europaea	0	1	1
Scrophularia nodosa	0	1	1
Silene dioica	0	1	1
Stachys sylvatica	1	2	1
Stellaria holostea	9	10	1
Teucrium scorodonia	2	3	1
Vaccinium myrtillus	1	2	1
Athyrium filix-femina	4	4	0
Brachythecium sp.	1	1	0
Chamerion angustifolium	2	2	0
Hieracium 'indeterminate'	1	1	0
Leucobryum glaucum	1	1	0
Luzula pilosa	7	7	0
Viola riviniana/reichenbiana	3	3	0
Circaea lutetiana	1	0	-1
Deschampsia cespitosa	10	9	-1
Epipactis helleborine	1	0	-1
Luzula campestris/multiflora	1	0	-1
Luzula sylvatica	4	3	-1
Lysimachia nemorum	2	1	-1
Pleurozium schreberi	1	0	-1
Ranunculus repens	3	2	-1
Sphagnum sp.	1	0	-1
Holcus lanatus	3	1	-2
Holcus mollis	11	9	-2
Hookeria lucens	2	0	-2
Lophocolea sp.	2	0	-2
Pellia sp.	3	1	-2
Poa trivialis	4	2	-2
Pseudoscleropodium purum	2	0	-2
Rhytidiadelphus loreus	2	0	-2
Stellaria media	2	0	-2
Brachypodium sylvaticum	3	0	-3
Galium saxatile	3	0	-3
Hypnum cupressiforme sens.lat.	3	0	-3
Rhytidiadelphus squarrosus	3	0	-3
Blechnum spicant	5	1	-4

SPECIES	1971	2000	Diff
Poa annua	5	0	-5
Rhytidiadelphus triquetrus	5	0	-5
Deschampsia flexuosa	7	1	-6
Hedera helix	8	2	-6
Plagiomnium undulatum	7	1	-6
Pteridium aquilinum	13	6	-7
Dicranum scoparium	8	0	-8
Polytrichum sp.	10	2	-8
Plagiochila sp	9	0	-9
Thuidium tamariscinum	14	0	-14

Shieldaig

SPECIES	1971	2000	Diff
Betula seedling/sp	19	13	-6
Pinus sylvestris	17	11	-6
Sorbus aucuparia	15	9	-6
Salix seedling/sp	2	0	-2
Ilex aquifolium	2	2	0
Leucobryum glaucum	9	1	-8
Succisa pratensis	11	4	-7
Agrostis canina sens.lat.	12	7	-5
Campylopus sp.	6	1	-5
Carex binervis	5	0	-5
Hypericum pulchrum	5	0	-5
Lophocolea sp.	6	1	-5
Empetrum nigrum	4	0	-4
Festuca ovina agg.	5	1	-4
Hookeria lucens	4	0	-4
Pleurozium schreberi	16	12	-4
Polygala serpyllifolia	5	1	-4
Blechnum spicant	15	12	-3
Digitalis purpurea	4	1	-3
Drosera rotundifolia	4	1	-3
Dryopteris filix-mas	3	0	-3
Erica cinerea	13	10	-3
Eriophorum vaginatum	3	0	-3
Rhytidiadelphus squarrosus	4	1	-3
Viola riviniana/reichenbiana	8	5	-3
Arctostaphylos uva-ursi	2	0	-2
Carex echinata	6	4	-2
Carex pulicaris	3	1	-2
Cirsium vulgare	2	0	-2
Erica tetralix	7	5	-2
Euphrasia officinalis agg.	2	0	-2
Festuca vivipara	2	0	-2
Goodyera repens	2	0	-2
Juncus effusus	3	1	-2
Luzula pilosa	2	0	-2

SPECIES	1971	2000	Diff
Pinguicula vulgaris	4	2	-2
Plantago lanceolata	2	0	-2
Prunella vulgaris	3	1	-2
Rubus chamaemorus	2	0	-2
Vaccinium vitis-idaea	2	0	-2
Veronica officinalis	2	0	-2
Carex nigra	2	1	-1
Carex panicea	6	5	-1
Dactylorhiza sp.	1	0	-1
Danthonia decumbens	1	0	-1
Drosera longifolia	1	0	-1
Erica ciliaris	1	0	-1
Hedera helix	1	0	-1
Juncus bulbosus	5	4	-1
Luzula campestris/multiflora	2	1	-1
Molinia caerulea	12	11	-1
Narthecium ossifragum	5	4	-1
Pedicularis sylvatica	1	0	-1
Potamogeton polygonifolius	1	0	-1
Pteridium aquilinum	13	12	-1
Rhytidiadelphus triquetrus	2	1	-1
Carex viridula subsp.oedocarpa	1	1	0
Dryopteris dilatata/carthusiana	2	2	0
Eriophorum angustifolium	3	3	0
Juncus conglomeratus	1	1	0
Melampyrum pratense	1	1	0
Potentilla erecta	12	12	0
Primula vulgaris	3	3	0
Ptilium crista-castrensis	4	4	0
Taraxacum agg.	1	1	0
Alchemilla sp.	0	1	1
Arctostaphylos alpinus	0	1	1
Brachypodium sylvaticum	0	1	1
Calluna vulgaris	15	16	1
Carex dioica	0	1	1
Carex pilulifera	0	1	1
Eleocharis multicaulis	0	1	1
Galium saxatile	4	5	1
Hymenophyllum sp.	0	1	1
Hypericum humifusum	0	1	1
Leontodon autumnalis	0	1	1
Lonicera periclymenum	0	1	1
Myrica gale	2	3	1
Oreopteris limbosperma	0	1	1
Phleum pratense sens.lat.	0	1	1
Pleurozia purpurea	0	1	1
Polypodium vulgare sens.lat.	0	1	1
Pseudoscleropodium purum	1	2	1
Ranunculus flammula	0	1	1

SPECIES	1971	2000	Diff
Rhynchospora alba	0	1	1
Solidago virgaurea	0	1	1
Trichophorum cespitosum	3	4	1
Viola palustris	0	1	1
Holcus lanatus	0	2	2
Holcus mollis	0	2	2
Nardus stricta	0	2	2
Philonotis sp.	0	2	2
Teucrium scorodonia	0	2	2
Thuidium tamariscinum	8	10	2
Vaccinium myrtillus	11	13	2
Anthoxanthum odoratum	3	6	3
Deschampsia flexuosa	9	12	3
Racomitrium lanuginosum	0	3	3
Dicranum scoparium	0	4	4
Hypnum cupressiforme sens.lat.	3	7	4
Oxalis acetosella	2	6	4
Polytrichum sp.	2	6	4
Dicranum majus	0	5	5
Hylocomium splendens	2	7	5
Agrostis capillaris	0	7	7
Rhytidiadelphus loreus	3	10	7

Spital

SPECIES	1971	2000	Diff
Sambucus nigra	14	15	1
Ulmus glabra	14	8	-6
Fraxinus excelsior	13	14	1
Crataegus monogyna	7	9	2
Quercus seedling/sp	6	7	1
Acer pseudoplatanus	5	5	0
Ulmus procera	4	10	6
Larix sp.	3	2	-1
Ulex sp.	2	9	7
Acer campestre	2	1	-1
Fagus sylvatica	1	0	-1
Ligustrum vulgare	1	0	-1
Acer platanoides	0	1	1
Carpinus betulus	0	1	1
Pseudotsuga spp.	0	1	1
Campanula latifolia	1	8	7
Galium aparine	1	7	6
Plagiomnium undulatum	1	5	4
Glechoma hederacea	0	3	3
Circaea lutetiana	0	2	2
Geranium robertianum	1	3	2
Hyacinthoides non-scripta	9	11	2
Poa trivialis	13	15	2

SPECIES	1971	2000	Diff
Rubus fruticosus agg.	10	12	2
Senecio vulgaris	0	2	2
Stellaria media	0	2	2
Alliaria petiolata	0	1	1
Arum maculatum	0	1	1
Cirsium vulgare	0	1	1
Epilobium montanum	1	2	1
Fissidens sp.	2	3	1
Galium palustre	0	1	1
Heracleum sphondylium	6	7	1
Rumex conglomeratus	0	1	1
Viola odorata	0	1	1
Dryopteris filix-mas	3	3	0
Geum urbanum	4	4	0
Rosa seedling/sp	1	1	0
Arctium agg.	2	1	-1
Arrhenatherum elatius	2	1	-1
Cirsium arvense	2	1	-1
Cirsium palustre	1	0	-1
Dryopteris dilatata/carthusiana	1	0	-1
Eurhynchium sp.	15	14	-1
Holcus lanatus	1	0	-1
Mnium hornum	1	0	-1
Poa annua	1	0	-1
Urtica dioica	15	14	-1
Viola hirta	1	0	-1
Dactylis glomerata	2	0	-2
Hedera helix	10	8	-2
Mercurialis perennis	15	13	-2
Polystichum aculeatum	2	0	-2
Stachys sylvatica	3	1	-2
Chamerion angustifolium	3	0	-3
Lamiastrum galeobdolon	15	12	-3
Viola riviniana/reichenbiana	3	0	-3
Brachypodium sylvaticum	4	0	-4
Bromopsis ramosa	7	3	-4
Milium effusum	11	7	-4
Moehringia trinervia	5	1	-4
Brachythecium sp.	6	1	-5
Silene dioica	16	11	-5
Anthriscus sylvestris	8	2	-6
Festuca gigantea	7	0	-7
Plagiochila sp	8	0	-8
Campanula trachelium	9	0	-9

Wellhanger Copse

SPECIES	1971	2000	Diff
Fraxinus excelsior	14	12	-2
Corylus avellana	11	13	2
Fagus sylvatica	8	8	0
Crataegus monogyna	7	6	-1
Acer pseudoplatanus	6	11	5
Quercus seedling/sp	6	7	1
Larix sp.	4	0	-4
Betula seedling/sp	3	2	-1
Cornus sanguinea	3	1	-2
Ilex aquifolium	3	0	-3
Sambucus nigra	2	5	3
Prunus spinosa	2	0	-2
Prunus laurocerasus	1	2	1
Castanea sativa	1	1	0
Daphne laureola	1	0	-1
Crataegus laevigata	1	0	-1
Viburnum opulus	1	0	-1
Acer campestre	0	4	4
Pseudotsuga spp.	0	1	1
Salix caprea	0	1	1
Hypericum tetrapterum	0	7	7
Arum maculatum	2	7	5
Cirsium arvense	0	5	5
Eupatorium cannabinum	0	5	5
Glechoma hederacea	6	11	5
Lapsana communis	1	6	5
Cirsium vulgare	0	4	4
Silene dioica	2	6	4
Urtica dioica	9	13	4
Arctium agg.	3	6	3
Dryopteris dilatata/carthusiana	0	3	3
Epilobium montanum	3	6	3
Epilobium parviflorum	0	3	3
Eurhynchium sp.	12	15	3
Hyacinthoides non-scripta	3	6	3
Myosotis seedling/sp	0	3	3
Scrophularia nodosa	1	4	3
Senecio jacobaea	0	3	3
Veronica chamaedrys	4	7	3
Agrostis capillaris	1	3	2
Atrichum sp.	0	2	2
Cerastium fontanum	0	2	2
Cirsium palustre	0	2	2
Cruciata laevipes	0	2	2
Festuca gigantea	2	4	2
Fragaria vesca	1	3	2
Galium aparine	2	4	2
Galium odoratum	0	2	2
Odontites vernus	0	2	2
Prunella vulgaris	1	3	2
Ranunculus repens	0	2	2

SPECIES	1971	2000	Diff
Rumex conglomeratus	0	2	2
Trifolium repens	0	2	2
Viola hirta	0	2	2
Aegopodium podagraria	0	1	1
Agrostis gigantea	0	1	1
Arrhenatherum elatius	0	1	1
Brachypodium sylvaticum	5	6	1
Brachythecium sp.	0	1	1
Bryonia dioica	1	2	1
Calliergon cuspidatum	0	1	1
Carex flacca	0	1	1
Centaurium erythraea	0	1	1
Clematis vitalba	6	7	1
Deschampsia cespitosa	3	4	1
Digitalis purpurea	0	1	1
Dryopteris filix-mas	6	7	1
Epilobium hirsutum	0	1	1
Euonymus europaeus	0	1	1
Euphorbia amygdaloides	2	3	1
Geranium robertianum	4	5	1
Holcus lanatus	1	2	1
Hypericum androsaemum	0	1	1
Inula conyzae	0	1	1
Juncus effusus	0	1	1
Lophozia ventricosa	0	1	1
Melica uniflora	0	1	1
Mentha aquatica	0	1	1
Poa pratensis sens.lat.	0	1	1
Potentilla reptans	0	1	1
Rumex acetosa	0	1	1
Solanum dulcamara	0	1	1
Sonchus asper	0	1	1
Stachys sylvatica	5	6	1
Taraxacum agg.	0	1	1
Torilis japonica	1	2	1
Trifolium pratense	0	1	1
Veronica serpyllifolia	0	1	1
Ajuga reptans	4	4	0
Carex sylvatica	5	5	0
Dactylis glomerata	3	3	0
Geum urbanum	4	4	0
Heracleum sphondylium	2	2	0
Plantago major	1	1	0
Poa trivialis	9	9	0
Primula vulgaris	4	4	0
Pteridium aquilinum	4	4	0
Rubus fruticosus agg.	12	12	0
Rumex obtusifolius	2	2	0
Tamus communis	1	1	0
Thuidium tamariscinum	1	1	0

SPECIES	1971	2000	Diff
Agrostis stolonifera	2	1	-1
Bellis perennis	1	0	-1
Bromopsis ramosa	1	0	-1
Campanula latifolia	2	1	-1
Cardamine hirsuta/flexuosa	1	0	-1
Chamerion angustifolium	2	1	-1
Fissidens sp.	3	2	-1
Geranium dissectum	1	0	-1
Holcus mollis	1	0	-1
Hypnum cupressiforme sens.lat.	1	0	-1
Hypochoeris spp.	1	0	-1
Impatiens noli-tangere	1	0	-1
Juncus bufonius sens.lat.	1	0	-1
Lonicera periclymenum	2	1	-1
Lophocolea heterophylla	1	0	-1
Moehringia trinervia	1	0	-1
Poa annua	1	0	-1
Polytrichum sp.	1	0	-1
Ribes sp.	1	0	-1
Triticum aestivum	1	0	-1
Veronica montana	2	1	-1
Vicia sepium	1	0	-1
Angelica sylvestris	2	0	-2
Circaea lutetiana	6	4	-2
Hypericum perforatum	2	0	-2
Luzula pilosa	2	0	-2
Mercurialis perennis	15	13	-2
Mnium hornum	2	0	-2
Plagiochila sp	2	0	-2
Potentilla sterilis	2	0	-2
Ranunculus acris	2	0	-2
Rubus idaeus	4	2	-2
Ruscus aculeatus	2	0	-2
Campanula trachelium	3	0	-3
Lamiastrum galeobdolon	11	8	-3
Hedera helix	13	9	-4
Stellaria media	4	0	-4
Thamnobryum alopecurum	5	1	-4
Viola riviniana/reichenbiana	10	6	-4
Rosa seedling/sp	8	3	-5
Sanicula europaea	5	0	-5
Plagiomnium undulatum	8	2	-6
Ligustrum vulgare	7	0	-7

		Balsham		Spital		Hill wood		Wellhanger Copse		Birds Marsh		Glan Morlies		Cil-Hen-Ros		Great Knott		Hall Brow		Eaves wood		Priestfield		Callender		Mill wood		Shieldaig		Mar Lodge	
SPECIES	**DBH**	**1971**	**2000**	**1971**	**2000**	**1971**	**2000**	**1971**	**2000**	**1971**	**2000**	**1971**	**2000**	**1971**	**2000**	**1971**	**2000**	**1971**	**2000**	**1971**	**2000**	**1971**	**2000**	**1971**	**2000**	**1971**	**2000**	**1971**	**2000**	**1971**	**2000**
Betula seedling/sp	1					23		3	8	52	28					51	6	122	6	80	2	19	39	279	44	143	56	157	131		24
	2					59	9	1		2	35					26	1	97			8	1	106	112	56	69	46	18	111		
	3					60	13	5			2					15		23	8		2	1	55	49	32	48	40	13	21		
	4					17	7	1			1			2		8		6	8		1	2	13	35	32	24	10	2	5		
	5					5	5									7	3	3	7					20	6	15	15	2	6	2	1
	6						1							1		3	1	2			1	2		13	6		8	3	4		
	7										1						2		3		2	4		6		4	2	1	1		
	8																	1	1		2	4		1	1		2	1			
	9																		1					2	2			1	1		
	10															1		1	1												
	11																	1								1					
	15																											1			
Betula seedling/sp Total						164	35	10	8	54	67			3		111	13	256	35	80	18	33	213	517	179	304	179	199	280	2	25
Corylus avellana	1	1322	640			436	185	1176	587	20	78	192	96	92	246	104	13	302	3	1470	348	36	189		1	522	171				
	2	100	61			26	10	80	39		2	38	9	20	74	2		114	15	14	55		5		9	62	19				
	3	6	4				2		7		1	4	3		2			6	2		1					10	2				
	4										1							2									2				
	6	2																2													
	7							2																							
Corylus avellana Total		1430	705			462	197	1258	633	20	82	234	108	112	322	106	13	426	20	1484	404	36	194		10	594	194				
Crataegus monogyna	1	22	74	55	51	58	39	70	2	1		20	21	14	24					22	4	3	6			1					
	2		2	6	46	4	3	7				1	6		12			3	2		2	2	1			2					
	3				10	2	1			2		2			2			3			5	2				3					
	4				2	1	1	1				2			2			2	1		1	1					1				
	5				1		1																				1				
Crataegus monogyna Total		22	76	61	110	65	45	78	2	3		25	27	14	40			8	3	22	12	8	7			6	2				
Fagus sylvatica	1							8	20	29	2			3			2			5		14	60								
	2							16		25	1	1			2				1			2	11								
	3		2				1	4	4		1			1	2							1	2								
	4		1					2	3		2											2	1								
	5		1					1	7		3		1		2		1					1	2								
	6							1	7		1	1																			
	7							1	5		1		1					1	1				1								
	8							1	1					1			1					1									
	9							1			1											2									
	10													1						1		1									
	11																					2									
	12																	1	1			2									

Appendix 8 Correlation matrix between environmental and vegetation based variables

	LC	LCAX1	EASTING	NORTHING	PTAQ71	PTD	RUB71	RUBD	URT71	URD	PH71	TOTPD	PHD	LOI71	LOIRT	LOID	DBH DF71	DBHD	PRNT 71	PRTD
LC	1.00	0.84	-0.16	0.97	0.28	0.24	-0.34	-0.21	-0.19	0.00	-0.33	0.01	0.15	0.28	0.30	-0.06	-0.12	-0.07	0.24	0.11
LCAX1	0.84	1.00	-0.38	0.88	0.18	0.28	-0.23	-0.14	-0.23	-0.08	-0.27	0.05	0.14	0.25	0.23	-0.04	-0.13	-0.04	0.16	0.03
EASTING	-0.16	-0.38	1.00	-0.21	-0.04	-0.15	-0.19	-0.14	0.34	0.04	0.35	-0.18	0.16	-0.14	-0.14	-0.04	0.27	0.01	-0.15	-0.07
NORTHING	0.97	0.88	-0.21	1.00	0.23	0.32	-0.38	-0.19	-0.15	-0.04	-0.28	0.05	0.14	0.29	0.31	-0.06	-0.13	-0.08	0.21	0.13
PTAQ71	0.28	0.18	-0.04	0.23	1.00	-0.42	-0.10	-0.10	-0.09	-0.05	-0.35	-0.35	0.10	0.11	0.12	0.02	-0.21	0.16	0.15	-0.06
PTD	0.24	0.28	-0.15	0.32	-0.42	1.00	-0.15	-0.05	-0.03	-0.01	-0.05	0.60	0.10	0.17	0.19	-0.09	-0.02	-0.15	0.05	0.17
RUB71	-0.34	-0.23	-0.19	-0.38	-0.10	-0.15	1.00	-0.11	0.01	-0.01	-0.02	-0.17	-0.06	-0.18	-0.17	0.08	-0.12	0.20	0.02	-0.06
RUBD	-0.21	-0.14	-0.14	-0.19	-0.10	-0.05	-0.11	1.00	0.00	0.05	0.01	0.69	-0.09	-0.13	-0.14	0.00	-0.21	0.13	0.22	-0.26
URT71	-0.19	-0.23	0.34	-0.15	-0.09	-0.03	0.01	0.00	1.00	-0.47	0.27	-0.19	0.00	-0.10	-0.09	-0.02	-0.05	0.22	0.00	-0.13
URD	0.00	-0.08	0.04	-0.04	-0.05	-0.01	-0.01	0.05	-0.47	1.00	-0.12	0.38	0.26	-0.07	-0.10	0.02	0.09	-0.22	0.01	0.13
PH71	-0.33	-0.27	0.35	-0.28	-0.35	-0.05	-0.02	0.01	0.27	-0.12	1.00	-0.07	-0.36	-0.11	-0.10	-0.05	0.44	-0.21	-0.25	-0.06
TOTPD	0.01	0.05	-0.18	0.05	-0.35	0.60	-0.17	0.69	-0.19	0.38	-0.07	1.00	0.09	-0.01	-0.01	-0.05	-0.13	-0.08	0.19	-0.03
PHD	0.15	0.14	0.16	0.14	0.10	0.10	-0.06	-0.09	0.00	0.26	-0.36	0.09	1.00	0.16	0.13	-0.13	0.00	-0.04	0.00	0.13
LOI71	0.28	0.25	-0.14	0.29	0.11	0.17	-0.18	-0.13	-0.10	-0.07	-0.11	-0.01	0.16	1.00	0.93	-0.60	0.19	-0.21	-0.10	0.16
LOIRT	0.30	0.23	-0.14	0.31	0.12	0.19	-0.17	-0.14	-0.09	-0.10	-0.10	-0.01	0.13	0.93	1.00	-0.54	0.17	-0.18	-0.10	0.20
LOID	-0.06	-0.04	-0.04	-0.06	0.02	-0.09	0.08	0.00	-0.02	0.02	-0.05	-0.05	-0.13	-0.60	-0.54	1.00	-0.06	-0.01	0.09	-0.05
DBHDF71	-0.12	-0.13	0.27	-0.13	-0.21	-0.02	-0.12	-0.21	-0.05	0.09	0.44	-0.13	0.00	0.19	0.17	-0.06	1.00	-0.75	-0.51	0.25
DBHD	-0.07	-0.04	0.01	-0.08	0.16	-0.15	0.20	0.13	0.22	-0.22	-0.21	-0.08	-0.04	-0.21	-0.18	-0.01	-0.75	1.00	0.29	-0.40
PRNT71	0.24	0.16	-0.15	0.21	0.15	0.05	0.02	0.22	0.00	0.01	-0.25	0.19	0.00	-0.10	-0.10	0.09	-0.51	0.29	1.00	-0.59
PRTD	0.11	0.03	-0.07	0.13	-0.06	0.17	-0.06	-0.26	-0.13	0.13	-0.06	-0.03	0.13	0.16	0.20	-0.05	0.25	-0.40	-0.59	1.00
GD71	-0.11	-0.11	-0.06	-0.17	0.59	-0.41	0.68	-0.15	0.26	-0.19	-0.18	-0.44	0.02	-0.09	-0.07	0.07	-0.26	0.33	0.12	-0.13
GDD	0.00	0.05	-0.18	0.04	-0.35	0.59	-0.18	0.68	-0.19	0.37	-0.09	0.98	0.10	-0.01	-0.01	-0.05	-0.13	-0.07	0.17	-0.02
LG71	-0.23	-0.25	0.60	-0.19	-0.27	-0.01	-0.12	-0.17	0.21	0.06	0.61	-0.10	0.09	0.15	0.13	-0.09	0.62	-0.41	-0.38	0.10
LGD	-0.09	0.03	-0.06	-0.19	0.04	-0.35	0.31	0.23	0.03	-0.11	-0.15	-0.10	-0.11	-0.27	-0.34	0.04	-0.22	0.41	0.12	-0.30
R71	-0.60	-0.54	0.36	-0.60	-0.46	-0.15	0.26	0.09	0.26	0.11	0.70	0.00	-0.17	-0.27	-0.31	-0.02	0.41	-0.16	-0.30	-0.03
RD	0.03	0.09	0.03	0.02	0.14	-0.31	-0.01	0.11	-0.03	0.01	-0.19	-0.12	0.21	0.00	0.00	-0.02	-0.05	0.11	0.03	-0.13
N71	-0.66	-0.62	0.40	-0.67	-0.47	-0.18	0.32	0.12	0.32	0.06	0.64	0.00	-0.16	-0.34	-0.36	0.04	0.32	-0.07	-0.25	-0.06

	LC	LCAX1	EASTING	NORTHING	PTAQ71	PTD	RUB71	RUBD	URT71	URD	PH71	TOTPD	PHD	LOI71	LOIRT	LOID	DBH DF71	DBHD	PRNT 71	PRTD
ND	-0.02	0.02	0.09	-0.03	0.19	-0.29	-0.01	0.11	-0.04	0.24	-0.21	-0.02	0.21	-0.11	-0.13	-0.04	-0.10	0.13	0.06	-0.15
L71	0.31	0.41	-0.51	0.38	0.24	0.11	0.06	-0.12	0.00	-0.19	-0.39	-0.08	-0.05	0.14	0.13	-0.05	-0.42	0.26	0.22	-0.04
LD	-0.05	-0.06	-0.01	-0.05	-0.19	0.12	-0.08	0.34	-0.23	0.35	0.07	0.44	-0.02	0.04	0.04	0.04	0.07	-0.17	-0.08	0.14
CR71	0.16	0.23	-0.03	0.14	0.60	-0.31	0.08	0.04	0.20	-0.15	-0.23	-0.22	0.12	0.01	-0.02	-0.01	-0.32	0.32	0.22	-0.21
CRD	0.00	-0.06	0.01	0.05	-0.42	0.69	-0.15	-0.02	-0.12	0.36	0.00	0.55	0.09	-0.07	-0.04	0.05	0.04	-0.19	0.02	0.18
SR71	0.08	-0.08	-0.06	0.04	-0.44	0.32	0.09	0.04	-0.24	0.25	0.00	0.32	0.05	0.06	0.13	0.09	0.06	-0.18	0.01	0.22
SRD	-0.14	-0.04	0.00	-0.15	0.18	-0.53	0.06	0.12	0.21	-0.44	0.16	-0.41	-0.12	0.07	0.03	-0.18	0.13	0.08	-0.02	-0.22
RR71	0.05	0.13	-0.22	0.13	-0.14	0.11	-0.32	0.15	-0.04	0.01	0.05	0.18	-0.19	-0.20	-0.24	0.03	-0.22	0.13	0.05	-0.06
RRD	0.21	0.13	0.09	0.17	0.08	-0.12	0.08	-0.32	-0.06	-0.01	0.01	-0.31	0.02	0.04	0.10	-0.07	0.06	0.01	-0.06	0.20
SPR71	0.44	0.56	-0.31	0.55	-0.03	0.23	-0.28	-0.13	-0.09	-0.08	0.15	0.03	-0.08	0.03	0.05	0.02	0.00	-0.10	0.04	0.01
SPRD	-0.22	-0.31	0.18	-0.28	0.02	-0.13	0.03	0.13	0.03	0.10	-0.10	0.05	0.14	-0.01	-0.01	-0.09	-0.16	0.20	-0.10	0.08
LSPRD	-0.17	-0.12	0.16	-0.20	-0.04	-0.12	-0.01	0.13	-0.03	0.05	-0.02	0.03	0.14	0.01	-0.04	-0.06	-0.04	0.14	-0.11	-0.03

	GD71	GDD	LG71	LGD	R71	RD	N71	ND	L71	LD	CR71	CRD	SR71	SRD	RR71	RRD	SPR71	SPRD	LSPRD
LC	-0.11	0.00	-0.23	-0.09	-0.60	0.03	-0.66	-0.02	0.31	-0.05	0.16	0.00	0.08	-0.14	0.05	0.21	0.44	-0.22	-0.17
LCAX1	-0.11	0.05	-0.25	0.03	-0.54	0.09	-0.62	0.02	0.41	-0.06	0.23	-0.06	-0.08	-0.04	0.13	0.13	0.56	-0.31	-0.12
EASTING	-0.06	-0.18	0.60	-0.06	0.36	0.03	0.40	0.09	-0.51	-0.01	-0.03	0.01	-0.06	0.00	-0.22	0.09	-0.31	0.18	0.16
NORTHING	-0.17	0.04	-0.19	-0.19	-0.60	0.02	-0.67	-0.03	0.38	-0.05	0.14	0.05	0.04	-0.15	0.13	0.17	0.55	-0.28	-0.20
PTAQ71	0.59	-0.35	-0.27	0.04	-0.46	0.14	-0.47	0.19	0.24	-0.19	0.60	-0.42	-0.44	0.18	-0.14	0.08	-0.03	0.02	-0.04
PTD	-0.41	0.59	-0.01	-0.35	-0.15	-0.31	-0.18	-0.29	0.11	0.12	-0.31	0.69	0.32	-0.53	0.11	-0.12	0.23	-0.13	-0.12
RUB71	0.68	-0.18	-0.12	0.31	0.26	-0.01	0.32	-0.01	0.06	-0.08	0.08	-0.15	0.09	0.06	-0.32	0.08	-0.28	0.03	-0.01
RUBD	-0.15	0.68	-0.17	0.23	0.09	0.11	0.12	0.11	-0.12	0.34	0.04	-0.02	0.04	0.12	0.15	-0.32	-0.13	0.13	0.13
URT71	0.26	-0.19	0.21	0.03	0.26	-0.03	0.32	-0.04	0.00	-0.23	0.20	-0.12	-0.24	0.21	-0.04	-0.06	-0.09	0.03	-0.03
URD	-0.19	0.37	0.06	-0.11	0.11	0.01	0.06	0.24	-0.19	0.35	-0.15	0.36	0.25	-0.44	0.01	-0.01	-0.08	0.10	0.05
PH71	-0.18	-0.09	0.61	-0.15	0.70	-0.19	0.64	-0.21	-0.39	0.07	-0.23	0.00	0.00	0.16	0.05	0.01	0.15	-0.10	-0.02
TOTPD	-0.44	0.98	-0.10	-0.10	0.00	-0.12	0.00	-0.02	-0.08	0.44	-0.22	0.55	0.32	-0.41	0.18	-0.31	0.03	0.05	0.03
PHD	0.02	0.10	0.09	-0.11	-0.17	0.21	-0.16	0.21	-0.05	-0.02	0.12	0.09	0.05	-0.12	-0.19	0.02	-0.08	0.14	0.14
LOI71	-0.09	-0.01	0.15	-0.27	-0.27	0.00	-0.34	-0.11	0.14	0.04	0.01	-0.07	0.06	0.07	-0.20	0.04	0.03	-0.01	0.01
LOIRT	-0.07	-0.01	0.13	-0.34	-0.31	0.00	-0.36	-0.13	0.13	0.04	-0.02	-0.04	0.13	0.03	-0.24	0.10	0.05	-0.01	-0.04
LOID	0.07	-0.05	-0.09	0.04	-0.02	-0.02	0.04	-0.04	-0.05	0.04	-0.01	0.05	0.09	-0.18	0.03	-0.07	0.02	-0.09	-0.06

DBHDF71	-0.26	-0.13	0.62	-0.22	0.41	-0.05	0.32	-0.10	-0.42	0.07	-0.32	0.04	0.06	0.13	-0.22	0.06	0.00	-0.16	-0.04
DBHD	0.33	-0.07	-0.41	0.41	-0.16	0.11	-0.07	0.13	0.26	-0.17	0.32	-0.19	-0.18	0.08	0.13	0.01	-0.10	0.20	0.14
PRNT71	0.12	0.17	-0.38	0.12	-0.30	0.03	-0.25	0.06	0.22	-0.08	0.22	0.02	0.01	-0.02	0.05	-0.06	0.04	-0.10	-0.11
PRTD	-0.13	-0.02	0.10	-0.30	-0.03	-0.13	-0.06	-0.15	-0.04	0.14	-0.21	0.18	0.22	-0.22	-0.06	0.20	0.01	0.08	-0.03
GD71	1.00	-0.44	-0.22	0.27	-0.05	0.08	0.01	0.11	0.22	-0.26	0.54	-0.44	-0.31	0.24	-0.35	0.09	-0.26	0.04	-0.04
GDD	-0.44	1.00	-0.10	-0.09	0.01	-0.12	0.01	-0.02	-0.07	0.43	-0.23	0.56	0.29	-0.38	0.20	-0.34	0.02	0.04	0.03
LG71	-0.22	-0.10	1.00	-0.47	0.58	-0.03	0.50	-0.09	-0.48	0.15	-0.22	0.03	0.03	0.08	-0.19	-0.03	-0.03	-0.07	0.04
LGD	0.27	-0.09	-0.47	1.00	0.05	0.20	0.12	0.20	0.01	-0.14	0.24	-0.36	-0.22	0.27	-0.03	0.05	-0.27	0.16	0.18
R71	-0.05	0.01	0.58	0.05	1.00	-0.28	0.96	-0.20	-0.56	0.17	-0.26	0.05	0.00	0.14	-0.02	-0.08	-0.17	0.02	0.04
RD	0.08	-0.12	-0.03	0.20	-0.28	1.00	-0.25	0.80	0.15	-0.22	0.20	-0.31	-0.12	0.19	-0.02	-0.01	-0.07	0.06	0.13
N71	0.01	0.01	0.50	0.12	0.96	-0.25	1.00	-0.22	-0.62	0.18	-0.23	0.03	0.02	0.14	-0.10	-0.05	-0.30	0.10	0.08
ND	0.11	-0.02	-0.09	0.20	-0.20	0.80	-0.22	1.00	0.19	-0.34	0.22	-0.13	-0.19	0.03	0.09	-0.08	-0.05	-0.02	0.01
L71	0.22	-0.07	-0.48	0.01	-0.56	0.15	-0.62	0.19	1.00	-0.49	0.20	-0.04	-0.27	0.08	0.37	-0.09	0.40	-0.25	-0.23
LD	-0.26	0.43	0.15	-0.14	0.17	-0.22	0.18	-0.34	-0.49	1.00	-0.10	0.18	0.35	-0.33	-0.15	0.18	-0.18	0.37	0.28
CR71	0.54	-0.23	-0.22	0.24	-0.26	0.20	-0.23	0.22	0.20	-0.10	1.00	-0.55	-0.48	0.25	-0.04	0.07	-0.05	0.04	0.06
CRD	-0.44	0.56	0.03	-0.36	0.05	-0.31	0.03	-0.13	-0.04	0.18	-0.55	1.00	0.41	-0.58	0.18	-0.10	0.12	-0.08	-0.14
SR71	-0.31	0.29	0.03	-0.22	0.00	-0.12	0.02	-0.19	-0.27	0.35	-0.48	0.41	1.00	-0.56	-0.14	0.06	-0.10	0.14	-0.02
SRD	0.24	-0.38	0.08	0.27	0.14	0.19	0.14	0.03	0.08	-0.33	0.25	-0.58	-0.56	1.00	0.02	-0.03	0.03	-0.13	0.01
RR71	-0.35	0.20	-0.19	-0.03	-0.02	-0.02	-0.10	0.09	0.37	-0.15	-0.04	0.18	-0.14	0.02	1.00	-0.44	0.47	-0.16	-0.11
RRD	0.09	-0.34	-0.03	0.05	-0.08	-0.01	-0.05	-0.08	-0.09	0.18	0.07	-0.10	0.06	-0.03	-0.44	1.00	-0.03	0.22	0.17
SPR71	-0.26	0.02	-0.03	-0.27	-0.17	-0.07	-0.30	-0.05	0.40	-0.18	-0.05	0.12	-0.10	0.03	0.47	-0.03	1.00	-0.63	-0.35
SPRD	0.04	0.04	-0.07	0.16	0.02	0.06	0.10	-0.02	-0.25	0.37	0.04	-0.08	0.14	-0.13	-0.16	0.22	-0.63	1.00	0.66
LSPRD	-0.04	0.03	0.04	0.18	0.04	0.13	0.08	0.01	-0.23	0.28	0.06	-0.14	-0.02	0.01	-0.11	0.17	-0.35	0.66	1.00

Appendix 9 Frequency of woody species at different stages of population development by species and by site

	Seedlings		Regeneration		Saplings		Trees	
	1971	2000	1971	2000	1971	2000	1971	2000
Alder								
Balsham	0	0	0	0	0	0	0	0
Birds Marsh	0	0	0	0	0	0	0	1
Callender	0	0	0	0	1	0	2	2
Cil-Hen-Rhos	0	0	0	0	0	0	0	0
Eaves Wood	0	0	0	0	0	0	0	0
Glan Morlies	0	1	0	0	1	0	5	10
Great Knott	0	0	0	0	0	0	1	0
Hall Brow	0	0	0	0	0	0	1	0
Hill	0	0	0	0	0	0	1	0
Mar Lodge	0	0	0	0	0	0	0	0
Mill Wood	0	0	0	0	0	0	3	3
Priestfield	0	0	0	0	0	0	0	1
Shieldaig	0	0	0	0	0	0	0	0
Spital	0	0	0	0	0	0	0	0
Wellhanger	0	0	0	0	0	0	0	0
Total	**0**	**1**	**0**	**0**	**2**	**0**	**13**	**17**
Ash								
Balsham	12	10	12	9	1	2	10	15
Birds Marsh	6	3	6	2	5	1	4	3
Callender	1	3	0	0	0	0	0	0
Cil-Hen-Rhos	3	8	1	4	2	2	13	12
Eaves Wood	14	11	16	10	16	14	10	14
Glan Morlies	4	7	3	3	1	3	7	8
Great Knott	0	2	0	0	0	0	0	0
Hall Brow	6	7	0	0	0	0	3	2
Hill	4	5	5	2	4	0	5	7
Mar Lodge	0	0	0	0	0	0	0	0
Mill Wood	1	2	0	1	0	1	1	0
Priestfield	11	10	0	3	0	3	4	3
Shieldaig	0	0	0	0	0	0	0	0
Spital	5	3	3	1	5	0	9	12
Wellhanger	9	6	10	10	7	2	10	7
Total	**76**	**77**	**56**	**45**	**41**	**28**	**76**	**83**
Beech								
Balsham	0	0	0	0	0	0	0	1
Birds Marsh	0	0	1	1	2	1	3	5

	Seedlings		Regeneration		Saplings		Trees	
	1971	**2000**	**1971**	**2000**	**1971**	**2000**	**1971**	**2000**
Callender	0	0	0	0	0	0	0	0
Cil-Hen-Rhos	0	0	2	0	1	0	2	2
Eaves Wood	1	1	5	1	0	0	0	0
Glan Morlies	0	0	0	0	0	0	0	1
Great Knott	0	7	0	4	0	1	1	0
Hall Brow	0	3	0	0	0	0	1	2
Hill	1	0	1	0	0	0	0	0
Mar Lodge	0	0	0	0	0	0	0	0
Mill Wood	0	0	0	0	0	0	0	0
Priestfield	10	5	0	9	0	8	10	10
Shieldaig	0	0	0	0	0	0	0	0
Spital	0	0	0	0	0	0	1	0
Wellhanger	0	0	3	0	3	5	8	4
Total	**12**	**16**	**12**	**15**	**6**	**15**	**26**	**25**
Birch								
Balsham	0	0	0	1	0	0	0	0
Birds Marsh	0	1	1	2	1	2	2	6
Callender	3	5	10	1	9	3	16	13
Cil-Hen-Rhos	0	0	0	0	0	0	1	0
Eaves Wood	1	2	12	2	6	1	0	5
Glan Morlies	0	0	0	0	0	0	0	1
Great Knott	1	5	5	1	8	2	2	12
Hall Brow	0	2	9	1	9	1	15	11
Hill	0	0	2	0	2	0	6	4
Mar Lodge	4	3	1	0	0	1	1	1
Mill Wood	6	1	1	6	1	3	16	15
Priestfield	3	5	0	3	0	6	6	11
Shieldaig	7	4	12	7	7	6	8	9
Spital	0	0	0	0	0	0	0	0
Wellhanger	1	0	0	1	0	1	2	1
Total	**26**	**28**	**53**	**25**	**43**	**26**	**75**	**89**
Hawthorn								
Balsham	5	5	4	6	2	2	0	1
Birds Marsh	3	1	1	1	0	0	2	0
Callender	0	0	0	0	0	0	0	0
Cil-Hen-Rhos	2	2	3	4	2	4	0	5
Eaves Wood	8	10	0	0	5	2	0	3
Glan Morlies	1	3	2	6	2	5	1	3
Great Knott	0	0	0	0	0	0	0	0
Hall Brow	7	4	1	3	0	0	3	1
Hill	4	0	4	5	5	2	2	3
Mar Lodge	0	0	0	0	0	0	0	0

	Seedlings		Regeneration		Saplings		Trees	
	1971	**2000**	**1971**	**2000**	**1971**	**2000**	**1971**	**2000**
Mill Wood	3	1	1	0	0	0	2	1
Priestfield	1	1	0	4	0	2	3	1
Shieldaig	0	0	0	0	0	0	0	0
Spital	1	0	4	1	4	3	3	8
Wellhanger	2	3	3	0	2	1	1	1
Total	**37**	**30**	**23**	**30**	**22**	**21**	**17**	**27**
Holly								
Balsham	0	0	0	0	0	0	0	0
Birds Marsh	2	3	0	0	0	1	0	0
Callender	0	0	0	0	0	0	0	0
Cil-Hen-Rhos	1	3	1	2	0	1	0	3
Eaves Wood	4	6	10	9	2	3	0	4
Glan Morlies	0	1	3	3	0	3	0	3
Great Knott	3	11	0	8	0	0	1	0
Hall Brow	3	1	0	0	0	0	0	0
Hill	0	0	0	0	0	0	0	0
Mar Lodge	0	0	0	0	0	0	0	0
Mill Wood	0	0	0	0	0	0	0	0
Priestfield	9	10	4	12	4	7	4	7
Shieldaig	0	1	0	0	0	0	0	0
Spital	0	0	0	0	0	0	0	0
Wellhanger	3	3	4	0	0	0	0	0
Total	**25**	**39**	**22**	**34**	**6**	**15**	**5**	**17**
Hornbeam								
Balsham	0	0	0	0	0	0	0	2
Birds Marsh	0	0	0	0	0	0	0	0
Callender	0	0	0	0	0	0	0	0
Cil-Hen-Rhos	0	0	0	0	0	0	0	0
Eaves Wood	0	0	0	0	0	0	0	0
Glan Morlies	0	0	0	0	0	0	0	0
Great Knott	0	0	0	0	0	0	0	0
Hall Brow	0	0	0	0	0	0	0	0
Hill	0	0	0	0	0	0	0	0
Mar Lodge	0	0	0	0	0	0	0	0
Mill Wood	0	0	0	0	0	0	0	0
Priestfield	0	0	0	0	0	0	0	0
Shieldaig	0	0	0	0	0	0	0	0
Spital	0	0	0	0	0	0	0	0
Wellhanger	0	0	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**
Oak								
Balsham	5	2	2	2	0	0	6	6

	Seedlings		Regeneration		Saplings		Trees	
	1971	2000	1971	2000	1971	2000	1971	2000
Birds Marsh	2	1	1	1	0	3	8	7
Callender	0	0	0	0	0	0	2	2
Cil-Hen-Rhos	3	1	1	1	1	1	6	7
Eaves Wood	8	8	9	2	5	1	10	13
Glan Morlies	2	7	0	1	0	0	3	5
Great Knott	9	14	4	3	7	2	12	15
Hall Brow	8	13	0	0	2	1	15	15
Hill	1	0	5	0	4	0	6	5
Mar Lodge	0	0	0	0	0	0	0	0
Mill Wood	0	0	0	0	0	0	0	0
Priestfield	8	2	0	3	0	6	4	13
Shieldaig	0	0	0	0	0	0	0	0
Spital	1	1	0	1	2	0	5	5
Wellhanger	1	1	5	1	1	2	4	3
Total	**48**	**50**	**27**	**15**	**22**	**16**	**81**	**96**
Scot's Pine								
Balsham	0	0	0	0	0	0	0	0
Birds Marsh	0	0	0	0	0	0	0	0
Callender	0	0	0	0	0	0	0	0
Cil-Hen-Rhos	0	0	0	0	0	0	0	0
Eaves Wood	0	0	0	0	0	0	0	0
Glan Morlies	0	0	0	0	0	0	0	0
Great Knott	0	0	0	0	0	0	0	0
Hall Brow	0	0	0	0	0	0	0	0
Hill	0	0	0	0	0	0	0	0
Mar Lodge	3	2	2	1	0	0	8	7
Mill Wood	0	0	0	0	0	0	0	0
Priestfield	0	0	0	0	0	0	0	0
Shieldaig	7	2	9	5	1	5	8	8
Spital	0	0	0	0	0	0	0	0
Wellhanger	0	0	0	0	0	0	0	0
Total	**10**	**4**	**11**	**6**	**1**	**5**	**16**	**15**
Sweet Chestnut								
Balsham	0	0	0	0	0	0	0	0
Birds Marsh	0	0	0	0	0	0	0	0
Callender	0	0	0	0	0	0	0	0
Cil-Hen-Rhos	0	0	0	0	0	0	0	0
Eaves Wood	0	0	0	0	0	0	0	0
Glan Morlies	0	0	0	0	0	0	0	0
Great Knott	0	0	0	0	0	0	0	0
Hall Brow	0	0	0	0	0	0	0	0
Hill	0	0	0	0	0	0	0	0

	Seedlings		Regeneration		Saplings		Trees	
	1971	2000	1971	2000	1971	2000	1971	2000
Mar Lodge	0	0	0	0	0	0	0	0
Mill Wood	0	0	0	0	0	0	0	0
Priestfield	0	0	0	0	0	0	0	0
Shieldaig	0	0	0	0	0	0	0	0
Spital	0	0	0	0	0	0	0	0
Wellhanger	0	0	1	0	1	0	1	1
Total	**0**	**0**	**1**	**0**	**1**	**0**	**1**	**1**
Sycamore								
Balsham	5	3	5	7	0	0	3	1
Birds Marsh	6	3	9	5	6	6	9	10
Callender	0	0	0	0	0	0	0	0
Cil-Hen-Rhos	2	5	5	7	1	4	12	14
Eaves Wood	9	2	12	4	7	2	3	3
Glan Morlies	4	4	4	2	0	3	1	3
Great Knott	0	2	0	0	0	0	0	0
Hall Brow	3	6	0	1	0	0	1	0
Hill	0	0	1	0	0	0	0	0
Mar Lodge	0	0	0	0	0	0	0	0
Mill Wood	0	0	0	0	0	0	0	0
Priestfield	2	2	0	10	0	9	2	12
Shieldaig	0	0	0	0	0	0	0	0
Spital	2	1	0	1	3	1	4	1
Wellhanger	4	4	4	1	4	5	4	9
Total	**37**	**32**	**40**	**38**	**21**	**30**	**39**	**53**
Field Maple								
Balsham	6	2	3	6	3	2	8	7
Birds Marsh	0	0	0	0	0	0	0	0
Callender	0	0	0	0	0	0	0	0
Cil-Hen-Rhos	0	0	0	0	0	0	0	0
Eaves Wood	0	0	0	0	0	0	0	0
Glan Morlies	0	0	0	0	0	0	0	0
Great Knott	0	0	0	0	0	0	0	0
Hall Brow	0	0	0	0	0	0	0	0
Hill	0	0	0	0	0	0	0	0
Mar Lodge	0	0	0	0	0	0	0	0
Mill Wood	0	0	0	0	0	0	0	0
Priestfield	0	0	0	0	0	0	0	0
Shieldaig	0	0	0	0	0	0	0	0
Spital	0	0	0	0	1	0	2	0
Wellhanger	0	1	0	0	0	0	0	2
Total	**6**	**3**	**3**	**6**	**4**	**2**	**10**	**9**

	Seedlings		Regeneration		Saplings		Trees	
	1971	**2000**	**1971**	**2000**	**1971**	**2000**	**1971**	**2000**
Suckering Elm								
Balsham	0	0	0	0	1	1	4	0
Birds Marsh	0	0	0	0	1	1	0	1
Callender	0	0	0	0	0	0	0	0
Cil-Hen-Rhos	0	0	0	0	0	0	0	0
Eaves Wood	0	0	0	0	0	0	0	0
Glan Morlies	0	0	0	0	0	0	0	0
Great Knott	0	0	0	0	0	0	0	0
Hall Brow	0	0	0	0	0	0	0	0
Hill	0	0	0	0	0	0	0	0
Mar Lodge	0	0	0	0	0	0	0	0
Mill Wood	0	0	0	0	0	0	0	0
Priestfield	0	0	0	0	0	0	0	0
Shieldaig	0	0	0	0	0	0	0	0
Spital	0	0	0	0	11	5	12	15
Wellhanger	0	0	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**13**	**7**	**16**	**16**
Wychelm								
Balsham	0	0	1	0	0	0	1	0
Birds Marsh	0	0	0	0	0	0	0	0
Callender	0	0	0	0	0	0	0	0
Cil-Hen-Rhos	0	0	0	0	0	0	2	0
Eaves Wood	1	0	8	0	1	1	1	1
Glan Morlies	0	0	0	0	0	0	0	0
Great Knott	0	0	0	0	0	0	0	0
Hall Brow	0	0	0	0	0	0	0	0
Hill	0	0	0	0	0	0	0	0
Mar Lodge	0	0	0	0	0	0	0	0
Mill Wood	0	0	0	0	0	0	0	0
Priestfield	0	0	0	0	0	0	0	0
Shieldaig	0	0	0	0	0	0	0	0
Spital	0	0	1	0	5	2	8	6
Wellhanger	0	0	0	0	0	0	0	0
Total	**1**	**0**	**10**	**0**	**6**	**3**	**12**	**7**
Rowan								
Balsham	0	0	0	0	0	0	0	0
Birds Marsh	0	0	0	0	0	0	0	0
Callender	5	3	7	1	2	0	1	6
Cil-Hen-Rhos	0	0	0	2	0	2	0	1
Eaves Wood	4	4	8	1	4	1	2	4
Glan Morlies	1	0	1	0	0	0	0	0
Great Knott	9	3	4	1	0	0	0	0

	Seedlings		Regeneration		Saplings		Trees	
	1971	**2000**	**1971**	**2000**	**1971**	**2000**	**1971**	**2000**
Hall Brow	12	7	1	3	0	1	1	1
Hill	0	0	0	0	0	0	0	0
Mar Lodge	3	3	0	0	0	0	0	0
Mill Wood	4	3	3	2	2	1	8	6
Priestfield	9	4	0	5	1	8	5	12
Shieldaig	7	8	8	4	4	1	1	0
Spital	0	0	0	0	0	0	0	0
Wellhanger	0	0	0	0	0	0	0	0
Total	**54**	**35**	**32**	**19**	**13**	**14**	**18**	**30**

Appendix 10 Soil handling and analyses protocols

1. Soil was sampled (approximately 2 kg to depth of 15 cm) from each plot, placed in plastic bags and returned to CEH Merlewood.

2. On arrival at CEH Merlewood, soil samples were placed in a cold room at ca. 4^{o}C until processing (typically up to 48 hrs).

3. Sample site and plot number were recorded on log sheets.

4. Where possible, soil samples sieved individually using a 2 mm stainless steel mesh – cleaned after each use, removing all stones and vegetation.

5. If sieving was not possible, the soil was broken up into lumps/crumbs to obtain a relatively homogeneous sample for pH analyses and to aid drying.

6. Fresh soil pH was measured using a standard protocol.

7. Soil samples air-dried in trays in an oven at 25^{o}C for ca. 7 days.

8. Air-dry soil pH measured again using standard protocol.

9. Sample taken for loss-on-ignition analyses at 550^{o}C using standard protocols of the Environmental Chemistry Section, CEH Merlewood (Appendix).

10. Samples placed in labelled air-tight polypropylene containers for long-term storage.

Soil pH - Method

1. Calibrate the pH meter using buffer solutions of pH 4 and pH 7.

2. Add 10cm^3 of the sample to a 100ml beaker.

3. Add ~ 10ml of spectrum water (ultra pure) obtained from the Environmental Chemistry reservoir. Mix vigorously with a glass rod / spatula to a paste, then top up to the 50ml mark.

4. Leave for 20 minutes.

5. Insert pH electrode, stir and press read button on pH meter.

6. Leave for a further minute.

7. Take pH reading and record result.

8. Rinse and dry electrode after each sample has been read.

Determination of air-dry moistures and loss-on-ignition (Soil Organic Matter)

1. Dry small crucible in small oven at 105^{o}C.

2. Cool in dessicator.

3. Weigh crucible and approx. 1g air-dry sieved sample (= W_1 g).

4. Dry 3 hours at 105^{o}C.

5. Cool and weigh as before (= W_2 g).

6. Place in muffle (ashing) at 550^{o}C for 2 hours (allow ½ hour to reach 550^{o}C).

7. Cool in dessicator and re-weigh (= W_3 g).

8. Run duplicate determinations and two standards.

9. Calculation

Let $(W_2 - W_1)$ oven dried = $(W_3 - W_1)$ muffle dried

Then % dry matter = $$\frac{(W_3 - W_1)}{(W_2 - W_1)} \times 100$$

Appendix 11 Tests of change in between-plot frequency of plant species across all sites

Plant species	p71a00	p00a71	ChiSqr	Sig	Dir
Acer campestre	3	8	1.45	ns	+
Acer platanoides	0	1	0.00	ns	+
Acer pseudoplatanus	21	33	2.24	ns	+
Achillea millefolium	5	0	3.20	ns	-
Achillea ptarmica	3	0	1.33	ns	-
Aegopodium podagraria	0	1	0.00	ns	+
Aesculus hippocastanum	1	0	0.00	ns	+
Agrostis canina sens.lat.	23	3	13.88	***	-
Agrostis capillaris	18	33	3.84	*	+
Agrostis gigantea	1	2	0.00	ns	+
Agrostis stolonifera	19	12	1.16	ns	-
Ajuga reptans	37	13	10.58	**	-
Alchemilla sp.	9	1	4.90	*	-
Alliaria petiolata	0	3	1.33	ns	+
Allium ursinum	1	1	0.50	ns	NoCh
Alnus glutinosa	11	12	0.00	ns	+
Alopecurus geniculatus	0	2	0.50	ns	+
Anagallis tenella	2	0	0.50	ns	-
Anchusa arvensis	0	1	0.00	ns	+
Anemone nemorosa	25	2	17.93	***	-
Angelica sylvestris	21	3	12.04	***	-
Anthoxanthum odoratum	25	6	10.45	**	-
Anthriscus sylvestris	7	2	1.78	ns	-
Apium graveolens	0	2	0.50	ns	+
Apium nodiflorum	0	1	0.00	ns	+
Arctium agg.	19	7	4.65	*	-
Arctostaphylos uva-ursi	1	0	0.00	ns	+
Arrhenatherum elatius	12	8	0.45	ns	-
Artemisia vulgaris	1	0	0.00	ns	+
Arum maculatum	16	12	0.32	ns	-
Asplenium ruta-muraria	2	1	0.00	ns	+
Asplenium trichomanes	3	1	0.25	ns	-
Athyrium filix-femina	34	9	13.40	***	-
Atrichum sp.	15	33	6.02	*	+
Aulacomnium palustre	0	2	0.50	ns	+
Azalea spp.	1	0	0.00	ns	+
Bellis perennis	9	1	4.90	*	-
Betula seedling/sp	28	26	0.02	ns	-
Blechnum spicant	26	16	1.93	ns	-
Brachypodium sylvaticum	31	20	1.96	ns	-
Brachythecium sp.	31	19	2.42	ns	-
Bromopsis ramosa	9	5	0.64	ns	-
Bromus hordeaceus	2	0	0.50	ns	-

Plant species	p71a00	p00a71	ChiSqr	Sig	Dir
Bryonia dioica	4	2	0.17	ns	-
Calamagrostis epigejos	0	1	0.00	ns	+
Calliergon cuspidatum	3	10	2.77	ns	+
Callitriche seedling/sp	1	1	0.50	ns	NoCh
Calluna vulgaris	7	1	3.13	ns	-
Caltha palustris	3	1	0.25	ns	-
Campanula latifolia	2	8	2.50	ns	+
Campanula rotundifolia	8	3	1.45	ns	-
Campanula trachelium	12	0	10.08	**	-
Campylopus sp.	0	4	2.25	ns	+
Capsella bursa-pastoris	1	0	0.00	ns	+
Cardamine amara	0	2	0.50	ns	+
Cardamine hirsuta/flexuosa	35	9	14.20	***	-
Cardamine pratensis	2	2	0.25	ns	NoCh
Carex binervis	1	5	1.50	ns	+
Carex caryophyllea	0	1	0.00	ns	+
Carex curta	0	1	0.00	ns	+
Carex digitata	0	5	3.20	ns	+
Carex echinata	2	1	0.00	ns	+
Carex flacca	1	11	6.75	**	+
Carex nigra	2	2	0.25	ns	NoCh
Carex pallescens	0	1	0.00	ns	+
Carex panicea	0	1	0.00	ns	+
Carex paniculata	0	1	0.00	ns	+
Carex pendula	6	0	4.17	*	-
Carex pilulifera	0	15	13.07	***	+
Carex pulicaris	0	2	0.50	ns	+
Carex pulicaris/serotina	0	1	0.00	ns	+
Carex remota	2	8	2.50	ns	+
Carex seedling/sp	0	9	7.11	**	+
Carex sylvatica	37	19	5.16	*	-
Carpinus betulus	0	3	1.33	ns	+
Carum verticillatum	2	0	0.50	ns	-
Castanea sativa	2	3	0.00	ns	+
Centaurea nigra	5	1	1.50	ns	-
Centaurium erythraea	1	1	0.50	ns	NoCh
Cephalozia bicuspidata	1	0	0.00	ns	+
Cerastium fontanum	18	4	7.68	**	-
Ceratocapnos claviculata	4	0	2.25	ns	-
Chamerion angustifolium	10	8	0.06	ns	-
Chrysosplenium oppositifolium	10	12	0.05	ns	+
Circaea lutetiana	53	12	24.62	***	-
Cirsium arvense	7	8	0.00	ns	+
Cirsium palustre	24	14	2.13	ns	-
Cirsium vulgare	3	10	2.77	ns	+
Clematis vitalba	5	8	0.31	ns	+
Conopodium majus	18	0	16.06	***	-
Convallaria majalis	7	0	5.14	*	-

Plant species	p71a00	p00a71	ChiSqr	Sig	Dir
Convolvulus arvensis	1	0	0.00	ns	+
Cornus sanguinea	7	5	0.08	ns	-
Corylus avellana	25	49	7.15	**	+
Cotoneaster sp.	0	6	4.17	*	+
Crataegus laevigata	1	0	0.00	ns	+
Crataegus monogyna	31	40	0.90	ns	+
Crepis paludosa	3	3	0.17	ns	NoCh
Cruciata laevipes	0	2	0.50	ns	+
Ctenidium molluscum	0	8	6.13	*	+
Cynosurus cristatus	8	2	2.50	ns	-
Cytisus scoparius	4	2	0.17	ns	-
Dactylis glomerata	23	11	3.56	ns	-
Dactylorhiza fuchsii	12	0	10.08	**	-
Dactylorhiza purpurella	1	0	0.00	ns	+
Danthonia decumbens	1	2	0.00	ns	+
Daphne laureola	2	2	0.25	ns	NoCh
Daphne mezereum	2	0	0.50	ns	-
Deschampsia cespitosa	32	21	1.89	ns	-
Deschampsia flexuosa	19	3	10.23	**	-
Dicranella heteromalla	16	8	2.04	ns	-
Dicranella sp	0	1	0.00	ns	+
Dicranum majus	6	13	1.89	ns	+
Dicranum scoparium	39	7	20.89	***	-
Digitalis purpurea	23	15	1.29	ns	-
Diplophyllum albicans	0	3	1.33	ns	+
Dipsacus fullonum	1	1	0.50	ns	NoCh
Drepanocladus revolvens	0	1	0.00	ns	+
Drosera rotundifolia	2	2	0.25	ns	NoCh
Dryopteris dilatata/carthusiana	30	26	0.16	ns	-
Dryopteris filix-mas	54	26	9.11	**	-
Eleocharis quinqueflora	0	1	0.00	ns	+
Elytrigia repens	0	1	0.00	ns	+
Empetrum nigrum	2	0	0.50	ns	-
Epilobium hirsutum	2	3	0.00	ns	+
Epilobium montanum	51	18	14.84	***	-
Epilobium obscurum	0	1	0.00	ns	+
Epilobium palustre	1	3	0.25	ns	+
Epilobium parviflorum	1	5	1.50	ns	+
Epilobium tetragon/obscurum	0	1	0.00	ns	+
Epipactis helleborine	2	0	0.50	ns	-
Equisetum arvense	10	0	8.10	**	-
Equisetum sp.	0	1	0.00	ns	+
Equisetum sylvaticum	2	2	0.25	ns	NoCh
Erica cinerea	5	1	1.50	ns	-
Erica tetralix	3	1	0.25	ns	-
Eriophorum angustifolium	2	1	0.00	ns	+
Euonymus europaeus	2	5	0.57	ns	+
Eupatorium cannabinum	1	5	1.50	ns	+

Plant species	p71a00	p00a71	ChiSqr	Sig	Dir
Euphorbia agg.	1	0	0.00	ns	+
Euphorbia amygdaloides	2	5	0.57	ns	+
Euphrasia officinalis agg.	0	4	2.25	ns	+
Eurhynchium sp.	35	31	0.14	ns	-
Fagus sylvatica	17	28	2.22	ns	+
Festuca arundinacea	0	3	1.33	ns	+
Festuca gigantea	13	13	0.04	ns	NoCh
Festuca ovina agg.	12	4	3.06	ns	-
Festuca rubra agg.	12	5	2.12	ns	-
Filipendula ulmaria	15	6	3.05	ns	-
Filipendula vulgaris	2	2	0.25	ns	NoCh
Fissidens sp.	19	13	0.78	ns	-
Fragaria vesca	20	7	5.33	*	-
Fraxinus excelsior	21	20	0.00	ns	+
Galeopsis tetrahit agg.	1	1	0.50	ns	NoCh
Galium aparine	24	26	0.02	ns	+
Galium mollugo	3	0	1.33	ns	-
Galium odoratum	4	8	0.75	ns	+
Galium palustre	16	10	0.96	ns	-
Galium saxatile	22	6	8.04	**	-
Galium sterneri	1	1	0.50	ns	NoCh
Galium verum	1	0	0.00	ns	+
Geranium dissectum	3	0	1.33	ns	-
Geranium robertianum	23	33	1.45	ns	+
Geranium sanguineum	0	3	1.33	ns	+
Geranium sylvaticum	10	2	4.08	*	-
Geum rivale	4	5	0.00	ns	+
Geum rivale x urbanum (G. x intermedium)	1	0	0.00	ns	+
Geum urbanum	47	19	11.05	***	-
Glechoma hederacea	16	22	0.66	ns	+
Glyceria fluitans	4	5	0.00	ns	+
Gymnadenia conopsea	1	0	0.00	ns	+
Gymnocarpium dryopteris	3	2	0.00	ns	+
Hedera helix	22	23	0.00	ns	+
Helianthemum nummularium	1	1	0.50	ns	NoCh
Helictotrichon pubescens	0	1	0.00	ns	+
Heracleum sphondylium	14	14	0.04	ns	NoCh
Hieracium 'indeterminate'	2	1	0.00	ns	+
Holcus lanatus	39	16	8.80	**	-
Holcus mollis	26	17	1.49	ns	-
Hookeria lucens	2	2	0.25	ns	NoCh
Humulus lupulus	0	1	0.00	ns	+
Hyacinthoides non-scripta	23	36	2.44	ns	+
Hydrocotyle vulgaris	2	0	0.50	ns	-
Hylocomium splendens	13	5	2.72	ns	-
Hypericum androsaemum	1	2	0.00	ns	+
Hypericum hirsutum	1	0	0.00	ns	+
Hypericum perforatum	6	0	4.17	*	-

Plant species	p71a00	p00a71	ChiSqr	Sig	Dir
Hypericum pulchrum	16	7	2.78	ns	-
Hypericum sp.	0	3	1.33	ns	+
Hypericum tetrapterum	4	7	0.36	ns	+
Hypnum cupressiforme sens.lat.	33	8	14.05	***	-
Hypochaeris radicata	0	1	0.00	ns	+
Hypochoeris spp.	9	1	4.90	*	-
Ilex aquifolium	14	40	11.57	***	+
Impatiens noli-tangere	1	0	0.00	ns	+
Inula conyzae	1	3	0.25	ns	+
Iris pseudacorus	1	1	0.50	ns	NoCh
Jasione montana	1	0	0.00	ns	+
Juncus articulatus/acutiflora	8	4	0.75	ns	-
Juncus bufonius sens.lat.	1	2	0.00	ns	+
Juncus bulbosus	5	3	0.13	ns	-
Juncus conglomeratus	2	3	0.00	ns	+
Juncus effusus	20	20	0.03	ns	NoCh
Juncus squarrosus	1	0	0.00	ns	+
Juniperus communis	0	1	0.00	ns	+
Lamiastrum galeobdolon	12	7	0.84	ns	-
Lamium purpureum	0	2	0.50	ns	+
Lapsana communis	10	11	0.00	ns	+
Larix sp.	10	18	1.75	ns	+
Lathyrus linifolius	7	1	3.13	ns	-
Lathyrus pratensis	7	2	1.78	ns	-
Leontodon autumnalis	0	1	0.00	ns	+
Lepidozia reptans	3	0	1.33	ns	-
Lepidozia sp.	0	1	0.00	ns	+
Leucanthemum vulgare	1	0	0.00	ns	+
Leucobryum glaucum	7	1	3.13	ns	-
Ligustrum vulgare	19	3	10.23	**	-
Linaria vulgaris	1	0	0.00	ns	+
Linum catharticum	0	1	0.00	ns	+
Listera ovata	5	0	3.20	ns	-
Lolium multiflorum	1	1	0.50	ns	NoCh
Lolium perenne	4	2	0.17	ns	-
Lonicera periclymenum	40	22	4.66	*	-
Lophocolea heterophylla	2	0	0.50	ns	-
Lophocolea sp.	38	2	30.63	***	-
Lophozia ventricosa	0	2	0.50	ns	+
Lotus corniculatus	6	4	0.10	ns	-
Lotus pedunculatus	5	1	1.50	ns	-
Luzula campestris/multiflora	24	3	14.81	***	-
Luzula pilosa	31	15	4.89	*	-
Luzula sylvatica	4	5	0.00	ns	+
Lychnis flos-cuculi	4	0	2.25	ns	-
Lycopus europaeus	1	0	0.00	ns	+
Lysimachia nemorum	38	9	16.68	***	-
Lysimachia nummularia	0	1	0.00	ns	+

Plant species	p71a00	p00a71	ChiSqr	Sig	Dir
Malus domestica	0	3	1.33	ns	+
Malus sylvestris	1	1	0.50	ns	NoCh
Marchantia spp.	0	1	0.00	ns	+
Matricaria discoidea	1	0	0.00	ns	+
Meconopsis cambrica	2	0	0.50	ns	-
Medicago lupulina	1	0	0.00	ns	+
Melampyrum pratense	3	2	0.00	ns	+
Melica nutans	2	0	0.50	ns	-
Melica uniflora	3	12	4.27	*	+
Mentha aquatica	4	1	0.80	ns	-
Mentha arvensis	1	0	0.00	ns	+
Mercurialis perennis	40	15	10.47	**	-
Milium effusum	9	9	0.06	ns	NoCh
Mnium hornum	46	16	13.56	***	-
Moehringia trinervia	16	2	9.39	**	-
Molinia caerulea	2	6	1.13	ns	+
Mycelis muralis	1	0	0.00	ns	+
Myosotis seedling/sp	11	6	0.94	ns	-
Myrica gale	1	0	0.00	ns	+
Nardus stricta	3	1	0.25	ns	-
Narthecium ossifragum	2	1	0.00	ns	+
Neckera crispa	0	3	1.33	ns	+
Nothofagus nervosa	0	1	0.00	ns	+
Odontites vernus	0	3	1.33	ns	+
Oenanthe crocata	1	2	0.00	ns	+
Orchis mascula	2	0	0.50	ns	-
Oreopteris limbosperma	2	9	3.27	ns	+
Oxalis acetosella	24	10	4.97	*	-
Paris quadrifolia	2	2	0.25	ns	NoCh
Pedicularis sylvatica	2	1	0.00	ns	+
Pellia sp.	15	14	0.00	ns	+
Persicaria hydropiper	5	0	3.20	ns	-
Persicaria maculosa	1	0	0.00	ns	+
Petasites spp.	1	0	0.00	ns	+
Phalaris arundinacea	1	0	0.00	ns	+
Phegopteris connectilis	0	1	0.00	ns	+
Philonotis sp.	0	1	0.00	ns	+
Phleum pratense sens.lat.	6	1	2.29	ns	-
Phyllitis scolopendrium	7	2	1.78	ns	-
Picea abies	2	5	0.57	ns	+
Picea sitchensis	0	2	0.50	ns	+
Pilosella officinarum	3	1	0.25	ns	-
Pinus nigra	0	1	0.00	ns	+
Pinus sp./seedling	1	0	0.00	ns	+
Pinus sylvestris	10	9	0.00	ns	+
Plagiochila sp	63	2	55.38	***	-
Plagiomnium undulatum	58	21	16.41	***	-
Plantago lanceolata	6	2	1.13	ns	-

Plant species	p71a00	p00a71	ChiSqr	Sig	Dir
Plantago major	10	2	4.08	*	-
Pleurozium schreberi	7	18	4.00	*	+
Poa annua	16	0	14.06	***	-
Poa pratensis sens.lat.	6	3	0.44	ns	-
Poa trivialis	38	23	3.21	ns	-
Pohlia nutans	1	0	0.00	ns	+
Polygala oxyptera	2	2	0.25	ns	NoCh
Polygonatum odoratum	2	0	0.50	ns	-
Polygonum aviculare agg.	2	0	0.50	ns	-
Polygonum nodosum	1	3	0.25	ns	+
Polypodium vulgare sens.lat.	17	0	15.06	***	-
Polystichum aculeatum	2	0	0.50	ns	-
Polytrichum sp.	23	17	0.63	ns	-
Populus nigra	0	1	0.00	ns	+
Populus tremula	4	2	0.17	ns	-
Potentilla anserina	4	1	0.80	ns	-
Potentilla erecta	32	7	14.77	***	-
Potentilla reptans	1	4	0.80	ns	+
Potentilla sterilis	23	10	4.36	*	-
Primula elatior	6	1	2.29	ns	-
Primula veris	1	0	0.00	ns	+
Primula vulgaris	28	11	6.56	*	-
Prunella vulgaris	36	10	13.59	***	-
Prunus avium	1	5	1.50	ns	+
Prunus laurocerasus	1	4	0.80	ns	+
Prunus padus	4	10	1.79	ns	+
Prunus spinosa	10	14	0.38	ns	+
Pseudoscleropodium purum	27	15	2.88	ns	-
Pseudotsuga spp.	0	7	5.14	*	+
Pteridium aquilinum	30	21	1.25	ns	-
Pulicaria dysenterica	2	0	0.50	ns	-
Pulmonaria longifolia	5	0	3.20	ns	-
Quercus seedling/sp	30	38	0.72	ns	+
Racomitrium lanuginosum	0	3	1.33	ns	+
Ranunculus acris	15	2	8.47	**	-
Ranunculus flammula	5	0	3.20	ns	-
Ranunculus repens	23	11	3.56	ns	-
Rhamnus cathartica	1	2	0.00	ns	+
Rhinanthus minor	5	0	3.20	ns	-
Rhododendron spp.	3	5	0.13	ns	+
Rhytidiadelphus loreus	3	28	18.58	***	+
Rhytidiadelphus squarrosus	30	13	5.95	*	-
Rhytidiadelphus triquetrus	25	7	9.03	**	-
Ribes sp.	9	6	0.27	ns	-
Ribes uva-crispa	2	2	0.25	ns	NoCh
Robinia pseudoacacia	1	0	0.00	ns	+
Rosa pimpinellifolia	0	3	1.33	ns	+
Rosa seedling/sp	33	12	8.89	**	-

Plant species	p71a00	p00a71	ChiSqr	Sig	Dir
Rubus caesius	0	2	0.50	ns	+
Rubus fruticosus agg.	26	20	0.54	ns	-
Rubus idaeus	18	14	0.28	ns	-
Rubus saxatilis	3	1	0.25	ns	-
Rumex acetosa	4	3	0.00	ns	+
Rumex acetosella	7	3	0.90	ns	-
Rumex conglomeratus	24	7	8.26	**	-
Rumex obtusifolius	6	7	0.00	ns	+
Rumex sanguineus	0	3	1.33	ns	+
Ruscus aculeatus	2	0	0.50	ns	-
Sagina sp.	2	2	0.25	ns	NoCh
Salix caprea	8	17	2.56	ns	+
Salix repens agg.	0	1	0.00	ns	+
Salix seedling/sp	22	3	12.96	***	-
Sambucus nigra	10	21	3.23	ns	+
Sanicula europaea	17	9	1.88	ns	-
Scabiosa columbaria	0	1	0.00	ns	+
Scrophularia auriculata	1	0	0.00	ns	+
Scrophularia nodosa	12	6	1.39	ns	-
Scrophularia vernalis	1	0	0.00	ns	+
Scutellaria galericulata	2	2	0.25	ns	NoCh
Scutellaria minor	4	0	2.25	ns	-
Senecio aquaticus	5	4	0.00	ns	+
Senecio jacobaea	7	15	2.23	ns	+
Senecio vulgaris	0	4	2.25	ns	+
Sesleria caerulea	1	4	0.80	ns	+
Silene dioica	21	13	1.44	ns	-
Silene dioicaxlatifolia	1	0	0.00	ns	+
Solanum dulcamara	3	5	0.13	ns	+
Solidago virgaurea	9	2	3.27	ns	-
Sonchus asper	0	1	0.00	ns	+
Sorbus aucuparia	30	14	5.11	*	-
Sorbus lancastriensis	0	1	0.00	ns	+
Sorbus sp.	1	1	0.50	ns	NoCh
Sphagnum sp.	5	3	0.13	ns	-
Stachys officinalis	4	3	0.00	ns	+
Stachys sylvatica	17	16	0.00	ns	+
Stellaria graminea	4	3	0.00	ns	+
Stellaria holostea	9	9	0.06	ns	NoCh
Stellaria media	10	5	1.07	ns	-
Stellaria nemorum	0	1	0.00	ns	+
Stellaria uliginosa	6	7	0.00	ns	+
Succisa pratensis	14	0	12.07	***	-
Symphytum sp.	1	0	0.00	ns	+
Tamus communis	12	3	4.27	*	-
Taraxacum agg.	17	6	4.35	*	-
Taxus baccata	3	4	0.00	ns	+
Tetraphis pellucida	1	0	0.00	ns	+

Plant species	p71a00	p00a71	ChiSqr	Sig	Dir
Teucrium scorodonia	39	8	19.15	***	-
Thalictrum minus	0	1	0.00	ns	+
Thamnobryum alopecurum	12	6	1.39	ns	-
Thuidium tamariscinum	57	23	13.61	***	-
Thymus polytrichus	4	2	0.17	ns	-
Tilia sp.	2	0	0.50	ns	-
Torilis japonica	1	2	0.00	ns	+
Tortella tortuosa	0	3	1.33	ns	+
Tortula sp.	0	2	0.50	ns	+
Trichophorum cespitosum	1	0	0.00	ns	+
Trientalis europaea	7	0	5.14	*	-
Trifolium dubium	1	0	0.00	ns	+
Trifolium pratense	6	2	1.13	ns	-
Trifolium repens	6	2	1.13	ns	-
Triticum aestivum	3	0	1.33	ns	-
Tussilago farfara	3	1	0.25	ns	-
Ulex minor	0	1	0.00	ns	+
Ulex sp.	1	14	9.60	**	+
Ulmus glabra	15	3	6.72	**	-
Ulmus procera	9	10	0.00	ns	+
Urtica dioica	32	27	0.27	ns	-
Vaccinium myrtillus	10	15	0.64	ns	+
Vaccinium uliginosum	0	1	0.00	ns	+
Vaccinium vitis-idaea	6	0	4.17	*	-
Valeriana officinalis	4	1	0.80	ns	-
Veronica agrestis	1	0	0.00	ns	+
Veronica arvensis	0	1	0.00	ns	+
Veronica beccabunga	4	3	0.00	ns	+
Veronica chamaedrys	35	10	12.80	***	-
Veronica montana	17	18	0.00	ns	+
Veronica officinalis	24	1	19.36	***	-
Veronica serpyllifolia	6	4	0.10	ns	-
Viburnum opulus	6	4	0.10	ns	-
Vicia sepium	6	2	1.13	ns	-
Viola hirta	1	3	0.25	ns	+
Viola odorata	0	6	4.17	*	+
Viola palustris	4	2	0.17	ns	-
Viola riviniana/reichenbiana	47	19	11.05	***	-

Appendix 12 National Woodland classification Survey 1971

Instructions on methods of survey and recording

General

An outline plan of operations giving the order in which you intend to survey the woods for which you are responsible should be prepared. This should attempt to reduce the amount of travelling as far as possible but must also take accommodation problems into account (ie it may be more efficient to survey several sites from the same base, rather than moving to get slightly nearer), any arrangements with Regional Staff and access permission if this is limited to specified dates.

You will be supplied with a full set of field equipment including all the necessary maps, recording sheets and other ancillary equipment before leaving Merlewood. A check list of all equipment is given in Appendix VI.

Woods will be located using road maps, 1" Ordnance Survey and the 2½" site maps as required. Having located the site the first important thing is obtaining **PERMISSION** to enter and survey the site in question.

Access and permission to survey sites

You will be given advanced information about all your sites which will indicate whether or not you are solely responsible for obtaining permission. In certain cases the Regional Office will have indicated in advance that special circumstances prevail with regard to access. For example, advance permission may have been obtained by the Regional Office or Merlewood, in which case you can proceed straight on to carry out the survey. In other cases, it may be necessary to contact Regional Staff or the land-owner himself (in which case all details will be supplied), and all that is necessary here is to follow out the instructions.

In other cases the task of obtaining permission to survey the site will be your responsibility. In some instances the owners name and address may be supplied and you should contact him or her. In other cases there may be several owners, some known, some unknown, and here it will be best to contact one of the owners (probably the one who owns the largest area if this is known) ask his permission and whether any of the others will mind. If he says yes on both counts you may proceed, and, in the unlikely event of your meeting any of the other owners, you will have to explain the situation. In yet other cases, and these may be in the majority in some areas, ownership of the woods may be a complete blank. In this case the best procedure is to contact the occupants of the farm or house, if any, which is nearest to the wood, and look as if they might themselves own it. Ask them if they do own it and if so, can you have permission to carry out your survey. If they do not know who owns it ask who does. If they know, it may be possible to ask if the owner would mind (this may be particularly useful if the owner does not live locally). If the real owner does live locally, it will be best to carry on to ask his permission direct.

In general, all that is required is common sense and tact. Try and appreciate the owners problems; he may have fences and wall's which he fears will get damaged; he may be raising game birds; he may just like his privacy and so on. If you meet with great reluctance or a blank refusal withdraw politely explaining that we have a list of alternative back-up sites which can be used if they would prefer not to allow access to their wood. If an owner gives you permission, as in our experience the vast majority will, ask him if there are areas he would like you to avoid or any precautions he would like you to take.

You will be provided with a brief written description of what the survey is about. If the owner, or anybody you come into contact with, asks you what it is all for, let him read this slip and try and answer any questions as best you can. If things get tricky offer to find out the answer for him or refer him direct to Merlewood.

Good public relations are an extemely important facet of the Nature Conservancy's work. If you upset anybody with whom you come into contact, the Regional Staff, in whose area you are working will be the ones who have to deal with the repercussions. Above all, make it quite clear the Nature Conservancy is not surveying their wood with a view to purchasing it. Some owners may fear compulsory purchase, a power which the Nature Conservancy holds (but has never exercised), or some other lesser interference with their ownership and enjoyment of the site. In the case of the present survey, nothing could be further removed from the intent, although it is of course remotely possible that the survey might turn up a few new sites which would be regarded as being of high conservation value. Some of the sites are already notified Sites of Special Scientific Interest (SSSIs) or Proposed National Nature Reserves (PNNRs), in which case the owner will know all about it anyway.

If you are unable to get permission to visit a site or think it unwise to pursue the matter further, you will have to contact Merlewood so that you can be supplied with the necessary information (map, sampling points, etc) for the back-up site. Give a forwarding or poste restante address, and then you can work on other sites until the information is available.

Starting the survey

Having obtained permission to visit the site the best access point(s) should be determined, as far as possible reducing the walking distance for yourself carrying equipment and samples. It may, for example, be possible to go to some of the sample points from an access point at one end of the wood and the rest from the other end. Do not, however, upset surrounding owners by flogging across fields or fences just to save a few yards walking. Try and use well marked tracks or footpaths wherever possible, it usually saves time and temper in the long run, and avoids many navigational difficulties.

Location of the sampling points

The 2½" map of the site has 16 random sampling points (numbered 1-16) marked on it and the method of locating these points on the ground is an extremely critical part of the survey procedure upon which much else depends. There are two important factors in the locating of the points:

(1) Accuracy
(2) Absence of subjective bias (ie exercising choice)

The latter being far more important than the former, although high accuracy automatically ensures absence of bias. In practice, high accuracy is not possible without resorting to time consuming methods using survey poles, tapes, compasses etc, and since in-point accuracy has no intrinsic value, more rapid, primitive methods of locating the points are valid so long as the unbiased nature of the process is not prejudiced. The essential features of the method adopted, and described below, are its predetermined, mechanical characteristics, of which reasonable accuracy is a part. Since certain information about the plots, eg altitude, slope position, measures of exposure, etc, will be taken from the map, a reasonable degree of accuracy is required if site and map collected data are to be compatible. The level of accuracy to be aimed at, and this should be easily obtainable in nearly all circumstances, is to get the sampling point within a 20 m radius of its true location. The following procedure should be followed:

(a) Decide on the point to be sampled next (they need not be surveyed in numerical order if this is not convenient).

(b) Look on the map for the nearest point that can be accurately and unmistakeably pin-pointed on the ground (a control point), eg a ride intersection, intersection of a wall or stream or a marked change in direction of a fence line etc.

(c) By orientating the map and compass take a bearing from the control point to the sample point, not forgetting to add 9_ for magnetic variation.

(d) Using the scale on the side of the compass, measure the distance from the control point to the sample point. On the 2½" = 1 mile scale 1/32nd = 22 yards.

(e) Find the control point on the ground.

(f) Take the correct compass bearing from the control point to the sample point and pace out the correct distance in this direction. Some correction for slope is advisable if this is more than 20_, as follows:

    20_ = + 6%, 25_ = + 10%, 30_ = + 15%, 35_ = + 22%, 40_ = + 31%

    Keeping accurate paces either up or down steep slopes is difficult and it is best to avoid both this problem and the slope correction by choosing a control point at the same height on the slope, if this is possible, and pacing on the level across the slope (even if it is a bit further than from some other control point).

(g) Short of endangering ones life **adhere absolutely to the number of paces that were predetermined, the centre point of the plot being adjacent to the toe of the boot on the forward foot. Similarly, wandering away from the predetermined direction must be avoided, even at the expense of making life difficult.**

Such considerations as, "this bit is not very typical", or, "we had a bit like this last time, we will walk on another 10 paces, it looks better there", must be avoided at all costs. Taking short or long paces in order to avoid a blackthorn thicket or nettle bed is an equally serious crime.

Order of recording the data

Having located the sample point according to the methods described above, four sets of data (a separate recording form for each) and two sets of samples have to be collected from each point. A flow chart showing the organisation and division of responsibility for the survey and recording of a site, and the plots therein, is given in Figure 1.

(a) Ground Flora - presence and absence in five successively increasing quadrat sizes (see details below and Figure 2) and % cover/abundance estimates for the largest of these. A comprehensive sample of bryophytes is also collected from the full plot.

(b) Trees, saplings and shrubs - trees, DBH (cm) and species being recorded from all four quarters of a 14.14 x 14.14 m plot (200 m^2), the same data for saplings and shrubs being collected from a pair of diagonally opposite quarters 1 and 3 (see Figure 2).

(c) Plot description and habitat data - mostly presence and absence of attributes, from the same 14.14. x 14.14 m plot.

(d) Soil data - from a small pit and auger borings taken in the centre of the plot. A composite soil sample from the top 10-15 cm is also obtained at the same time.

These can be obtained in any other order if this is found to be more convenient, except that the (a) ground flora should be recorded first so that it is not unduly disturbed by the extensive trampling that is usually involved in recording (b) tree, saplings and shrubs and to a lesser extent (d) the soil data.

The methods of laying out the necessary plots and the collecting and recording of the data are now dealt with in detail.

Recording of plot data

(a) Ground flora

The first operation when the plot centre has been located, is to lay out the plot. The centre post is stuck firmly in the ground at this point and the right angle gauge on top, spun to give a random orientation to the plot. When this has ceased turning, the clamping nut is screwed tight to prevent further movement. The four corner poles now have their distance lines (10 m) clipped into the centre and run out to their full extent in line with the arms of the right angle gauge and stuck into the ground. These corner posts delineate the largest 14.14 x 14.14 m (200 m^2) plot. Spaced along each of the distance strings are four coloured markers which give the half-diagonal distances of the four smaller plots (see Figure 2). The four short pegs supplied are used to mark the corners of the successively larger plots for 2 x 2 m (4 m^2) up to 10 x 10 m (100 m^2).

Starting with the smallest 2 x 2 m plot, the area within is carefully searched recording the presence of all ground flora species - all vascular plants (monocots., dicots, and ferns) - including tree or shrub seedlings <25 cm in height. The species names (or the abbreviation thereof as used on a BSBI card) are entered in the wide column under the appropriate quadrat size. Assigned names which are specified in the herbarium (see Appendix I) can also be used.

NB It was not originally intended to include the 2 x 2 m size and on most forms there is no separate column for this. **Species for this quadrat should be entered in the column for the 5 x 5 m (25 m^2) quadrat and a clear line drawn across the column where the smaller quadrat ends and the larger one begins.**

Having recorded all species in a given quadrat size, the corner pegs are moved one marker further out and the new area thus enclosed is searched for **additional species only**, which are recorded in their appropriate column (under the line delineating the 2 x 2 m quadrat in the case of the 5 x 5 m size). This procedure is repeated until the full 14.14 x 14.14 m (200 m^2) has been recorded. The most convenient method of search for the successive sizes of quadrat, is for the two operators to spiral outwards moving in opposite directions so that both cover the whole area.

Plants which cannot be immediately identified, or for which a subsequent check, in flora or herbarium, is required, should be placed in a labelled polythene bag. Specimens for the herbarium (see Appendix I) should be collected at the same time.

Because of identification difficulties, bryophytes are not being recorded in the field but a **comprehensive collection of all bryophytes growing on the soil (but NOT on tree bases, logs, rocks or other specialised habitats) should be made in the course of searching the plot for vascular plants.** These should be placed in the polythene bag supplied and labelled on completion. Great care should be taken to include samples of the less common or inconspicuous species. No breakdown of bryophytes into the successive quadrat sizes is required; just one collection from the whole 14.14 x 14.14 m plot. Having completed the record of presence of the vascular plants in all five quadrat sizes and collected the sample of bryophytes, an estimate of cover abundance for the full plot (14.14 x 14.14 m) should be carried out. This should include all vascular plants recorded as present, plus the six additional categories (litter, wood, rock, bare ground, water and bryophytes) printed at the foot of the form. This is best accomplished by imaging 100 random strikes with a pin over the whole plot and estimating how many times it would touch the species in question. **Estimates should be given to the nearest 5% only. Species present in appreciable quantity (either in area occupied or number of individuals, if widely scattered), but with less than 5% cover, should be recorded as 1. Those which are present as only single or few specimens with little cover should be recorded as +.** The total cover should add up to about 100% (making due allowance for the +'s and 1's), or more if the ground flora is markedly layered. These values should be entered in the right-hand column. The left-hand column, headed Code No., is for "office use only" (where the species identification codes will be inserted for subsequent data punching).

(b) **Trees, saplings and shrubs**

These are recorded in the 14.14 x 14.14 m plot, the laying out of which has already been described in (a) above. Decisions as to whether individuals are in the plot or not are based on rooted base being 50% or more within the plot.

(i) Trees - stems of >5 cm DBH of any species which is normally capable of attaining a tree like habit. Exceptions include hazel, blackthron, viburnum, juniper and a number of other less common shrubs, which rarely produce stems >5 cm diameter anyway. The species and DBH (cm) of all stems in the whole plot over 5 cm diameter is measured (recording by quarters). Trees with multiple stems have each stem measured and recorded separately **but these are bracketed together on the recording sheet**. Dead trees (standing of course) or dead stems on multi-stemmed trees, are designated by a capital “D” in the top right-hand corner of the cell in which its diameter is recorded.

(ii) Saplings - tree species, with the same definition as (i), but with a height >130 cm (ie over breast height) but <5 cm DBH are recorded only in the diagonally opposite quarters 1 and 3 (see Figure 2 - numbers on right angle gauge). The same measurements as for trees, species and DBH (cm), are recorded for these with the same conventions for multi-stemmed and dead trees or stems*.

(iii) Shrubs - as defined above according to species. Like the saplings these are only recorded in the diagonally opposite quarters 1 and 3; same data, same conventions.

* See additional instructions for Native Pinewood Survey.

The final job is to measure the height of the largest tree in the plot (the tree with the largest DBH - regardless of species). This is done using the height measuring instrument provided (Haga or Blume-Leiss hypsometer). In the eventuality of the largest tree being in some way atypical (ie top broken off) the next largest should be substituted.

An example of a completed recording form is given in Appendix III.

(c) **Plot description and habitats**

This is recorded on the basis of presence within the 14.14 x 14.14 m plot by striking out the appropriate attributes on the form. A detailed account of methods and definitions of the attributes is given in Appendix IV. **In the case of attributes which have an appreciable defined area, eg ponds, glades, etc., only part of the full area need to be included in the plot for it to be recorded as present.** For example if only part of a glade 50 m across occurred actually within the plot it would be recorded as present and attribute 76 struck off.

The plot form is in fact a much reduced version of the site form. The object of the plot form is to obtain frequency data about some of the more important attributes which can reasonably be expected to occur a measurable number of times within a single site. Definitions for all the attributes occur in Appendix IV, the second number in brackets referring to plot form (first and without brackets to the site form). Only attributes 5 and 6 (really codes for variables) need further explanation.

5 Slope in degrees of % - (depends on whether you are equipped with a Haga (%) or a Blume-Leiss (_) hypsometer. This is measured on a 20 m baseline passing through the plot centre (10 m either side) between the lowest and highest point that can be found by rotating the axis of the line. The best method is to locate your partner at the top end of the baseline and measure the angle from his eye to yours (suitable corrections should be made for poorly matched height pairs).

6 Aspect ^{o} magnetic - is the bearing of the line of maximum slope used for 5 above. Care should be taken not to record the back-bearing, the down slope bearing is what is required.

The comments column can be used to record any information that is not included elsewhere and is considered relevant or useful in interpretation.

Finally, a sketch of the ground profile along the line of maximum slope (same line as the slope that was actually measured) should be entered on the reverse side of the plot description and habitat form. This should show all the major features within the plot such as cliffs, rocks or lesser irregularities in the ground, banks boggy areas, streams, etc. The plot centre and two corners should be marked to give scale. Some artistic licence is permissible as to the exact line of section and the representation of features. Annotations can be included and additional sections if the topography is complex.

(d) **Soil data**

A full description of the methods of interpretation and recording of the soil data is given in Appendix V.

The small pit and auger samples are taken from the centre of the plot or as near as possible (not more than 1 m distant). A small bit is dug using the entrenching tool to expose the upper 25-30 cm of the profile (less if this is not possible). This will usually yield information on the A00, A0, A1 or A2 and possibly the upper part of the B horizons. A basic interpretation of what is visible can be made and the information on the upper horizon recorded. Investigation of the lower horizons can then be accomplished, probably with no further digging, using the screw auger. This instrument can also be used to determine the depth of soil if within auger range (ie about 70 cm or 80 cm using the pit).

Having completed the record form, a composite sample of the top 10-15 cm mixed should be obtained from the wall of the pit. A total of 700-800 g, ie a bag full, should be obtained if possible.

If difficulties in obtaining sufficient sample are encountered it may be necessary to supplement from nearest possible point in the plot, (again within 1 m distance). Should this occur, a note to this effect should be appended to the soil data form. The soil pit should be filled in and roughly disguised before leaving the plot - this is important.

Completion of the plot

Having filled in all 4 sets of data and collected both series of samples, the recording of the plots is now complete, or at least it should be. At this point it is advisable to:

(i) check that all forms have been fully entered - a quick check through to see that major items have not been omitted should be made, and that the **site and plot number have been correctly entered at the top of each form.**

(ii) Check all the samples into the sample carrying haversack.

(iii) Check all the equipment into the equipment carrying haversack.

(iv) Check the soil pit has been filled in.

(v) Take one last quick look round the plot to see that nothing important has been omitted and no equipment left behind.

The data you are collecting is being collected “forever”. Make sure that it is comprehensive and correct to the best of your ability even at the expense of taking a little extra time.

One additional set of data has to be collected for the site as a whole (ie comprising the plots and the ground in-between), namely site description and habitats for the whole site - separate but similar form to that for the plot.

Total site description and habitats

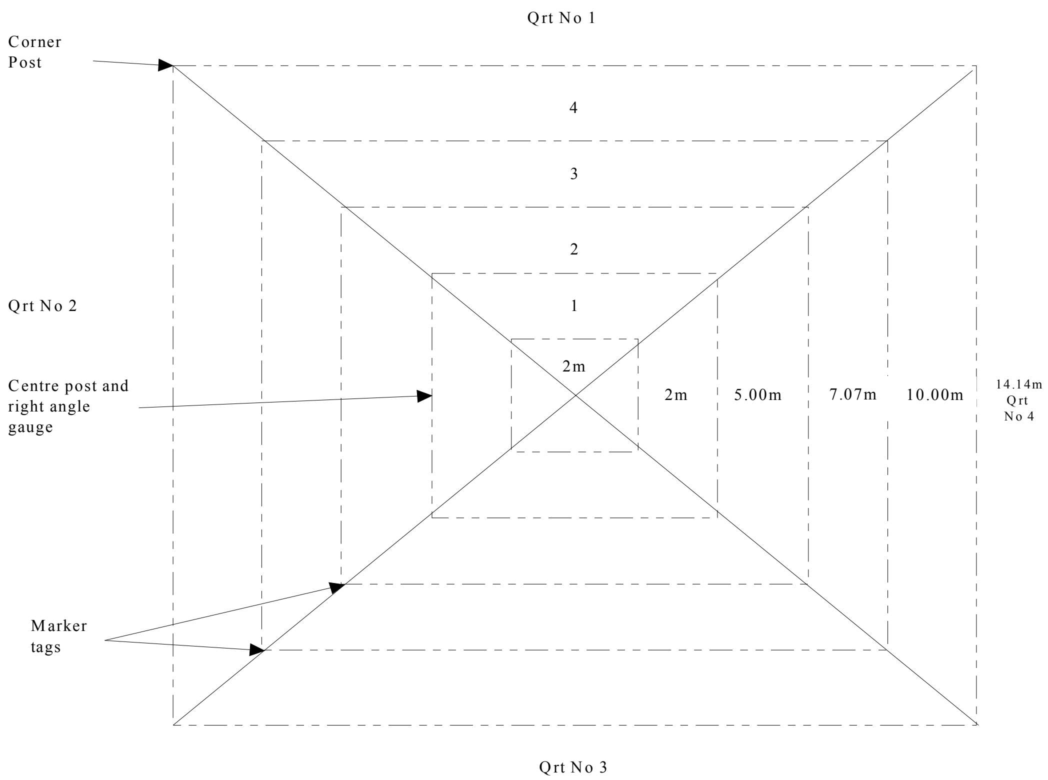
A detailed description of how this data should be collected and recorded on the form and definitions for all attributes is given in Appendix IV (attribute numbers not in brackets). Coverage is of the whole site, both within and between plots. In order to record section L (Marginal Land Use) and M (Boundary Type) it will almost certainly be necessary to walk round all or part of the boundary. Use of control points on the boundary, where this is possible, can be made to economise on walking. Useful information can also be obtained from the site map.

Completion of the site

When the whole site has been completed (4 sets of data and 2 sets of samples for 16 plots, plus the site description and habitats) all the sheets should be stapled together in plots, using the ministapler provided, checked and put into the polythene bag they were supplied in. Four cardboard boxes have been supplied for each site and the soil samples should be put into three of these (checking at the same time that they are all present and correct and securely labelled) so that no box weighs more than about 16 lbs (maximum weight for a 1st class parcel). The bryophytes and field sheets, sealed in their polythene bag, should be placed in the remaining box (it might be necessary to overflow bryophytes into a soil box). The boxes should be sealed and securely tied up using the sellotape and string provided. A pre-paid, pre-addressed sticker and tie-on label should be affixed to each and the parcels dispatched by post at the earliest convenient opportunity. It is desirable to measure the pH reasonably fresh and it will also prevent your vehicle becoming cluttered up with samples.

Figure 2

LAYOUT OF GROUND FLORA QUADRATS



Distance string possition from centre - 1/2 diagonal
2 m quadrat (4m^2) = 1.42 m
1 Q = 25 m^2 (5.00 x 5.00 m) = 3.54 m
2 Q = 50 m^2 (707 x 707 m) = 5.00 m
3 Q = 100 m^2 (10.00 x 10.00 m) = 7.07 m
4 Q = 200 m^2 (14.14 x 14.14 m) = 10.00 m

Not to scale

Appendix 13 Instructions for the collection of Herbarium Specimens

In order to ensure a high standard and uniformity of species identification all team leaders are responsible for the preparation and subsequent submission of a herbarium collection to demonstrate the accuracy of their species records. A type specimen should be obtained for **all** species occurring in the quadrats. As good a specimen as possible should be obtained with sufficient morphological characters to permit accurate identification later (preferably with flowering shoots). The supposed correct name of the species, or whatever name or code number it has been entered as in the field sheets, should be written clearly on the herbarium sheet to which the specimen should be securely attached with sellotape. A box file, blotting paper and hardboard sheets cut to size and sellotape are all provided for use in preparation of the herbarium.

When collecting and subsequently recording species under a supposed or code name, great care should be taken to ensure that all plants recorded under this identity are indeed the same. Key features for identifying such species should be noted at their first occurrence and rigidly adhered to thereafter. **The rule is, if in doubt collect a specimen and enter it into the herbarium.** If it does turn out to be a duplication nothing is lost and it can be merged with other records for that particular species.

Please try to present a comprehensive and well prepared herbarium. They will be examined in great detail because systematic mis-identification of species could introduce serious errors into the subsequent analysis of data.

Appendix 14 Ground flora data

(Old type form)

Site no: *200* **Plot no:** *1* **Recorder:** *MWS* **Date:** *24/06/71*

Code no.	1. Q. 25m^2 Species	CA %	Code no.	2. Q. 50m^2 Species	CA %
	Agrostis tenuis *Deschampsia flexuosa* *Holcus mollis* *Lonicera periclymenum* *Teucrium scorodonia* *Pteridium aquilinum*	1 5 5 5 1 75		Dryopteris filix-mas Potentilla erecta	+ 1
	Dryopteris dilatata *Oxalis acetosella* *Oak sdlg* *Galium hercynicum*	1 1 + 1			
Code no.	3. Q. 100m^2 Speces	CA %	Code no.	4. Q. 200m^2 Species	CA %
	Rubus fruticosus *Anthoxanthum odoratum* *Endymion non-scripta*	1 + +		Rowan sdlg	+

Cover/Abundance other categories % **Litter % *80*** **Wood % *5*** **Rock % *1*** **Bare ground % *1*** **Water % -** **Bryophytes % *5***

Appendix 14 (cont) Ground flora data

(new type form)

Site No: *200* **Plot No:** *1* **Recorder:** *MWS* **Date:** *24/06/71*

Code No.	1. Q. 4m^2 Species	CA %	Code No.	2. Q. 30m^2 Species	CA %
	Agro. ten. Desch. flex. Hol. mol. Lonic. per. Teuc. scor. Pter. aqu.	1 5 5 5 1 75		Dryopteris-f-m. Pot. ere.	+ 1
			Code No.	3. Q. 100m^2 Species	CA %
				Rub. frut. Autho. od. Endy. n-s.	1 + +
Code no.	4. Q. 25 Species	CA %			
	Dry. dil. Oxal. acet. Oak sdlg. Gali. herc.	1 1 + 1			
			Code no.	5. Q. 200m^2 Species	CA %
				Rowan sdlg.	+

Cover/Abundance other categories % **Litter %** *80* **Wood %** *5* **Rock %** *1* **Bare ground %** **Water %** - **Bryophytes %** *5*

Appendix 15 Tree, sapling and shrub data

Site No. *200* **Plot No.** *1* **Recorder:** *MWS* **Date** *24/06/71*

Q No	Species													Ht (m)
1														
T	Oak	37	34											16
R														
E	Birch	9	7	12										
E														
S														
S	Birch	2	5	2	2									
A														
P														
S														
S	Hazel	2	5	4	3	1	1	2	4	2	1			
H														
R														
B														
2														
T	Oak	16^{D}	24											
R														
E														
E														
S														
3														
T	Oak	15	16^{D}	15										
R														
E														
E														
S														
S	Birch	4	1											
A	Rowan	4	3	4										
P														
S														
S	Hazel	2	5	2	1	1	2	3	2^{D}	3^{D}	1	1	3^{D}	
H														
R														

Q No	Species													Ht (m)
B														
4														
T	Oak	34												
R														
E														
E														
S														

Appendix 16 Instructions for completing the plot and site description and habitat forms

General

One copy of the Site Description and Habitat Form is completed for each site. The Plot Description and Habitat Form is a somewhat reduced version of the Site Form and one is completed for each plot (ie 16 per site). For simplicity in the subsequent handling of the data, the code numbers for the attributes are different on the two forms, the attributes being numbered sequentially on each form without gaps, except for unallocated codes. Since the methods of recording and definitions of attributes remain the same on the two forms it is possible to treat them together by giving both code number series - site code first unbracketed, and plot code second in brackets ( ).

Checking that all the appropriate attributes for a given plot have been recorded is part of the routine procedure dealt with in the main text. A further check should, however, be made that there are no logical inconsistencies between the plot and site forms; attributes which are present on the plot form **must** be present on the site form (but not necessarily vice versa). If any significant area of the site has not been covered in connection with locating or recording the plots (or for other purposes) it should be briefly visited to check that no attributes have been missed. Particular care should be taken with the site form as the recording of a given attribute is an all or nothing proposition and is therefore critical.

The attribute code numbers are dealt with in order below:

(SE = self-explanatory; and UA = unallocated).

1 (1) Site Number - SE

2 (2) Plot number - SE, on site form fill in as 1 -16

3 (3) Recorder - recorder's initials

4 (4) Date - day, month, year. Inclusive dates on site form.

(5) Slope - (plot only) in _ or %. Depends on the instrument provided - Blume Leiss = _, Haga = %. (See main text for methods).

(6) Aspect - _ magnetic, SE (See main text for methods).

A. **Trees - management**

5 Planted hardwoods - must be clear evidence that the trees have been planted, eg visible lines, uniform age and/or, in the case of mixtures, regular alternation of species. Gets more difficult to detect planted origin with age.

6 Planted conifers - these can usually be assumed to be planted except in the case of European larch and Scots pine, unless there is strong evidence to the contrary, eg irregular distribution and age. May be natural regeneration of some species.

7 Pollards - trees that have had their main branch systems cut off at some time at a height above breast height (4'3" or 130 cm) but have now resprouted. An ancient method of marking boundaries or obtaining firewood and/or browse for stock.

8 (7) Coppice stools - trees that have been cut off below breast height and have resprouted. Most multi-stemmed trees are the result of coppicing but not all. Usually the point of cutting can be seen and there are usually >2 stems. Hazel stools should not be recorded as coppice stools unless there are unmistakable cut stems to be seen; a multi-stemmed growth form is normal for this species. Many woods all over Britain, but particularly in the south, were formerly managed on a coppicing system. Most coppice origin woods have not been cut for 20, 50 or even more years and have grown on so that their former use is less evident (but see attribute 10 (9)).

9 (8) Singled coppice - where, in what was formerly coppice, with a preponderance of multi-stemmed trees, selected stools have had the number of shoots reduced to one by cutting the others off. This can be detected by the swollen base of the tree with scars where the other main shoots were removed or by the presence of residual twiggy growth. Becomes less detectable with time.

10 (9) Recently cut coppice - where there is evidence that coppicing is still, or has been until very recently, in progress. Recent coppice can be detected from cut shoot stubs on the stools and/or the presence of coppice produce (see also 20) in the wood. Recent - <c 5 years.

11 Mature conifers - trees >40 years old or >20 m height.

12 (10) Stumps hardwood new - hardwood stumps can usually be distinguished from conifers by the presence of ring-porous wood and/or medullary rays. Often the remnants of bark can be used to identify the hardwood species, eg oak, ash, birch. New stumps can be distinguished from old 13 (11) by the absence of advance rot, luxuriant growths or bryophytes and by the fact that the ring growth is still discernible without cutting or scraping the stump.

13 (11) Stumps hardwood old - the inverse of the characters used to identify new stumps in 12 (10) above. Stumps of species like birch rot away completely in a very short time, whilst those of more resistant species like oak persist for many (>50) years, so the old/new scale is necessarily arbitrary.

13 (12) Stumps conifer new - conifer stumps can be distinguished from hardwoods by the absence of ring-porous wood or medullary rays. Identifiable bark is often useful, as also is resin exudation, and the smell of resin if reasonably fresh. Apart from Sequoias (not very likely) **NO** conifers produce any coppice shoots from stumps cut near the ground. So if there are any signs of coppice shoots live or dead it is sure to be hardwood. the same rules for new/old hardwood stumps also apply to conifers. Yew coppices quite frequently but is easy to identify.

15 (13) Stumps conifer old - fully explained above, SE.

16 Stumps overgrown - in the more open woodlands, the older stumps in an advance state of decay will often be completely overgrown by such species as bramble, honeysuckle or bryophytes.

17 Brashing/pruning - where the lower branches of the trees have been artificially removed by cutting to improve access and/or timber quality.

18 Brash heaps - can result from brashing or pruning, or from the cutting of scrub species, or as the lop and top (the thinner branches) of felled trees. Essentially, therefore, a heap of thin branches which have been left to rot.

19 Cord wood - odds and ends of felled trees, almost invariably hardwood, which have been cut to log size (as for putting on the fire) and have been piled into regular stacks (usually about 4'-6' high and 2'-3' wide and any length).

20 Coppice sticks - the product from cutting coppice which has been tidily stacked for subsequent use. Can vary from large sizes such as hop poles down to pea sticks.

21 Stack timber - the larger parts of the stems of felled trees which have been cut into regular lengths (3' up to 30' or 40') and stacked. Anything from pulp bolts up to the largest sizes in saw timber.

22 Felled trees - trees that have been felled but have not been processed any further than having had the branches cut off.

23 Chips/sawdust - SE

24 Fire sites - SE, often used to get rid of brash 18.

25 Paint/blaze marks - used to mark trees for some special purpose; often for felling, retaining or thinning out the surrounding trees in favour of the best trees. Paint marks may consist of dots, rings or even numbers. Blaze marks consist of the bark being cut off in a strip at about breast height. The latter almost invariably means the tree is marked for felling. Also include scribe marks.

26 Extraction routes - places where logs have obviously been dragged or strips of trees removed for the same purpose.

27 Vehicle tracks - the use of vehicles on **unmade ground** off the main roads or tracks (see also attributes 114-118 (79-82)).

28 (14) UA

B. **Trees - regeneration**

29-48 (15-34)(as per species listed) - **regeneration is any tree species >25cm height and <5cm DBH and must be of seedling origin.** The only exception (ie non-tree) is hazel which must of course be >25 cm in height but must also be of obvious, recent, seedling origin (**do not** record coppice shoots - upper limit of 5 cm hardly applies here). Coppice shoots are not to be recorded as regeneration and care should be taken to check this point as far as possible. Younger seedlings, <25 cm height, will be recorded by plots as a part of the ground flora. Regeneration over breast height will similarly be recorded in more detail with the saplings.

C. **Trees - dead (= Habitats)**

49 Live/Dead - trees which, although still alive, have substantial dead parts on them, >50%.

50 Standing dead <10 cm diameter - SE.

51 Standing dead >10 cm diameter - SE.

52 (35) Fallen broken - trees dead, or recently alive, which have fallen and are lying on or near the ground due to the main trunk breaking. Includes trees that have been felled and abandoned. Must be <10 cm diameter at widest point - does not include very small trees.

53 (36) Fallen uprooted - as for 52 but uprooted with a mass of soil and roots pulled out of the ground leaving a hole. Must be >10 cm diameter again.

54 (37) Log very rotten - a very old version of 52 (35) or 53 (36), the sort you can kick into with your boot (with no broken toes). Must be >10 cm diameter again.

55 (38) Fallen branch >10 cm diameter - SE.

56 (39) Hollow trees - as indicated by large holes in base or higher up, SE.

57 (40) Rot hole - smaller holes <25 cm diameter where branches have fallen off or the tree has been damaged in some way. In general not large or deep enough to indicate the tree is hollow.

58 (41) Stump <10 cm diameter - hardwood or conifer of any age and state of decay.

59 (42) Stump >10 cm diameter - as for 58 (41) apart from size.

60 UA.

D. **Trees - epiphytes and lianes**

61 (43) Bryophytes base - <50 cm height SE.

62 (44) Bryophytes trunk - >50 cm height, trunk referring to primary structural members(s) of tree.

63 (45) Bryophytes branch - no height or diameter limitations, branch referring to secondary (and lesser) structural members of tree.

64 (46) Lichen trunk - as 62 (44) above. Refers to foliose lichens only (**not** the less conspicuous granular types). SE.

65 (47) Lichen branch - as 63 (45) above. SE.

66 (48) Fern - ferns growing anywhere on the tree.

67 Mistletoe - SE

68 Clematis - must ascend at least into the lower crown of trees to be counted.

69 Ivy - as for 68 SE.

71 Macrofungi - growing anywhere on tree from base to crown. Includes both mushroom and bracket-shaped types.

72 UA.

E. **Habitats - rock**

73 (51) Stones <5 cm - as with all attributes in this group, must be on the surface of the ground, otherwise SE.

74 (52) Rocks 5-50 cm - SE.

75 (53) Boulders >5 cm - SE.

76 (54) Scree - the essential characteristics of a scree is its actual or potential mobility, thus distinguishing it from a rock pile (attribute 82 (62)). In order to exhibit this mobility a scree consists of a mass of rock fragments resting at or near the maximum angle or repose. The instability of a scree is conferred either by additions from above or active erosion at the base (possibly at high altitudes by the severe climatic regime). The minimum size for recording screes is 25 m^2. Man-made screes produced by various earth-moving operations also count (see also 133 (87) and 134 (88)).

77 (55) Rock outcrop <5 cm (height) - should be, as far as it is possible to tell, part of the solid geology. Height refers to vertical height (includes low angle outcrops such as limestone pavement).

78 (56) Cliff >5 m - a larger version of 77 (55).

79 (57) Rock ledges - horizontal surfaces of any size on rock outcrops or cliffs (77 (55) and 78 (56)). No width limits apply. Will usually be made very obvious by the presence of vegetation on the rock faces.

80 (58) Bryophyte covered rock - logically must record one or more of attributes 74 (52), 75 (53), 77 (55), and 78 (56) as well. Otherwise SE.

81 (59) Gully - where two rock faces or cliffs face one another. Must be at least 3 m in height and length and not more than 1.5 x their height apart. Logically must also record one or both of attributes 77 (55) and 78 (56) as well.

82 (60) Rock pile - as name suggests a pile of rocks, not less than 1 m in height and 2 m in diameter (see also 76 (54)). Logically must also record one or both attributes 74 (52) and 75 (53) as well.

83 (61) Exposed gravel or sand - must be at least 1 m^2 in extent in one piece.

84 (62) Exposed mineral soil - must be at least 1 m^2 in extent in one piece.

F. **Habitats - aquatic**

85 (63) Small pool <1 m^2 - must not be running water, otherwise SE.

86 (64) Pond 1-20 m^2 - as for 85 (63) SE.

87 (65) Pond/lake >20 m^2 - as for 85 (63) SE.

88 Stream slow <1 m - speed less than 1 mph (very slow walking or 1 m/2 secs).

89 Stream fast <1 m - speed over 1 mph.

90 River slow 1-5 m speed as 88, SE.

91 River fast 1-5 m - speed as 89, SE.

92 River slow >5 m - speed as 88, SE.

(66) Stream/river slow (plot only) - as above but no size limits.

(67) Stream/river fast (plot only) - as below but no size limits.

93 River fast >5 m - speed as 89, SE.

94 Bottom rock - SE.

95 Bottom gravel - SE.

96 Bottom sand - SE.

97 Bottom mud - if water turbid, may have to poke with a stick (if turbid most likely mud anyway).

98 Bottom peat - SE.

99 (68) Aquatic vegetation - must be true water plants, not terrestrial plants submerged by an abnormally high water level.

100 (69) Spring - water emerging from ground, SE.

101 (70) Marsh/bog - water exuded under feet.

102 (71) Ditch/drain dry - may be wet at other times of year, SE.

103 (72) Ditch/drain wet - SE.

104 (73 & 74) - UA.

G. **Habitats - open**

105 Glade 5-12 m grass - in order to qualify must be an area of 5-12 m in two dimensions at right angles not covered by tree canopy (ie. Trees >130 cm) and with grass as the main vegetation type. A gap 8 x 4 m would not count but one 11 x 5 m would.

106 Glade >12 m grass - same rules as 105 above, SE.

107 Glade 5-12 m mixed - as for 1-5 but vegetation mixed, eg. Grass, herbs, brambles or even woody species <130 cm.

108 Glade >12 m mixed - as 107 above, SE.

109 Glade 5-12 m boggy - as for 105 but ground exuding water under foot. Vegetation can be any of the boggy types, eg. Rushes, Sphagnum, even grasses such as Molinia. Is distinguished from attributes 105-108 by wetness.

110 Glade >12 m boggy - as for 109, SE.

(75) Glade 5-12 m (plot only) - as above but any vegetation type.

(76) Glade >12 m (plot only) - as above but any vegetation type.

111 (77) Rocky knoll <12 m (width) - consists of an area raised above the surrounding ground consisting largely of rocks with relatively little covering of soil.

112 (78) Rocky knoll >12 m - as 111 (77), SE.

113 Field - a field is a definite management division, an area of ground being currently or having been in the past managed as a field. Normally there will be well marked boundaries with the wood - wall or fence, but these may be in poor repair. In order

to count as being in the wood it must be at least partly within the survey boundary and enclosed on at least three sides by the wood.

114 (79) Path 1-5 m - not normally used by wheeled vehicles. Vegetated apart from a narrow trodden area.

115 (80) Ride >5 m - same as for 114 (79) but largely vegetated.

116 (81) Track non-prepared - quite extensively used by wheeled vehicles and therefore deeply rutted, vegetation being significantly affected by this use (>25% destroyed). Has not been the subject of large scale earth-moving operations nor has any metal (stones) been added to the surface.

117 (82) Track metalled - as for 116 (81) but earth-moving and/or addition of stone to surface used in construction.

118 Road tarmac - must be within the site boundary SE.

119 & 120 UA.

H. **Habitats - human**

121 House occupied - SE.

122 House unoccupied - SE.

123 Farm occupied - a farm is a complex of buildings for both human habitation and agricultural use (eg. Farmhouse, barn, cowshed, pigsty, etc.). Do not fill in 121 as well unless there is a quite separate occupied house. Similarly 125.

124 Farm unoccupied - as for 123. Same rules apply to 122 and 125.

125 Agricultural building - must be separate from farm SE.

126 Other building - SE.

127 Ruined building - SE.

128 Sheep pen/enclosure - SE.

129 (83) Wall dry - dry stone walling, no use of mortar or earth packing.

130 (84) Wall mortared - wall held together with lime mortar, cement or earth. Also includes brick walls.

131 (85) Wall ruined - formerly 129 or 130, but fallen down. If the walls in a wood are part fallen and part standing must be at least 50 m fallen to count.

132 (86) Embankment - must be man-made either by the removal or addition of earth.

133 (87) Soil excavation - rather similar to 132, but more contemporary in nature, with exposed soil surfaces either because excavation is still in progress or subsequent erosion of the surfaces has not yet ceased (see also 84 (62) and possibly 83 (61)).

134 (88) Quarry/mine - historical or contemporary, SE.

135 (89) Rubbish domestic - SE.

136 (90) Rubbish other - SE.

I. **Habitats - vegetation**

137 Alder grove - must be at least 400 m^2 in one piece to count.

138 Hazel grove - as for 137, SE.

139 Willow grove - as for 137, SE.

140 Conifer grove - must have typical “grove” characteristics, ie. Dense branches near the ground, plenty of cover. Will therefore usually be restricted to young conifers. Otherwise as for 137, SE. See also 11.

141 (91) Blackthorn thicket - must be at least 100 m^2 in one piece.

142 (92) Hawthorn thicket - as for 141 (91) SE.

143 (93) Rhododendron thicket - as for 141 (91) SE.

144 (94) Bramble clump - must be at least 25 m^2 in one piece to count.

145 (95) Nettle clump - as for 144 (94) SE.

146 (96) Rose clump - as for 144 (94) SE.

147 (97) Willow-herb clump - as for 144 (94) SE.

148 (98) Umbellifer clump - as for 144 (94) SE.

149 (99) Bracken dense - must be at least 100 m^2 in one piece to count.

150 (100) Moss bank - must be at least 5 m^2 in one piece to count.

151 (101) Fern bank - as for 150 (100) SE.

152 (102) Grassy bank - must be at least 25 m^2 in one piece to count.

153 (103) Leaf drift - must be at least 10 m^2 in one piece to count and >5 cm in depth.

154 Isolated scrub - must be at least 100 m^2 in one piece to count, and at least 30 m from the nearest woodland.

155 Isolated trees - must not be more than 3 trees together and at least 30 m from the nearest woodland to count.

156 (104) Herbaceous vegetation >1 m - species other than those already recorded in 144-149 (94-99) inclusive. Same minimum size.

157 (105) Macrofungi soil - SE.

158 (106) Macrofungi wood - on dead wood (see also 71 (50) on standing live or dead trees).

159 & 160 UA.

J. **Animals**

Evidence from a number of different sources can be used to record the presence of these animals; sight, signs or sound. In the plots it will usually depend mainly on signs. A few suggestion are given below.

161 (107) Sheep - dropping, hoof marks, wool on brambles, tree bark and fences, bleating.

162 (108) Cattle - droppings, hoof marks.

163 (109) Horse/pony - care is required here because only horses living and/or feeding in the wood at some time should be recorded. Horses ridden through the wood should not be recorded. Droppings, hoof marks (may be unshod).

164 (110) Pig - droppings, hoof marks, digging, noises.

165 Goat - no suggestions (not very likely anyway).

166 (111) Red deer - droppings, fraying >1 m, hoof marks, scrapes.

167 (112) Other deer - droppings, fraying <1 m, hoof marks, scrapes.

168 (113) Rabbit - droppings (usually concentrated on small hummocks), holes and incipient holes, fur.

169 Hare - not easy, apart from sight, larger than rabbit, black tips to ears, runs differently.

170 (114) Badger - setts (large holes with remains of bedding materials outside, no smell), footprints, hairs on fence, latrines (groups of holes with dropping in them), feeding excavations and scrapings.

172 (116) Mole - mole hills.

173 Red squirrel - apart from dreys, not really distinguishable from those of grey squirrel, must rely on sight.

174 Grey squirrel - as for 173, SE.

(117) Squirrel (plot only) - red or grey together, SE.

175 (118) Anthill - refers to larger species, with hill >25 cm.

176 (119) Corpse/bones - SE but can also be used to detect the presence of the deceased, eg. Rabbit bones record rabbit, etc.

(120) Spent cartridges - SE.

(121) and (122) UA.

K. **Birds**

177 Rook - heavy beak, baggy trousers, usually in flocks.

178 Crow - like rook apart from above characteristics, usually seen singly or in pairs.

179 Jackdaw - smaller than rook or crow, greyish skull cap.

180 Magpie - easy.

181 Jay - easy, characteristic call as well.

182 Raven - larger than crow or rook, characteristic call.

183 Pigeon - easy, can also use grey feathers, egg shells, and nests to detect.

184 Owl - easy, call and pellets.

185 Buzzard - heavy birds, broad wings, soaring, characteristic mewing call.

186 Kestrel - more delicate, frequently hovering.

187 Other birds of prey - if in doubt about identity, record this.

188 Blackbird - easy, also alarm call.

189 Thrush - easy.

190 Heron - easy

191 Wildfowl - easy.

192 Robin - easy.

193 Wren - easy, also alarm call.

194 Finches - includes house sparrow, chaffinch, green finch, etc. Heavy finch-like beaks.

195 Tits - includes blue, great, coal, marsh, willow and long-tailed tits.

196 Woodpecker - green and others, nests, also drumming on trees.

197 Pheasant - easy, also call of cock pheasant.

198 Other game - SE.

199 Spent cartridges - SE.

200 UA.

L. **Marginal land use** (<400 m distant)

For some of these, eg. Road, railway, river, etc. it will be possible to obtain correct records from the map. The map can also be used to pinpoint parts of the marginal land for which it will be necessary to check the use on the ground. It will be necessary to walk much of the boundary anyway to fill in section M. A good deal of navigation to determine the plot positions can make use of the boundary, thus economising in walking time.

201 Woodland hardwood - >75& hardwood < 25% conifers.

202 Woodland mixed - hardwood 25 -75%, conifer 25-75%.

203 Woodland conifer - >75% conifer <25% hardwood.

204 Scrub - woody species overall height <5 m. (Woodland 201-203 >5 m).

205 Orchard - SE.

206 Arable - SE.

207 Permanent pasture - SE.

208 Rough grazing - may merge a bit with 207 and 209, but not critical.

209 Heath/moorland - SE.

210 Marsh/fen/bog - SE.

211 River - SE.

212 Lake - SE.

213 Road - SE.

214 Railway - SE.

215 Housing - more than five houses in a reasonable group.

216 Industrial - SE.

217 Quarry/mine - SE.

218 Tipping - rubbish dumps or industrial waste.

219 Waste - land which is under no immediately obvious usage.

220 UA.

M. **Boundary type**

221-236 All fairly self-explanatory. Must be at least 10 m in length in one piece of any type for it to be recorded. Attributes 234 and 235, hedge thin and thick, distinguished as <2 m and >2 m respectively. Note distinction between 228 bank and 229 ditch separately and 230 bank and ditch together. A bank must be >1 m high.

N. **Subjective overall impression of site**

236-241 Quite straightforward, simply one's subjective impression of the site.

242 Approximately time taken to survey - SE.

Comments

Anything (but anything) that was noted about any aspect of the site and which was not formally recorded on the form may be included here. Obviously it will not be possible to use this information in a formal, analytical sense, but it may constitute an extremely valuable aid to interpretation or in designing the collection of information for future surveys.

Appendix 16 (continued)
Plot Description and Habitats

1 Site No. *200*	2 Plot No. *1*	3 Recorder *MWS*	4 Date *24/06/71*
5 Slope 12° or %	6 Aspect 120° Mag		
A	**TREES - MANAGEMENT**		
~~7 Cop. Stool~~	8 Singled cop.	9 Rec. cut. cop.	~~10 Stump hard.new~~
11 Stump hard.old	12 Stump con.new	13 Stump con.old	14
B	**TREES - REGENERATION**		
15 Alder	16 Ash	17 Aspen	18 Beech
~~19 Birch~~	20 Hawthorn	~~21 Hazel~~	22 Holly
23 Hornbeam	24 Lime	~~25 Oak~~	~~26 Rowan~~
27 Rhododendron	28 Sweet chestnut	29 Sycamore	20 Wych elm
31 Other hrwd.	32 Scots pine	33 Yew	34 Other con.
C	**TREES - DEAD (- HABITATS)**		
35 Fallen brkn	~~36 Fallen uprtd.~~	~~37 Leg.v.rotten~~	38 Fall. bnh.>10cm
39 Hollow tree	40 Rot hole	41 Stump<10cm	~~42 Stump >10cm~~
D	**TREES - EPIPHYTES AND LIANES**		
~~43 Bryo.base~~	~~44 Bryo.trunk~~	~~45 Bryo.branch~~	~~46 Lichen trunk~~
~~47 Lichen branch~~	48 Ferm	49 Ivy	~~50 Macrofungi~~
E	**HABITATS - ROCK**		
~~51 Stone.<5cm~~	~~52 Rocks 5-50cm~~	~~52 Boulders >50cm~~	54 Scree
~~55 Rock outcp.>5m~~	56 Cliff >5m	57 Rock ledges	~~58 Bryo.covd.rock~~
59 Gully	60 Rock piles	61 Exp.grav/sand	62 Exp.min.soil
F	**HABITATS - AQUATIC**		
63 Sml.pool <1m^2	64 Pond 1-20 m^2	65 Pon/lake>20 m^2	66 Strm/riv.slow
67 Strm/riv. fast	68 Aquatic veg.	69 Spring	70 Marsh/bog
71 Dtch/drain dry	72 Dtch/drain wet	73	74
G	**HABITATS - OPEN**		
~~75 Gld.5-12m~~	76 Gld.>12m	77 Rky.knoll<12m	78 Rky.knoll>12m
79 Path <5m	80 Ride >5m	~~81 Track non prop~~	82 Track metalled
H	**HABITATS - HUMAN**		
~~83 Wall dry~~	84 Wall mortared	85 Wall ruined	86 Embankment
87 Soil excav.	88 Quarry/mine	89 Rubbish dom.	90 Rubbish other
I	**HABITATS - VEGETATION**		
91 Blkthorn.thkt.	92 Hawthron thkt.	93 Rhodo.thkt	94 Bramble clump
95 Nettle clump	96 Rose clump	97 W.herb clump	98 Umbel.clump
~~99 Bracken dense~~	100 Moss bank	101 Ferm bank	102 Grass bank
103 Leaf drift	104 Herb veg.>1m	105 Macfungi.soil	106 Macfungi.wood
J	**ANIMALS (mainly signs)**		
~~107 Sheep~~	108 Cattle	109 Horse/pony	110 Pig
111 Red deer	~~112 Other deer~~	113 Rabbit	114 Badger
115 Fox	~~116 Mole~~	~~117 Squirrel~~	118 Anthill
119 Copse/bones	120 Spent ctrdgs.	121	122

COMMENTS

Appendix 16 (continued)
Site dscription and habitats

1 Site No. *200*	2 Plot No. *1-16*	3 Recorder *MWS*	4 Date *24/06/71*
A TREES - MANAGEMENT			
~~5 Plnted.hard~~	~~6 Plnted.con~~.	7 Pollards	~~8 Cop. stool~~
~~9 Singled cop~~.	10 Rec.cut cop.	~~11 Mature con~~.	~~12 Stump hard.new~~
~~13 Stump hard.old~~	14 Stump con.new	~~15 Stump con.old~~	~~16 Stump ovgwn~~.
17 Brash/pruning	~~18 Brash heaps~~	19 Cord wood	20 Cop.sticks
21 Stack timber	22 Felled trees	~~23 Chips/sawdust~~	24 Fire sites
25 Pnt/blaze mks.	26 Extrn. routes	~~27 Vehicle tracks~~	28
B TREES - REGENERATION			
29 Alder	30 Ash	31 Aspen	32 Beech
~~33 Birch~~	34 Hawthorn	~~35 Hazel~~	~~36 Holly~~
37 Hornbeam	38 Lime	~~39 Oak~~	~~40 Rowan~~
41 Rhododendron	42 Sweet Chestnut	43 Sycamore	44 Wych Elm
~~45 Other bard~~	46 Scots pine	47 Yew	~~48 Other con~~.
C TREES - DEAD (- HABITATS)			
~~49 Live/dead~~	~~50 Stnd.dead <10cm~~	~~51Stnd.dead>10cm~~	~~52 Fallen brkn~~
~~53 Fallen uprtd.~~	~~54 Log.v rotten~~	~~55 Fall bnb.>10cm~~	56 Hollow trees
57 Rot holes	~~58 Stump <10cm~~	~~59 Stump >10cm~~	60
D TREES - EPIPHYTES AND LIANES			
~~61 Bryo.base~~	~~62 Bryo.trunk~~	~~63 Bryo.branch~~	~~64 Lichen trunk~~
~~65 Lichen branch~~	~~66 Fern~~	67 Mistletoe	68 Clematis
~~69 Ivy~~	~~70 Honeysuckle~~	~~71 Macrofungi~~	72
E HABITATS - ROCK			
~~73 Stones~~	~~74 Rocks 5-50cm~~	~~75 Boulders >50cm~~	76 Scree
~~77 Rock outop.<5m~~	78 Cliff >5m	~~79 Rock ledge~~	80 Bryo.covd.rock
81 Gully	~~82 Rock piles~~	83 Exp.grav/sand	~~84 Exp.min.soil~~
F HABITATS - AQUATIC			
85 Sml.pool <1m^2	86 Pond 1-20m^2	87 Pond/lake>20m^2	~~88 Strm.slow <1m~~
~~89 Strm.fast <1m~~	90 Riv.slow 1-5m	91 Riv.fast 1-5m	92 Riv.slow >5m
93 Riv.fast>5m	~~94 Bottom rock~~	~~95 Bottom gravel~~	~~96 Bottom sand~~
97 Bottom mud	98 Bottom peat	99 Aquatic veg.	100 Spring
~~101 Marsh/bog~~	102 Dtch/drain dry	103 Dtch/drain wet	104
G HABITATS - OPEN			
~~105 Gld.5-12m grs~~	~~106 Gld.>12m grs~~	~~107 Gld.3-12m mxd.~~	~~108 Gld.>12, mxd.~~
~~109 Gld.5-12m bgy~~	~~110 Gld.>12m bgy~~	111 Rky.knoll <12m	112 Rky.knoll >12m
113 Field	~~114 Path 1-5m~~	115 Ride >5m	~~116 Track non-prep~~.
~~117 Track metalled~~	118 Road tarmac	119	120
H HABITATS - HUMAN			
121 House occ.	122 House unocc.	123 Farm occ.	124 Farm unocc.
~~125 Agri.bldg~~.	126 Other bldg.	127 Ruined bldg.	~~128 Sheep pen/enc~~.
~~129 Wall dry~~	130 Wall mortared	~~131 Wall ruined~~	132 Embankment
133 Soil excav.	134 Quarry/mine	~~135 Rubbish dom~~.	136 Rubbish other
I HABITATS - VEGETATION			
137 Alder grove	~~138 Hazel grove~~	139 Willow grove	140 Con.grove
141 Blkthorn.thkt	142 Hawthorn thkt.	143 Rhodo.thkt.	144 Bramble clump
145 Nettle clump	146 Rose clump	147 W.herb clump	148 Umbel.clump
~~149 Bracken dense~~	~~150 Moss bank~~	~~151 Fern bank~~	152 Grass bank
153 Leaf drift	154 Isolated scrub	~~155 Isolated trees~~	~~156 Herb veg.>1m~~
~~157 Macrofungi soil~~	~~158 Macrofungi wood~~	159	160

J	**ANIMALS (Sight. sign or sound)**		
~~161 Sheep~~	162 Cattle	163 Horse/pony	164 Pig
165 Goat	166 Red deer	~~167 Other deer~~	168 Rabbit
169 Hare	~~170 Badger~~	171 Fox	~~172 Mole~~
173 Red squirrel	~~174 Grey squirrel~~	175 Anthill	~~176 Corpse/bones~~
K	**BIRDS (Sight, sign or sound)**		
~~177 Rook~~	~~178 Crow~~	~~179 Jackdaw~~	~~180 Magpie~~
~~181 Jay~~	182 Raven	~~183 Pigeon~~	184 Owl
185 Buzzard	186 Kestrel	187 Other BOP	~~188 Blackbird~~
~~189Thrush~~	190 Heron	191 Wildfowl	192 Robin
~~193 Wren~~	~~194 Finches~~	~~195 Tits~~	~~196 Woodpecker~~
197 Pheasant	198 Other game	199 Spent ctrdge.	200
L	**MARGINAL LAND USE (<400 m distant)**		
~~201 Woodland hrwd~~.	202 Woodland mixd.	~~203 Woodland con~~.	~~204 Scrub~~
205 Orchard	206 Arable	~~207 Permnt.pasture~~	~~208 Rough grazing~~
~~209 Heath/moorland~~	~~210 Marsh/fen/bog~~	211 River	212 Lake
~~213 Road~~	214 Railway	215 Housing	216 Industrial
217 Quarry/mine	218 Tipping	219 Waste	220
M	**BOUNDARY TYPE**		
~~221 Fence good~~	~~222 Fence holes~~	223 Fence derelict	~~224 Wall good~~
~~225 Wall gaps~~	~~226 Wall derelict~~	227 Post and rail	~~228 Bank~~
229 Ditch	230 Bank and ditch	231 Water	~~232 Road~~
233 Railway	234 Hedge thin	235 Hedge thick	~~236 Merging direct~~
N	**SUBJECTIVE OVERALL IMPRESSION OF SITE**		
~~237 Cracking~~	238 Pleasant	239 OK	240 Nasty
241 Nightmare	242 Approx.time taken to survey = hours		

COMMENTS

Appendix 17 Instructions for collecting the soil data and completing the form

Unfortunately many of the properties of soils which affect the plants and animals which are primarily or secondarily dependent on them are difficult or time-consuming to measure. In the case of large surveys, such as the present one, with a total of 1648 plots for which information on the soils is required, it is quite out of the question to carry out a full range of physical or chemical analyses. The traditional methods of studying soils depend largely on descriptive methods which cannot readily be adapted to the types of numerical analysis which are to be used in the current project.

The solution to the problem of obtaining adequate soil data within the resource limitations of the project has been to combine the measurement of a limited number of physical/chemical characteristics together with a numerical method of soil description using presence or absence of attributes. The physical/chemical measurements which will be carried out on the soil samples collected from the plots are:

(a) pH

(b) Loss on ignition

(c) Mechanical analysis (% sand/silt/clay, by a simplified method)

Dried sub-samples will also be retained so that further analyses may be carried out at a later stage in the project if necessary.

In order to get the maximum interpretable information out of the method of numerical description, it has been found desirable to incorporate some of the elementary profile interpretative procedures which are involved in the standard descriptive methods. This involves dividing the soil profile up into named horizons according to the main trends in the pedological processes. Fortunately there is a fairly limited range of major soil types in Britain and the identification of the basic pedological process is not difficult.

Major woodland soil types in Britain

In the basically temperate climate of Britain, most soils under conditions of free drainage belong to the Podzolic Soil Group. This group as a whole is characterised by consisting of freely leached soils in which calcium carbonate (or sulphate) is only a fugitive constituent. They are thus on the acid side of neutrality (<pH 7). Brown earths, brown forest soils, brown podzolic soils and podzols are some of the common types within this group.

When drainage conditions become sufficiently impeded, and often this is just a localised condition, there is a transition to hydromorphic soils in which the position of the water table and its chemical composition are the dominant factors. Gley, peat, and similar soils found in marshes and bogs, belong to this group. Similarly, where the weathered mineral layer on which soils are developed is shallow, either due to the nature of the underlying rock or erosion, skeletal soils are developed in which the dominant factor is lack of constituent material. Both hydromorphic and skeletal soils tend to occur mixed with the basic, climatically determined podzolic types, often in a complex mosaic based on the land form and drainage patterns.

The degree to which leaching has advanced in podzolic soils is dependent on a number of factors, some independent, some interrelated.

(i) Rainfall - or better still the potential amount of water available to run through the soil (= rainfall - evapotranspiration).

(ii) The nature of the soil matrix - water percolates freely through sandy or stony soils but not through clay.

(iii) The base and/or weatherable mineral content of the soil - siliceous sands and sandstones are low in bases and weatherable minerals, and what there is is soon removed by leaching (water is also free to percolate - see (ii)), whereas calcareous rocks (chalk and limestone) or base rich igneous rocks are high in bases, and leaching takes much longer to remove them. Base rich materials often include, or weather to produce, a high clay fraction, which also tends to reduce the intensity of leaching.

(iv) The vegetation type and/or land use - heathy vegetation, often with burning, increases the rate of leaching (change to mor humus type producing organic acids etc) whereas mixed deciduous woodland slows leaching down (mull humus and possibly less available leaching water).

(v) Time - the longer the soil has been developing, in the absence of disturbance by erosion, the more leached it will become. In Britain the soils are generally relatively young, those north of the glaciation line (Thames - Bristol Channel) having been under development for only 20,000 years or less.

Many podzolic soils in high rainfall areas (>70" pa) are for various reasons, finely balanced on the threshold of impeded drainage. Changes in land-use and vegetation or advancing podzoloisation can tip the balance resulting in the formation of a surface layer of peat (peats and peaty podzols).

In addition to the podzolic soils and their related types, there is another group of soils which also occur in Britain and will certainly be encountered in the survey, and this is the calcareous soils. These are characterised by the presence of free calcium carbonate in the profile and are thus on the alkaline side of neutrality (>pH 7). As might be expected under British climatic conditions, calcareous soils are limited to those developed on calcium rich rocks, and particularly chalk and limestone. As already explained for the podzolic soils, the dynamics of these soils are also very complex, and they indeed grade without discontinuity into the podzolic group. There is also a strong geographical/geological relationship since the soft, easily weathered chalk mostly occurs in southern England where, due to the high evapotranspiration, potential leaching is at a minimum. Under these conditions, calcium carbonate in the profile is thus not readily leached out and the Rendzina soil type is quite common in this area. The harder, less weatherable limestones, most areas of which occur further north than the chalk, also produce calcareous soils, sometimes black, base saturated soils (pH >7) but under other conditions red soils, or Terra Rossa, which border on the acidic (c. pH

7) are developed. The degree to which calcium carbonate is retained in the soil depends on such factors as time, rainfall, depth of the soil to the calcareous rock, the hardness of fragmentation of that rock. On flat ground markedly acid soils may develop over hard, massive, limestone lying only a few inches below the surface. Similarly, shallow podzols can be observed on deep soils over chalk in the Chilterns.

In some situations the calcareous base rock (the solid geology) may be overlain by other material of different origin and composition, eg may be a layer of non-calcareous drift over a calcareous base rock and in this case, the soil profile will be determined by the superficial material. Within a given site, the depth of superficial deposit may vary so that a mosaic of types is produced. Even where larger fragments of limestone are well distributed in the profile, their effect may be quite localised with no free calcium carbonate in most of the material (pH <7). Such soils belong to the podzolic group.

It will be appreciated from the above discussion that the soil forming or pedological processes are essentially dynamic, and most of the soils you will meet in the field will be immature and undergoing changes of one sort or another, which means they will often be transitional between the classical textbook descriptions.

Methods of interpretation and recording soil profile

The use of the mattock and/or trowel to dig a small sloping pit is described in the main text. The auger can be used to investigate the lower levels. The first thing to do is dig a small pit about 30 cm deep if this is possible (ie the soil is not too rocky or shallow).

Having filled in the attributes 1-4 Site No., Plot No., etc. at the top of the form, the best procedure is to continue working down the profile (and form) interpreting on the way.

Each section of the form deals with a single named horizon (with the exception of the B horizon which is the B1 and B2 horizon combined). Having decided that a particular horizon is present according to the methods of interpretation and definitions given below, the appropriate section of the form should be completed starting with depth from/to (cm). The from/to method is used instead of simple depth = thickness to avoid cumulative errors in scaling of the profile. Where horizon limits are irregular or poorly defined an average or best approximation should be given. Only in C Underlying Material, is the depth given as from, and if this value is not the soil depth, in terms of auger penetration, this should be given separately in brackets. Methods of determining, and the definitions of, the other attributes are given in their appropriate sections below. If a given horizon is not present it should be deleted by a diagonal line and not applicable = NA written across it.

Aoo Litter layer (identifiable plant remains)

This is quite straightforward, either there are plant remains, and they can be identified from their appearance or by inference from the vegetation, or there are not.

Whether there is or is not a layer of identifiable plant remains at the soil surface and its depth, is the first major clue as to the nature of the profile (ie the pedological process that is dominant):-

(i) If there is no Aoo horizon or a shallow one, this is indicative of a MULL humus type and soil profile in which there will probably be no, or a very shallow Ao horizon, a + or - well developed A1 horizon, no A2 horizon, and no deposition layer in the B horizon.

(ii) If there is a well developed Aoo, several cm in depth, then this is indicative of a MOR humus type and a soil profile in which there is likely to be a well developed Ao horizon, no or a poorly developed A1 horizon, there may be a well developed A2 horizon and there may be a deposition layer in the B horizon.

Intermediate or MODER humus types are quite common, resulting in an intermediate profile type.

Composition - attributes 6-13 are all self-explanatory, more than one may be recorded and normally this will be the case.

Ao Organic layer (decomposed plant remains with little or no mineral soil)

As explained above this may be very shallow, or virtually non-existent, or it may occupy the whole of the rest of the profile with no other recordable horizons; in other words, deep peat.

The presence or absence of mineral material can be tested by rubbing a sample between the fingers or on the palm of the hand, when mineral particles will normally be felt.

Having decided whether or not there is an Ao horizon delete or record.

Texture - attributes 15-17, needs little explanation. Pulling the material apart will detect whether it is 15 fibrous (do not mistake live roots for fibres, dead ones are legitimate) and breaking in the fingers will decide whether it is 16 granular or 17 amorphous.

Moisture - attributes 18-21, should be decided as follows:-

18 v wet	-	dripping with water without squeezing.
19 wet	-	water expressed on squeezing.
20 damp	-	obviously containing appreciable water but none expressed on squeezing.
21 dry	-	looks and feels reasonably dry.

A1 Mixed mineral/organic layer (humus masking colour of mineral soil)

Again, the first thing to do is decide if this horizon is present or not:-

(i) If there is a well developed A1 horizon there will be little or no distinction between the Aoo, Ao and A1 layers, the profile grading almost imperceptibly from organic to organic/mineral mixed soil (this is a true brown earth or brown forest soil). In this case, the humus content will gradually decrease with depth, the soil paling from dark brown to a lighter colour as the true mineral colour of the soil is revealed by decreasing humus content. The actual boundary may be difficult to see and may be <40-50 cm in depth.

On the other hand, the A1 horizon may be poorly developed, shallow and exhibiting a + or - sharp transition with the mineral soil below. Common sense, colour and rubbing sample between the fingers will decide this.

(ii) If immediately beneath the Ao horizon there is a much paler, often white or greyish, layer with no organic matter in it (if there were organic matter it would be black or brown), then there is indeed no A1 horizon and what you are looking at is an A2 horizon (this is a true podzol).

Difficulties may arise in wet soils but this will usually occur in boggy areas (due to local draining conditions) or on very heavy clay soils. Both these contingencies will be fairly obvious. In these cases water level, and the seasonal changes thereof, will be affecting the profile by producing alternate aerobic and anaerobic conditions. Where this is taking place in mineral soil, deposition of iron oxides on the structural units of the soil will occur. Breaking the soil between the fingers will reveal alternating pale and ocherous patches. If there is evidence of organic matter in this layer, it must be regarded as a gleyed A1 (and recorded appropriately) if not then it is a gleyed B horizon (also to be recorded appropriately). Both gleyed A1 and B horizons will occur together in some profiles.

If the A1 has a high organic content, (but an appreciable quantity of mineral material must still be present) as may occur in boggy areas, the signs of mottling will not be visible. In this case it will be recorded as dark coloured (brown or black), wet or v. wet A1.

Having decided whether or not an A1 horizon is present, delete or record.

Transition with mineral soil - attributes 23 and 24, have already been discussed above and should now be obvious.

Texture - attributes 25-28, can be decided as follows:-

Roll a sample on the palm of the hand, wetting with spit if necessary. If it can be rolled into a coherent sausage it is either clay or silt.

25 Clay - if a sausage about 10 cm (4") long can be bent into a complete circle without breaking (must of course be sufficiently moistened) it is clay.

26 Silt - if the sausage breaks it is silt.

27 Sand - if it cannot be rolled into a sausage it is sand.

28 Stony - unless almost pure gravel will normally be recorded as well as one of the attributes 25-27. Must be >10% stones of any size to count.

Structure - attributes 29-31, refers to the compounding of the primary particles (sand, silt or clay) into aggregates. Breaking of the soil between the finger will reveal if such aggregates occur.

29 Powder - aggregates non-existent or very weak (coarse sands will usually exhibit this condition but other soils as well).

30 Crumb - aggregates, as the name suggests, like crumbs from a loaf of bread.

31 Clod - aggregates large and adherent, often breaking in more or less flat sided lumps up to several cm in length. Usually occur only on soils with a high silt or clay content.

Colour - attributes 32-35, self-explanatory. It the colour is markedly different from black, brown or possibly reddish-brown, then you have probably incorrectly identified this layer as A1, because the humus which must be present mixed with the mineral soil, being itself black or brown, will be masking other mineral colours.

35 mottled, has been adequately described above as indicating alternate aerobic/anaerobic conditions as a result of impeded drainage. Most commonly found in silts or clays.

Moisture - attributes 36-39 as for the Ao horizon.

A2 Leached or eluviated layer (bleached mineral soil)

The identification of this horizon has already been discussed at some length in connection with the Ao and A1 layers. Normally there will be a very sharp transition of the Ao with a paler layer of soil, usually showing a whitish or greyish colour, but it may be speckled with black humus fragments. Beneath this leached layer the soil will be much more brightly coloured again (= B horizon), and in extreme cases will have intensely coloured, horizontal zonation of black and/or reddish-brown colour. The black is humus deposition and the reddish-brown oxides of iron. A closer examination will reveal that these materials have been deposited on the surface of the soil particles, (sand grains or pebbles). In the majority of cases, particularly in western Britain, the A2 will merely be underlain by a fairly uniform, bright red or reddish-brown layer which again is the B horizon but with generalised, rather than localised, deposition of iron oxides. Many of these soils are only incipient podzols and no distinct A2 horizon will be visible, the profile passing from a sharply defined Ao, through a brownish layer to the much brighter B horizon. In this case it will be necessary to record what, although it is an incipient A2, as an A1 horizon (small quantities of humus are indeed present in this layer).

Having decided whether an A1 horizon is present or not delete or record.

Colour - attributes 40 and 41 have already been explained above. Must be one or other of these colours to be an A2.

Texture - as above for the A1 horizon. Is very unlikely to be clay of course, as the processes leading to the development of an A2 requires both low base status and free drainage. Note, that neither structure nor moisture are recorded for this layer as these will invariably be powdery (ie no aggregates) and damp or dry, respectively, almost by definition.

B Weathered mineral layer (B1 and B2 combined)

The B horizon is commonly divided into two layers, the B1 deposition layer and the B2 weathered mineral soil. For the purposes of this survey they are being grouped together.

As explained above the B1 can consist of local or more generalised deposition of humic or iron materials. A deposition layer is only to be recorded as present if it is of the localised variety with distinct horizontal (may be somewhat wavy) zonation. If present, record attributes 48-51, if not, delete and write NA on this sub-group of attributes.

Colour - attributes 48 and 49 are self-explanatory.

Compaction - attributes 50 and 51, pick at the layer with a finger tip, if it is hard, record compacted, if not uncompacted.

Texture - attributes 52-55, as A1 above.

Colour - (other than deposition layer) attributes 56-60, as A1 above.

Structure - attributes 61-63, as A1 above.

Moisture - attributes 64-67, as Ao above.

C Underlying material

This may or may not be the parent material of the soil and for the purposes of this survey it will not be necessary to determine whether this is the case.

The term underlying material refers to whatever lies under the lowest of the overlying horizons that has been recorded for a given profile. Most commonly it will refer to the material that is immediately under the B horizon but in other cases it may be the A1 or Ao horizons, but not the A2 horizon which will always have some sort of B horizon beneath it.

On deep soils it may not be possible to determine the depth or nature of the underlying material since investigations will be limited to the length of auger (about 70 cm) plus the depth of the hole (ie about 80 cm at the limit). In this case the lower limit of the overlying horizon will be given as 75 cm + and the section on underlying material deleted and TOO DEEP written across it.

The most common problem will be determining the transition between the B horizon and the underlying material, and indeed there may be no marked division if the soil matrix is deep and uniform. Generally, the underlying material should be taken as commencing from where there is no further colour change (usually a gradual paling) in the B horizon. Other cases will be quite clear, with the B or some other horizon lying immediately on the top of some quite different material such as fragmentary or solid rock, gravel, clay etc. If the depth to which the auger can be inserted in the pit is less than 70 cm this should be recorded separately in a bracket ( ) immediately beneath attribute 47.

The only attributes to be recorded for this horizon are Texture - attributes 69-74. The first four of these are as previously described for the A1 horizon, to which has been added 73 Rock (fragments) and 74 Rock (solid). These are self-explanatory and both can be recorded if necessary.

Rocks in soil

Refers to stones or rocks anywhere in the profile from surface to underlying material.

Shape % - attributes (variables) 75-77, record approximate %, self-explanatory; rounded = really rounded, sub-angular = angular with the corners knocked off, angular - sharp corners.

Size range % - attributes (variables) 78-81, self-explanatory.

Composition % - attributes 82-89, very much depends on how good you are at identifying rocks. Scratching with a knife or breaking with the mattock may assist in identification. If in doubt, retain samples of main types and send samples in with soil in separate bags clearly labelled. Also add note to field sheet to this effect.

Comments

Earthworms - attribute 90, if you see any earthworms whilst digging the profile or observe earthworm burrows or casts record as present.

Any comments can be added on the reverse side of the form. In cases of extreme difficulty or doubt in the interpretation of a profile, draw a fully annotated diagram of the horizons observed and their various characteristics, on the back of the form. Disturbed profiles (excavation, ploughing, etc), buried profiles, newly layed alluvium and soils on steep slopes with rapid erosion, may all present rather atypical horizons or total lack of same. Skeletal or immature soils may also have very limited horizon development. Watch out for all of these.

Two sample forms are attached as an example, showing the method of filling in two common profile types:

A = a deep brown earth.
B = a slightly developed podzol.

Appendix 17 (Continued) **Example 1**

Soil Data

1 Site No: *200*	**2 Plot No:** *1*	**3 Recorder:** *MWS*	**4 Date:** *24/6/71*

Aoo LITTER LAYER (identifiable plant remains)

(5 Depth - cm		(6 Leaves tree		(10 Fern
	Composition	(7 Needles	Composition	(11 Ericoid
		(8 Grass		(12 Bryophyte
		(9 Herb		(13 Wood

Ao ORGANIC LAYER (decomposed plant remains with little or no mineral soil)

(14 Depth - cm		(15 Fibrous		(18 V. wet
	Texture	(16 Granular	Moisture	(19 Wet
		(17 Amorphous		(20 Damp
				(21 Dry

A1 MIXED MINERAL/ORGANIC LAYER (humus masking colour of mineral soil)

(22 Depth *0 - 30* cm			(25 Clay		(32 Black
		Texture	~~(26 Silt~~	Colour	~~(33 Brown~~
Transition	(23 Sharp		(27 Sandy		(34 Red
with min. soil	~~(24 Gradual~~		(28 Stony		(35 Mottled
		Structure	(29 Power	Moisture	(36 V. wet
			~~(30 Crumb~~		(37 Wet
			(31 Clod		~~(38 Damp~~
					(39 Dry

A2 LEACHED OR ELUVIATED LAYER (bleached mineral soil)

40 Depth - cm	Colour	(41 Whitish		(43 Clay
		(42 Greyish		(44 Silt
			Texture	(45 Sandy
				(46 Stony

B WEATHERED MINERAL LAYER (B1 and B2 combined)

47 Depth *30 - 60* cm			(52 Clay		(61 Powder
		Texture	~~(53 Silt~~	Structure	~~(62 Crumb~~
			(54 Sandy		(63 Clod
			~~(55 Stony~~		
Deposition layer if present	(48 Black				(64 V. wet
	(49 Red/brown				(65 Wet
		Colour	(56 Yellow	Moisture	~~(66 Damp~~
	(50 Comp.	Other	~~(57 Yell./brn~~		(67 Dry
	(51 Uncomp.	than	(58 Brown		
		deposition	(59 Red		
		layer	(60 Mottled		

C UNDERLYING MATERIAL

68 Depth from *60* cm		(69 Clay		~~(72 Stony~~
70 +	Texture	~~(70 Silt~~	Texture	(73 Rock (frag)
		(71 Sandy	(cont)	(74 Rock (solid)

1 Site No: *200* **2 Plot No:** *1* **3 Recorder:** *MWS* **4 Date:** *24/6/71*

ROCKS AND STONES IN SOIL

	(75 Round = 100%		(82 Slate-shale = *80%*
Shape %	(76 Sub-angular = %		(83 Sandstone = *20* %
	(77 Angular = %	Composition %	(84 Grit = %
	(78 < 5 cm = *75* %		(85 Chalk = %
Size	(79 5-10 cm = *25* %		(86 Limestone = %
			(87 Flint = %
range %	(80 10-20 cm = %		(88 Granite = %
	(81 > 20 cm = %		(89 Others = %

GENERAL

Fauna	~~(90 Earthworms~~	Soil depth at (91 1 / 2 cm	(93 3 / 4 cm
		Plot corner (92 2 / 3 cm	(94 4 / 1 cm

Appendix 17 (Continued) **Example 2**

Soil Data

1 Site No: *200* **2 Plot No:** *2* **3 Recorder:** *MWS* **4 Date:** *24/06/71*

Aoo LITTER LAYER (identifiable plant remains)

5 Depth *0-4* cm	Composition	~~(6 Leaves tree~~ (7 Needles ~~(8 Grass~~ (9 Herb	Composition	(10 Fern ~~(11 Bricoid~~ (12 Bryophyte (13 Wood

Ao ORGANIC LAYER (decomposed plant remains with little or no mineral soil)

14 Depth *4-10* cm	Texture	(15 Fibrous (16 Granular ~~(17 Amorphous~~	Moisture	(18 V. wet (19 Wet ~~(20 Damp~~ (21 Dry

A1 MIXED MINERAL/ORGANIC LAYER (humus masking colour of mineral soil)

22 Depth **-** cm	Texture	(25 Clay (26 Silt (27 Sandy (28 Stony	Colour	(32 Black (33 Brown (34 Red (35 Mottled
Transition with min. soil (23 Sharp (24 Gradual	Structure	(29 Power (30 Crumb (31 Clod	Moisture	(36 V. wet (37 Wet (38 Damp (39 Dry

A2 LEACHED OR ELUVIATED LAYER (bleached mineral soil)

40 Depth *10-13* cm	Colour	~~(41 Whitish~~ (42 Greyish	Texture	(43 Clay (44 Silt ~~(45 Sandy~~ (46 Stony

B WEATHERED MINERAL LAYER (B1 and B2 combined)

47 Depth *13-35* cm	Texture	(52 Clay (53 Silt ~~(54 Sandy~~ (55 Stony	Structure	(61 Powder ~~(62 Crumb~~ (63 Clod
Deposition layer if present? (48 Black (49 Red-brown (50 Comp. (51 Uncomp.	Colour Other than deposition layer	(56 Yellow (57 Yell/brn (58 Brown ~~(59 Red~~ (60 Mottled	Moisture	(64 V. wet (65 Wet ~~(66 Damp~~ (67 Dry

C UNDERLYING MATERIAL

68 Depth from *35* cm *50 +*	Texture	(69 Clay (70 Silt ~~(71 Sandy~~	Texture (cont)	~~(72 Stony~~ (73 Rock (frag) (74 Rock (solid)

1 Site No: *200* **2 Plot No:** *2* **3 Recorder:** *MWS* **4 Date:** *24/06/71*

ROCKS AND STONES IN SOIL

	(75 Round = *100* %		(82 Slate-shale = %
Shape %	(76 Sub-angular = %	Composition %	(83 Sandstone = *100* %
	(77 Angular = %		(84 Grit = %
	(78 < 5 cm = *100* %		(85 Chalk = %
Size	(79 5-10 cm = %		(86 Limestone = %
range %	(80 10-20 cm = %		(87 Flint = %
	(81 > 20 cm = %		(88 Granite = %
			(89 Others = %

GENERAL

Fauna	(90 Earthworms	Soil depth at	(91 1 / 2 cm	(93 3 / 4 cm
		Plot corner	(92 2 / 3 cm	(94 4 / 1 cm

Appendix 18 List of field equipment

1 x plot marking equipment (comprising centre pole + right angle gauge, 4 x corner poles + distance strings)

Haversack 1 (clean)

1 x magnetic compass	2 x tag boards	(Soil and bryophyte samples
1 x hypsometer	2 x label sticks	usually carried in this bag)
1 x diameter tape	1 x calipers	
1 x 30 m tape		

Haversack 2 (dirty)

1 x mattock
1 x trowel
1 x auger + handle
4 x marker pegs

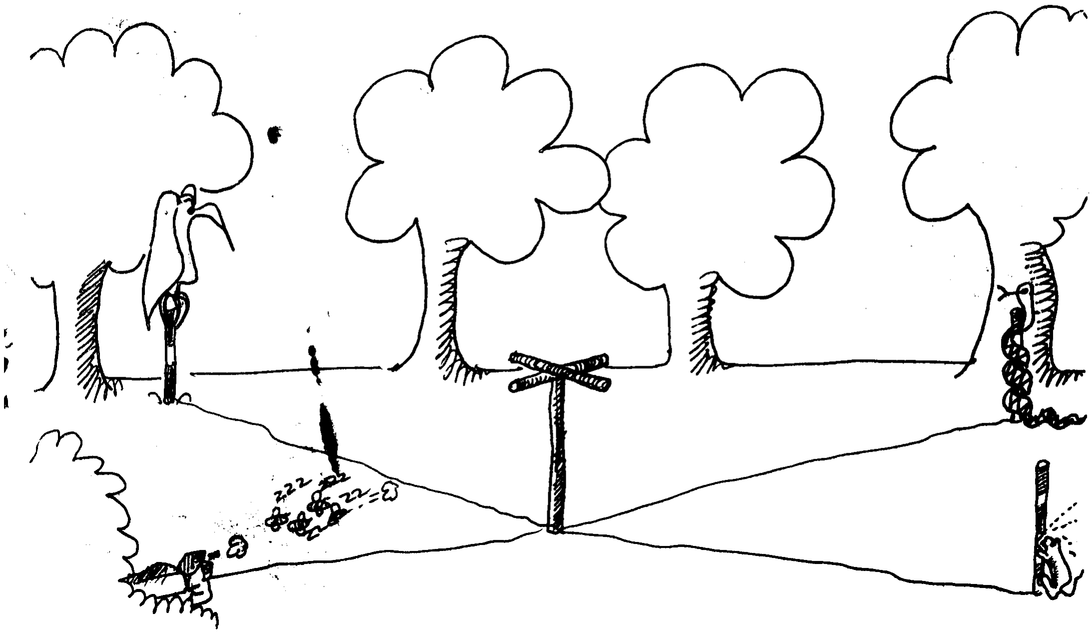
Site Bag (polythene bag one per site)

Map
Field sheets
Metal labels (soil and bryophyte)
Polythene bags (soil and bryophyte)
Paper labels
Spare metal labels

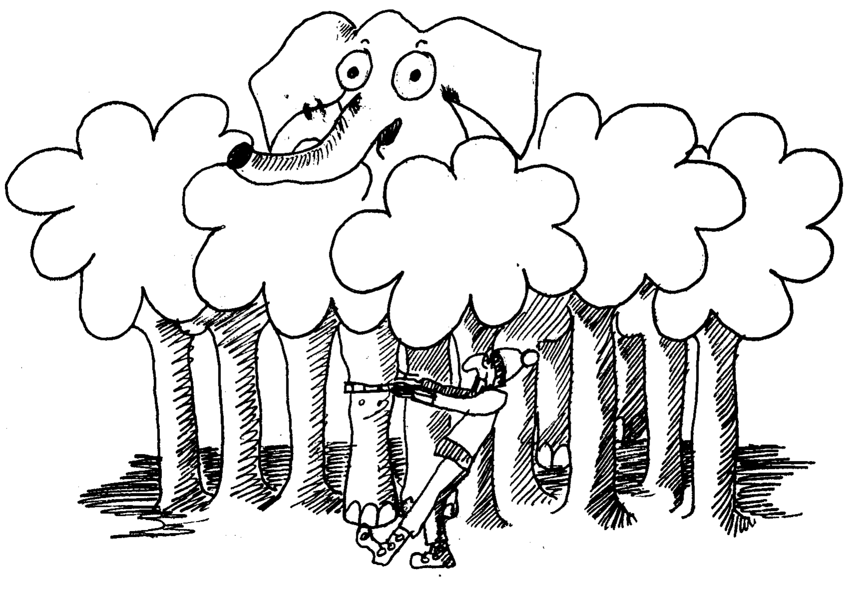
General Equipment

Balls of string
Roll narrow sellotape
Roll broad sellotape
Spare pencils
Rubber
Herbarium box + hardboard and blotting paper sheets
Fold-flat cardboard boxes
Set 1" maps
Spare labels
Mini-stapler
Insect repellant cream

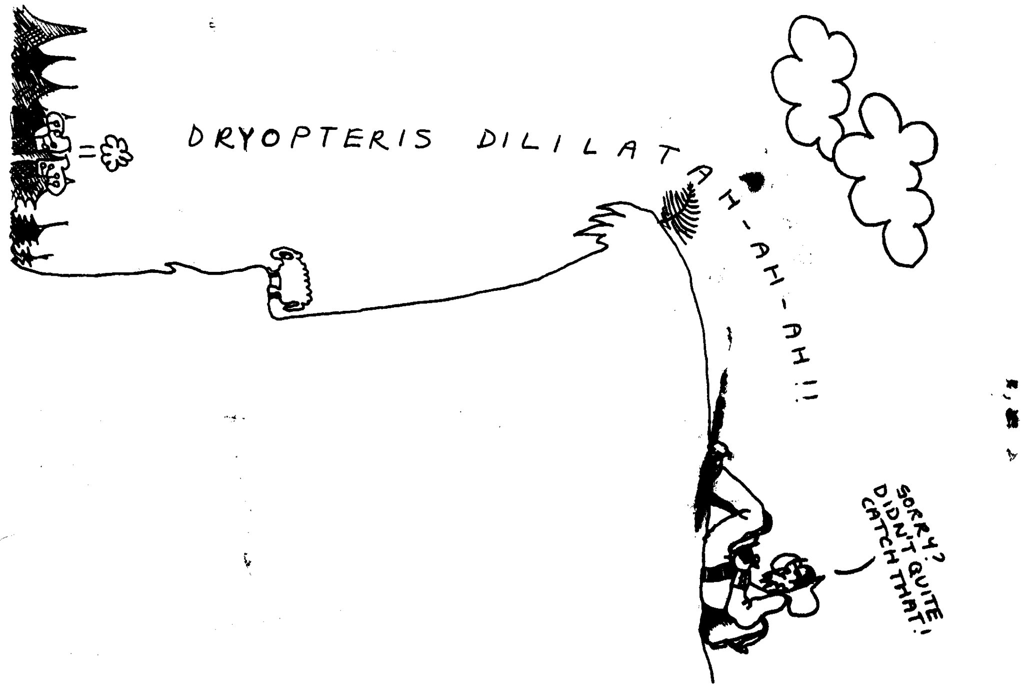
Setting out a plot



Measuring tree d.b.h.'s



Recording ground flora



Taking a soil sample