V Protocol

VEGETATION

Aim

To monitor change in semi-natural vegetation, permanent grass and cereals

Rationale

Semi-natural and managed vegetation is often very sensitive to the main drivers of environmental change, ie climate, pollutants and land use practices. Its monitoring requires as a starting point an accurate and comprehensive description of the extent and character of the vegetation cover of each ECN site. Referring this variation in vegetation to a descriptive scheme that is applicable at least to all network sites, and preferably to a wider geographical area, is important for comparing changes across ECN. The monitoring methods must be sufficiently sensitive to detect responses in any element of the vegetation, but must also set repeatable standards for both present and future recording and analysis. It has been concluded therefore that it is better to use an objective method which records presence and absence of plant species rather than to attempt difficult and subjective assessment, such as cover estimation. Further, it has been thought more efficient statistically to use a relatively large number of small plots rather than a small number of larger plots.

The basic unit for recording and storing lists of plant species in the monitoring programme for semi-natural vegetation is a cell 40 cm x 40 cm, and this is used in different spatial configurations in the two major elements of the sampling programme. These elements are (i) coarse-grain monitoring which is based on a sample of vegetation selected at random from a series of systematically located grid points and with recording repeated every nine years, and (ii) fine-grain monitoring which is based on a sample of vegetation selected from vegetation types recognisable at the beginning of the programme and with recording repeated at three-year intervals. Coarse-grain monitoring aims to provide a record of broad changes in vegetation at a site, whilst fine-grain monitoring provides the detail which allows changes to be related to the UK's National Vegetation Classification (Rodwell 1991 *et seq*.) The number of fine-grain monitoring locations required is at least two in each vegetation type and this is likely to provide approximately 20 or fewer locations at most ECN sites. The number of coarse-grain monitoring locations is larger, being set at approximately 50, and the detail recorded is less than in fine-grain monitoring.

Provision is also made for additional monitoring of woodlands and of linear features such as hedgerows and at vegetation boundaries, which may shift as a result of environmental change. Some ECN sites are managed in part or in their entirety as permanent grassland or for cereal production, and provision is made for monitoring the annual yield of these crops, using methods which are well established in agricultural research practice.

Method

Vegetation mapping to provide baseline data and sample stratification (VB)

A vegetation map is an essential prerequisite for characterising the vegetation types of each site and thus for selecting areas in which change is to be monitored. An existing vegetation map may be adequate, provided the boundaries between the vegetation types are known to be accurate at the start of the programme. If no such map is available, one should be prepared using recent remotely sensed imagery, land use cover or local botanical survey with ground-truthing of boundaries. It is not necessary at this stage to know the identity of the different vegetation types which can be distinguished. The map should be at a scale of 1:10 000 for sites up to 50 km^2 in extent, and 1:25 000 for sites over 50 km^2. Annual patterns of land use at agricultural sites will be recorded on maps and stored in the ECN GIS.

Location

An approximately regular grid, coincident with the National Grid, should be superimposed on the site map, scaled so as to provide approximately 400 sample grid positions. The purpose of the grid is to provide plot locations which are unbiased and re-locatable. If a site includes short-term leys, arable areas, or experimental plots likely to be subject to changing management over the duration of ECN, these should be distinguished on the map under these broad headings, and grid positions falling in these areas excluded from subsequent survey of semi-natural vegetation. Remaining grid positions, falling within semi-natural vegetation, permanent grass and conifer or broadleaf plantations, will be used to characterise the vegetation of the site, together with additional randomly located sample positions placed in other distinguishable vegetation types which are unrepresented or under-represented at the grid positions. There should be at least two sample (infill) points in such additional vegetation types, with no more than 100 in total. A maximum of 500 sample positions will now be available for characterising the vegetation.

If there are existing data of this general kind which can be used to characterise the vegetation types, new sampling can be limited to those areas which were originally under-recorded or where change has obviously taken place since the data were collected.

A 2 m x 2 m plot is centred on each grid and infill point, orientated N, E, S, W using magnetic bearings on the first visit. The centres and corners of plots selected for continued monitoring (see following paras VC, VF, etc) should be permanently marked at this stage. At extensive sites having few landscape features and low-intensity management, it may be essential to use a plot centre marker which can be seen easily from a distance. Plot corners should be marked with buried metal stakes.

Sampling

A species list of all vascular plants, bryophytes and lichens, except those growing on rock or wood, is recorded in the 2 m x 2 m plot, using Tutin *et al*. (1964 *et seq*.), Corley and Hill (1981) and Purvis *et al*. (1993) as standards for nomenclature. Where points fall in peaty pools, streams or lowland ponds, recording will be more difficult, but should nevertheless be attempted unless it results in an unacceptable health or safety risk. Where points fall in woodland or scrub, the trees and shrubs in a 10 m x 10 m plot, centred on the 2 m x 2 m plot and oriented in the same directions, should be listed separately to provide a more representative sample of the canopy and understorey.

Vegetation types identified as a result of this initial survey of the site will be used as a basis for selecting samples for future vegetation monitoring. It is therefore very important that the vegetation types are named by reference to a single classification scheme relevant to all ECN sites. The National Vegetation Classification (NVC) (Rodwell 1991 *et seq*.) provides such comprehensive national coverage of all British semi-natural vegetation, improved grasslands and plantations and is compatible with the European Community CORINE (Co-ordinated Environmental Information in the European Community) Biotopes and Palaearctic Habitat Classifications. Samples can be allocated to NVC vegetation types individually or in groups characterised from the data using a multivariate classificatory technique such as TWINSPAN (Hill 1979). The programs MATCH (Malloch 1991) and TABLEFIT (Hill 1989,1993) provide simple statistical techniques to assist with such matching.

If competence in identifying plants is lacking, then both the original recording and the subsequent monitoring must be subcontracted to skilled surveyors. Sampling must in any case always be timed well within the growing season (June-August at most UK sites) when identification is usually more reliable.

Where sampling is in grass managed for silage, recording should precede the first cut.

Method

Coarse-grain vegetation monitoring (every nine years) (VC)

Location

A random selection should be made of 40 of the 2 m x 2 m plots on the regular grid set up for baseline vegetation recording (see VB). Where infill plots exist, up to ten of these plots should be selected randomly in addition, providing a total of up to 50 plots for coarse-grain monitoring. Plots selected for this purpose should be permanently marked (see VB) and are recorded every nine years.

Sampling

Plots should be divided into 25 cells, each 40 cm x 40 cm. In each cell the presence of all vascular plants rooted in the cell is recorded, with the exception of those growing on rock or wood; non-vascular plants are recorded in the same way but in three groups: sphagna, other bryophytes and lichens. This will provide an estimate of local frequency of taxa in each plot. The presence of bare soil, bare rock, litter, dead wood or open water are recorded in the same way.

The altitude, slope, aspect, land use and slope form are noted for each 2 m x 2 m plot (using the terminology of Hodgson 1974), as also are biotic or treatment effects such as grazing and browsing, trampling and dunging by stock or wild herbivores, burning or disturbance, as specified on the recording form which is provided.

If the plot falls within woodland or scrub, then additional monitoring should be carried out as described below (see VW).

Fine-grain vegetation monitoring (every three years) (VF)

Location

Fine-grain monitoring is to be carried out every three years in the TSS and in at least two locations in each of the vegetation types characterised by the methods described above. The locations are chosen to coincide with original grid and infill locations where possible, but otherwise should be selected using randomly selected pairs of co-ordinates. They should not coincide with coarse-grained monitoring locations so as to avoid unnecessary and repeated disturbance to the vegetation. The same plots are recorded on each occasion.

Sampling

A 10 m x 10 m plot is centred around each selected position and oriented N, E, S, W using magnetic bearings, and marked as described above (see VB). Ten 40 cm x 40 cm cells are selected randomly, using a different randomisation for each plot, and marked in their NE and SW corners; each cell is used for recording the presence of all species of vascular plants rooted in the cell, and bryophytes and lichens, except those growing on rock or wood. The presence of bare soil, bare rock, litter, dead wood and open water should be recorded in the same way. Physical and biotic features of the 10 m x 10 m plot are recorded on each occasion, as described above (see VC).

Method

Additional coarse-grain monitoring in woodland (every nine years*) (VW)

Location

Where grid and infill samples selected for coarse-grain monitoring fall in scrub or woodland, a 10 m x 10 m plot, centred on the 2 m x 2 m plot, will be used for recording trees and shrubs. The corners of the 10 m x 10 m plot should be marked to aid relocation.

Sampling

Tree and shrub species rooted in the 10 m x 10 m plot will be listed, with a note on whether they are represented (see Appendix II) as canopy dominants (C), subdominants (S), intermediate (I), suppressed (U), shrub layer, saplings or seedlings (Figure 12). A species may be represented in more than one of these categories. Ten cells, each 40 cm x 40 cm, are selected at random using a different randomisation for each 10 m x 10 m plot; the cells are marked, for relocation, in their NE and SW corners. The diameter at breast height (dbh, measured with a tape to the nearest 0.1 cm at a height 1.3 m above the ground) and height (measured to the nearest 0.5 m using a hypsometer or poles) of up to ten trees or shrubs of >5 cm dbh will be recorded*; the individuals chosen are those nearest to the centre points of the ten randomly selected cells. If the plant is multiple-stemmed, the dbh and height of the tallest live stem are measured and the number of stems is counted and recorded. The distance, at a height of 1.3 m, between the approximate centre of the chosen stem and the centre of its associated random cell will be recorded. The measured stems should be marked with paint at 1.3 m, numbered and re-measured on subsequent occasions. If a stem dies between surveys, a replacement stem is selected from the same randomly selected cell using the procedure outlined above.

Seedlings will be counted by species in the ten selected 40 cm x 40 cm cells. Seedlings can be individually marked if monitoring of survival is of interest and recording repeated annually if necessary.

Forest health will be assessed annually using UN-ECE (United Nations Economic Commission for Europe) guidelines (Innes 1993).

* Tree diameters are measured every three years

Method

Additional monitoring of vegetation boundaries and linear features, including hedgerows (every three years) (VH)

Location

Boundaries between the vegetation types characterised and monitored using the methods outlined above can themselves be very sensitive to change. Such boundaries should be identified, from baseline or other surveys, or from aerial photographs, and a number of these should be selected which will adequately represent major discontinuities of the vegetation present at the site. Linear features of particular interest, such as hedgerows and ditches, should also be sampled using the same methodology. Having defined the boundaries to be sampled, one or more transect lines will be located at random and laid out at right angles to each boundary.

Cells of 40 cm x 40 cm are centred on each transect line and are located at suitable regular intervals along the line, spaced as closely and extending as far on each side of the boundary as required; they should be permanently marked at the points where the transect crosses the cell boundaries.

Sampling

The presence of all species of vascular plants rooted in the cell, and of bryophytes and lichens, is recorded, excluding those growing on rock or wood, together with bare soil, bare rock, litter, dead wood and open water, and other physical and biotic factors (see VC). A sketch map should be drawn to show the transect profile and the location of cells along the transect.

Where a boundary shifts during the ECN programme, the transect line and number of cells will be extended accordingly.

Where a hedgerow is to be sampled, species composition of a 10 m length of the hedgerow is recorded in addition. The sample is centred on the transect line described above (see **Location**), ie taking a 5 m length of hedge on both sides of the transect line. Woody species occurring in the whole width of hedge are listed.

Method

Additional monitoring of permanent grass (four times per year) (VP)

Location

At lowland sites the TSS will usually have been selected in an area of permanent grass (>5 years since sowing) which has been managed and utilised in a standard manner for several years, normally by grazing.

The TSS should be divided into ten subplots of approximately equal area, within each of which one exclusion cage, covering a minimum area of 3 m^2, is sited at random in mid-March and re-located at random annually.

The existing system of management, including the amount of fertilizer applied and the method of utilisation, should be maintained on the sampled area throughout the ECN programme. All treatments should be recorded, including stocking rates.

Sampling

Species presence will already have been recorded in the TSS in accordance with the protocol for fine-grain monitoring of semi-natural vegetation at three-yearly intervals (see VF).

Grass yield will be recorded in each of the ten exclusion cages. Dry matter yields from the sward will be estimated by mowing under the cages. Four cuts will be taken from the cages using a hand-driven autoscythe, the first in mid-May and again in mid-July, early September and late October. Every effort should be made to make cuts on the same date each year. Although this procedure will not measure the herbage consumed by the stock, it indicates the potential production of the pasture which has been grazed in previous years. The final cut, in October, is intended to coincide with the end of the growing season. Samples will be oven-dried and results expressed as dry matter production/cut and as production ha^{-1} $year^{-1}$.

Where the permanent grass has to be regularly managed by mowing, every effort should be made to follow the timing described above.

As optional, additional monitoring, it is desirable that one or two sites should look for evidence of change in the potential productivity of grassland by using freshly sown, monospecific swards each year (Corrall & Fenlon 1978).

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Method

Additional monitoring of continuous cereal (annually) (VA)

Location

Continuous cereal cropping in a uniform area which has been cropped in a standard manner for a significant period is recommended for ECN monitoring. In these circumstances a standard fertilizer treatment will be required; herbicide will be required to deal with grass weed problems in autumn-sown cereal sequences. Spring herbicide treatment should be delayed until after the spring recording of species presence (see **Sampling** below). Fungicides and insecticides will be used as required. All treatments should be recorded.

Species presence will be recorded annually (weeds and crop plants) in at least two 10 m x 10 m plots before the crop elongates and after the spring flush of weeds. The plot locations are chosen to coincide with original grid and infill locations where possible, but otherwise should be selected using randomly selected pairs of co-ordinates.

Estimates of yield will be made within the crop area in close proximity to that used for vegetation monitoring.

Sampling

Apart from its being annual and not triennial, recording of species presence will follow the principles laid down for fine-grain monitoring in semi-natural vegetation (see VF above), ie it will use ten permanent 40 cm x 40 cm quadrats randomly located in each 10 m x 10 m plot.

Twenty plots, each 20-25 m long and the width of the plot combine (minimum plot area 50 m^2), will be harvested. The grain produced on each plot will be weighed, as will a 10 m length of straw swath. Grain yield will be recorded as grain at 15% moisture content; dry matter yield of straw will also be recorded.

As optional extra monitoring, arable crops can be compared in terms of biomass production, for which purpose it will be necessary to aim for sampling at maximum biomass. Winter wheat will therefore be sampled at anthesis by cutting as near as possible to the ground. Twenty plots, each 1 m^2, should be sampled from within a uniformly growing area of at least 50 m x 100 m which is as similar as possible to the area sampled for grain yield.

The dates of standard growth stages of wheat crops at ECN sites should be recorded annually (Tottman & Broad 1987). Assuming that the winter wheat crop is drilled before the end of October, it is recommended that the dates should be recorded on which the following stages are reached:

- GS 31 (start of stem elongation)
- GS 39 (flag leaf emerged).

The dates should be recorded on which 50% of a sample of tillers on a 50 m x 100 m area have reached these stages of development.

Time

Because the size and character of the ECN sites, and the amount of existing remotely sensed, cartographic and survey data are so variable, it is difficult to estimate the time needed to prepare a basic vegetation map.

Estimated times for the collection of initial plot records for characterisation of the vegetation types and for subsequent monitoring are as follows. Estimates are based on an initial array of 500 plots (400 grid + 100 infill), and make some allowance for walking time and bad weather.

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Initial recording	30 mins/plot	10 weeks in year 1
Location and marking of monitoring plots	30 mins/plot	2 weeks in year 1
Coarse-grain monitoring	1 hour/plot	4 weeks in years 1,10,19, etc
Fine-grain monitoring	1 hour/plot	4 weeks in years 1,4,7,10, etc
Woodland monitoring	½ day/plot	2 weeks in years 1,10,19, etc

Estimated times required for additional monitoring of hedgerows and linear features, permanent grass and continuous cereal are as follows.

Initial plot establishment	15 days
Hedgerows and linear features	15 days/3 years
Grassland	5 days/year
Continuous cereal	9 days/year

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References

Corley, M.F.V. & Hill, M.O. 1981. *Distribution of bryophytes in the British Isles*. Cardiff: British Bryological Society.

Corrall, A.J. & Fenlon, J.S. 1978. A comparative method for describing the seasonal distribution of production from grasses. *Journal of Agricultural Science*, **91**, 61-67.

Hill, M.O. 1979. *TWINSPAN - a Fortran program for arranging multivariate data in an ordered two-way table by classification of individuals*. Ithaca, New York: Section of Ecology and Systematics, Cornell University.

Hill, M.O. 1989. Computerised matching of releves and association tables, with an application to the British National Vegetation Classification. *Vegetatio*, **83**, 187-194.

Hill, M.O. 1993. *TABLEFIT Version 0.0, for identification of vegetation types.* Huntingdon: Institute of Terrestrial Ecology.

Hodgson, J.M. 1974. *Soil survey field handbook.* Harpenden: Soil Survey.

Innes, J.L. 1993. *Forest health: its assessment and status*. Wallingford: CAB International.

Malloch, A.J.C. 1991. *Running a computer programme to aid the assignment of vegetation data to the communities and sub-communities of the National Vegetation Classification.* Lancaster: University of Lancaster.

Purvis, O.W., Coppins, B.J., Hawksworth, D.L., James, P.W. & Moore, D.M. 1993*. Lichen flora of Great Britain and Ireland.* London: Natural History Museum.

Rodwell, J.S. 1991 *et seq. British plant communities.* Cambridge: Cambridge University Press.

Tottman, D.R. & Broad E.H. 1987. Decimal code for the growth stages of cereals. *Annals of Applied Biology*, **110**, 683-687.

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Tutin, T.G., Burges, N.A., Chater, A.O., Edmondson, J.R., Heywood, V.H., Moore, D.M., Valentine, D.H., Walters, S.M. & Webb, D.A. 1964 *et seq.* *Flora Europaea.* Cambridge: Cambridge University Press.

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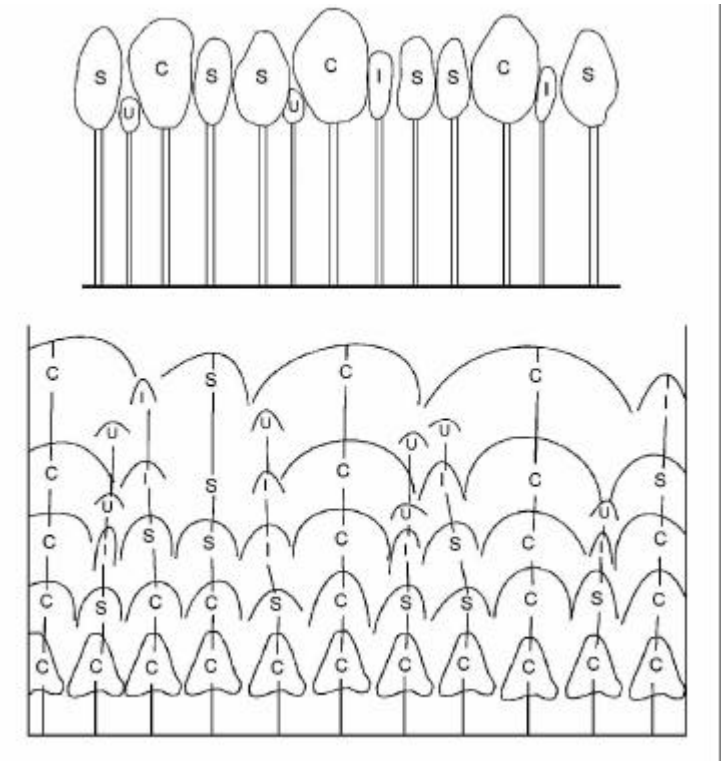

Figure 12.

i. Relative positions of trees in different crown classes in an even-aged, unthinned pure stand

ii. Development of different crown classes with advancing age as a result of competition amongst trees originally dominant

C, dominant; S, subdominant; I, intermediate; U, suppressed

Appendix I. Siting of vegetation plots and the effects of artefacts

ECN vegetation plots are located according to systematic and then random criteria in order to sample vegetation as objectively as possible. Some of these locations may be in difficult terrain, or may include obstructions or types of land cover which prevent vegetation growth (eg tarmac). The following guidelines should be used in such situations.

· Plots should be laid out so as to follow the ground surface as closely as is practicable. This includes following the profile of ditches, turf banks, bluffs, etc. Descriptive and quality information should be given as indicated in the recording forms.

· If part of the plot is occupied by artefacts such as tarmac

Baseline recording	Record the percentage of the plot occupied by the artefact and therefore unsurveyed. (This is provided for in the Baseline Descriptive/Quality Form)
Coarse-grain recording	If a cell could not be surveyed, use 'Quality Code' 136 (provided for in the Coarse-grain Descriptive/Quality Form for cells)
Fine-grain recording	If five cells or more in the 10 m x 10 m plot are not able to be surveyed, then select randomly another grid plot (if none are available then use random co-ordinates within the vegetation type being sampled). If less than five cells are affected, then re-select those cells using random local co-ordinates

· If part of the plot is obstructed by an 'impenetrable' barrier such as a stone wall

Baseline recording	Survey that part of the plot which falls on the same side of the barrier as the plot centre point. Record the percentage of the plot unsurveyed, as above
Coarse-grain recording	Survey that part of the plot which falls on the same side of the barrier as the plot centre point. Record at cell level that a cell could not be surveyed, as above
Fine-grain recording	Select randomly an alternative grid plot so that the whole of the plot falls within the vegetation type being sampled. If no grid plots are available, select a plot using random co-ordinates

· If part of the plot includes a fence, natural boundary, or other linear feature

Baseline and coarse -grain recording	Survey as a normal plot, but record that the feature is present on the appropriate forms
Fine-grain recording	Select randomly an alternative grid plot so that the whole of the plot falls within the vegetation type being sampled. If no grid plots are available, select a plot using random co-ordinates

·Woodland monitoring

Seedlings	If more than half a cell is taken up by a mature tree stem, then select an alternative cell using random local co-ordinates

Appendix II. Tree crown classes

1. **Dominant**
   Trees with crowns extending above the general level of the crown cover and receiving full light from above and partly from the side; usually larger than the average trees in the stand, and with crowns well developed but possibly somewhat crowded on the sides

2. **Subdominant**
   Trees with crowns forming the general level of the crown cover and receiving full light from above but comparatively little from the sides; usually with medium-sized crowns more or less crowded on the sides

3. **Intermediate**
   Trees shorter than those in the two preceding classes but with crowns extending into the crown cover formed by dominant and co-dominant trees; receiving a little direct light from above but none from the sides; usually with small crowns considerably crowded on the sides

4. **Suppressed**
   Trees with crowns entirely below the general level of the crown cover, receiving no light either from above or from the sides

5. **Tree**
   A woody perennial plant with a diameter at breast height (dbh; 1.3 m above the ground) >5 cm, typically with a single, well-defined stem carrying a more or less definite crown

6. **Sapling**
   A young tree, no longer a seedling and typically growing vigorously. It has a dbh between 0.5 cm and 5 cm

7. **Seedling**
   A young tree or shrub, grown from seed, from its germination up to the sapling stage, ie with a dbh <0.5 cm

8. **Shrub**
   A woody perennial plant with persistent and woody stem(s). It differs from a tree or sapling, as defined here, in its lower stature and the general absence of a well-defined main stem, ie the side shoots are generally well developed

Specification of results and recording conventions

The measurement variables listed below are those required for each V sampling location at an ECN Site. Sites submitting data to the ECNCCU should refer to the accompanying Data Transfer documentation for the specification of ECN dataset formats, available on the restricted access Site Managers' extranet. Contact ecnccu@ceh.ac.uk if you need access to this documentation.

The first 4 key parameters uniquely identify a sample or recording occasion in space and time, and must be included within all datasets:

• Site Identification Code (e.g. T05)	Unique code for each ECN Site
• Core Measurement Code (e.g. PC)	Unique code for each ECN 'core measurement'
• Location Code (e.g. 01)	Each ECN Site allocates its own code to replicate sampling locations for each core measurement (e.g. for different surface water collection points)
• Sampling Date (/time)	Date on which sample was collected or data recorded. This will include a time element where sampling is more frequent than daily

ECNCCU 2001

Core measurement: vegetation (V Protocol)

Vegetation baseline recording (VB)
Initial survey in first year of monitoring for approximately 400 grid plots and up to 100 'infill' plots over the whole ECN site

Variable	Units	Precision of recording
For each plot		
Site Identification Code		
Core Measurement Code		
Location Code		
Sampling date		
Plot position ID	numeric code[1]	
Plot position type	character code: (G=Grid, I=Infill)	
Grid reference	UK National Grid (m)	1
Altitude	m	10
Plot type	character code S=Standard 2 m W=Woodland 10 m	
National Vegetation Classification	NVC category code[2]	
Species present	'VESPAN'[3] numeric codes	
Plot features present	character codes[4] (eg ditch, wall, bank)	
% plot unsurveyed (eg if obstruction)	%	10

Vegetation coarse-grain recording (VC)
Initially and again every nine years for 50 randomly selected plots from the original grid and infill positions.

Variable	Units	Precision of recording
For each plot		
Site Identification Code		
Core Measurement Code		

Location Code		
Sampling date		
Plot position ID	numeric code[1]	
Land use	Hodgson[5] codes	
Slope	degrees	1
Aspect	degrees	1
Slope form	Hodgson[5] codes	
For each cell		
Cell ID	numeric code[6]	
Species present	'VESPAN'[3] numeric codes	
Cell features present (eg ditch, wall, bank)	character codes[4]	

Vegetation woodland recording (VW)
Initially and again every nine years (except diameter at breast height (dbh) every three years) for those coarse-grain plots falling in scrub or woodland.

Variable	Units	Precision of recording
Site Identification Code		
Core Measurement Code		
Location Code		
Sampling date		
Plot position ID		
Species present	'VESPAN'[3] numeric codes	
Dominance categories	character codes[7]	
For each of ten randomly selected trees		
Species	'VESPAN'[3] numeric codes	
Diameter at breast height (dbh)	cm	0.1
Height	m	0.5
Number of stems (eg if coppiced)	count	1
Distance of stem from centre of random cell	m	0.1
For each of ten randomly selected cells		
Cell ID	numeric code[6]	
Cell co-ordinates	local co-ordinates[6]	
Species of seedling	'VESPAN'[3] numeric codes	
Number of seedlings of each species		

Vegetation fine-grain recording (VF)
Initially and again every three years for at least two random plots in the TSS and two within each NVC type, from the original grid where possible.

Variable	Units	Precision of recording
For each plot		
Site Identification Code		
Core Measurement Code		
Location Code		
Sampling date		
Plot position ID	numeric code[1]	
Land use	Hodgson[5] codes	
Slope	degrees	1
Aspect	degrees	1
Slope form	Hodgson[5] codes	
For each cell		
Cell ID	numeric code[6]	

Cell co-ordinates	local co-ordinates[6]	
Species present	'VESPAN'[3] numeric codes	
Plot features present (eg ditch, wall, bank)	character codes[4]	

Vegetation boundaries recording (VH)
Initially and again every three years for selected vegetation boundary plots.

Variable	Units	Precision of recording
For each plot		
Site Identification Code		
Core Measurement Code		
Location Code		
Sampling date		
Plot position ID	numeric code[1]	
Grid reference	UK National Grid (m)	1
Altitude	m	10
Sketch map of transect profile		
For each transect cell		
Cell ID	numeric code[6]	
Species present	'VESPAN'[3] numeric codes	
Land use	Hodgson[5] codes	
Slope	degrees	1
Aspect	degrees	1
Slope form	Hodgson[5] codes	
Plot features present (eg ditch, wall, bank)	character codes[4]	
For each hedgerow length		
Species present	'VESPAN'[3] numeric codes	

Vegetation: permanent grass (VP)
Four times per year.

Variable	Units	Precision of recording
For each exclusion cage		
Site Identification Code		
Core Measurement Code		
Location Code		
Cage number	numeric code	
Dry matter yield	kg ha^{-1}	1

Vegetation: continuous cereal (VA)
Annually.

Variable	Units	Precision of recording
For each species recording plot (10 m x10 m)		
Site Identification Code		
Core Measurement Code		
Location Code		
Sampling date		
Plot position ID	numeric code[1]	
For each cell		
Cell ID	numeric code[6]	
Cell co-ordinates	local co-ordinates[6]	
Species present	'VESPAN'[3] numeric codes	

For each cereal plot (20-25 m length)		
Plot position ID	numeric code[1]	
Weight of grain	kg ha^{-1}	1
Dry matter yield of straw	kg ha^{-1}	1
For winter wheat crop		
Plot position ID	numeric code[1]	
Date of start of stem elongation (GS 31)		
Date flag leaf emerged (GS 39)		

Recording forms

Fifteen field recording forms have been designed for ECN vegetation monitoring, as listed below; these are available from the CCU. Example recording forms for vegetation baseline monitoring (VB) are provided in Appendix II.

1. Plot position and status information
2. Baseline (VB) species recording
3. Baseline (VB) descriptive information - plots
4. Coarse-grain (VC) species recording (4 sheets)
5. Coarse-grain (VC) environmental information - plots
6. Coarse-grain (VC) descriptive information - cells
7. Fine-grain (VF) species recording (4 sheets)
8. Fine-grain (VF) environmental information - plots
9. Fine-grain (VF) descriptive information - cells
10. Boundaries (VH) species recording (4 sheets)
11. Boundaries (VH) environmental information - cells
12. Boundaries (VH) hedgerow species
13. Woodland (VW) species and dominance
14. Woodland (VW) tree diameter and height
15. Woodland (VW) seedlings

Notes

1. Numbering plot positions: All plot *positions* (for plots and transects) should be given a unique reference number within each ECN site. Different types of plots centred on and recorded at these positions will be referenced by a status code (eg VB, S for Baseline Standard plot)
2. National Vegetation Classification: see Rodwell, J.S. (1991).
3. Species naming and coding
   The recording forms supply the abbreviated names of the 200 most common species in GB (from a GB sample of 11 000 plots surveyed by the ITE Countryside Survey 1990 (Barr *et al.* 1993)). Species names conform to *Flora Europaea*, which should be used as the standard for ECN vegetation recording. Each species has an associated *unique* code number, used by the National Vegetation Classification system (see Malloch 1988 - available from: Institute of Environmental and Biological Sciences, University of Lancaster, Lancaster LA1 4YQ, UK).
   Note that, although the abbreviated names used on the forms are unique within the list of the 200 most common species, they are not necessarily unique for the complete list of all species. A list of the full names and codes of the 200 most common species is supplied in Appendix II with the example vegetation recording forms. A complete list of full names and codes of all species (*c* 4500 records) can be provided by the CCU.
   If a species is found which is not included in the list given on the form, it should be recorded in the 'Other species' section. The code number can be looked up in the complete species list and added later in the laboratory. For those genera whose species are considered difficult to distinguish, the genus name only has been provided on the form. If a surveyor is uncertain in distinguishing between species for a plant, then the 'Other species' section should be used to put down only the genus name.
   The (c), (s), and (g) codes which follow some species on the lists refer to canopy layer, shrub layer and ground layer respectively - different code numbers exist for the different layers. If you find a species which exists on the recording form list, but which is in a different layer, then use the 'Other species' section to record it. For example, a young *Betula pendula* seedling will have to be recorded in the 'Other species' section as 'Betu pendu (g)', as only the canopy layer - 'Betu pendu (c)' - is given in the list on

the recording form. VESPAN codes are also used to record the presence of bare soil, bare rock, litter, dead wood and open water.

4. Feature codes

P=Path	S=Stream
W=Wall	H=Hedge
D=Ditch	N=Natural boundary
F=Fence	X=No feature
B=Bank	

5. Hodgson slope form and land use codes and their descriptions are given in Hodgson (1974). They are summarised as follows.

Slope form
1 Convex
2 Straight (rectilinear)
3 Concave

Land use codes

- *Enclosed farmland*

1 Ley grassland
2 Permanent or long-term grassland
3 Rough grazing
4 Cereals
5 Green crops
6 Root crops
7 Horticultural crops
8 Fallow
9 Other crops (specify)
10 Orchard

- *Semi-natural vegetation, woodland and unenclosed farmland*

11 Deciduous woodland
12 Coniferous woodland
13 Scrub
14 Lowland heath
15 Heather moor
16 Grassland
17 Saltmarsh
18 Fen, moor or bog
19 Montane vegetation

- *Land in other use*

20 Public park
21 Golf course
22 Other (specify)

6. Cells and points within plots

These should be given a local reference number as follows.

Coarse-grain cells (40 cm x 40 cm) within the 2 m x 2 m plots should be labelled from 1 to 25 as shown on the recording form, with 1 being the NW cell, 2 being the next cell to the east, and 25 being the SE cell. These correspond to the 25 numbered columns on the field form.

Fine-grain cells (40 cm x 40 cm) within 10 m x 10 m plots should be centred on randomly selected co-ordinate points (1-24 in X and Y, ignoring the edges of the plot). Each cell should be given a local reference number from 1 to 10 which will then correspond with the numbered columns of the respective recording form. The local co-ordinates referencing the centrepoints of each of the 10 cells within each plot should be provided for the ECN database.

Woodland points and cells within 10 m x 10 m plots should be randomly selected, handled and numbered in the same way as the fine-grained cells described above. (Note that the diagrams on the fine-grain and woodland forms are purely illustrative and in no way indicate the location of the cells or points within the plot.)

Boundary transect cells should be labelled from -n to n, corresponding with the columns of the recording form (cells -10 to +10 have been provided for, so far). Cell 1 should be the 'origin' cell and have one edge as near as possible to the middle of the linear feature or boundary. Cells can be added in future years as boundaries change, and cells labelled using the next positive or negative integer.

7. Woodland dominance categories

C = canopy dominant	U = suppressed	E = seedling
S =subdominant	H = shrub layer	
I = intermediate	A = sapling	