466
Oct 1982

INSTITUTE OF TERRESTRIAL ECOLOGY
(NATURAL ENVIRONMENT RESEARCH COUNCIL

NCC/NERC CONTRACT F3/03/80
ITE PROJECT 466
Final Report to Nature Conservancy Council

THE BIOLOGICAL SURVEY OF BRITISH RAIL PROPERTY

CAROLINE SARGENT

Monks Wood Experimental Station
Abbots Ripton
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"The railways were built with the idea that they would make the countryside more beautiful."

Sir John Betjeman, 1979
BBC Radio Broadcast

SUMMARY

Following the introduction, in which the aims of the project are outlined, a brief review of the literature is given. This has been largely concerned with alien and adventive plants, dispersing with traffic and goods, although more recently the ruderal vegetation of some European station yards has been studied and the ecology of railway embankments in Finland described. The Section continues with a discussion of the railway environment, and selected plant species (complete lists given) are related to particular habitats. Species found during the survey are compared with those mentioned in County Floras. A bias toward grassland plants and bryophytes occurs in the survey lists, whilst the Floras describe more alien and ruderal species. The reasons for this bias are discussed.

In Section 3, the collection of data using a geographical stratification (track classification) of railway land is described. An outline of the stepwise numerical technique developed to handle the very large amounts of information gathered is given, and the classification of 32 defined plant communities discussed in some detail. Several of these communities (*noda*) are unique, and have developed in response to the particular conditions found along railway verges, which are not strictly mimicked elsewhere. The distribution of each *nodum* is given in relation to the track classification, and environmental characteristics are defined.

In the final Section, the selection and distribution of sites of biological interest are described. 185 sites were considered to be biologically outstanding, and these are listed, together with notes on preferred management, in 5 independent appendices designed to be distributed in the 5 BR Regions. The appendices complement detailed site files previously prepared for the NCC. The report concludes with a description of changes in railway vegetation. 265 quadrats first recorded in 1977 were revisited in 1981. A Markov population model has been constructed from this information and predicts the increase in area of fine-leaved grassland. The value of the model is discussed and its implication for the conservation of BR verges considered.

C O N T E N T S

1 INTRODUCTION

This is the final report to the Nature Conservancy Council (NCC) on the survey of British Rail land (BRS). The survey was begun in response to concern about changing vegetation management practices. The use of chemical weed control was questioned in Parliament (Parliamentary debates 1961). To assess the situation, quantifiable information about the resource was needed.

In attempting to provide such information, the Institute of Terrestrial Ecology (ITE) has asked the following questions:

a. How large is the resource? The length of actively used BR line is given by BR as 18 000 km (11 300 miles), although estimates of the area of verge and permanent way (cess) were not available, and measurements have therefore been made.

b. What kind of habitats occur? There are distinct differences between cess and verge; but is the slope, aspect or kind (cutting or embankment) of engineered formation important in determining the distribution of vegetation and animals? What are the important effects of management and disturbance?

c. Does the railway provide a refuge for some plants and animals? What species move along, or are blocked by, this linear environment?

d. What kinds of vegetation occur? Are these associations unique to the railway, or essentially continuous with neighbouring forms?

e. Is the system comparatively stable, or are irreversible changes occurring? Is intervention needed to prevent such change or to protect particular areas?

Six reports have been prepared by ITE for the NCC. A history of railway formations (Sheail 1979) describes the building and maintenance of the habitat. Unfortunately, detailed records of management for any particular stretch of line were not kept, although the general strategy of cutting, clearing and burning is known.

The first interim report (Way & Sheail 1977) outlined the objectives of the work and described a preliminary look at railway land in which selected lengths of line in 3 of the 5 (Eastern, Southern, Western, London Midland and Scottish) BR Regions were walked.

Each of 4 other interim reports (Way *et al.* 1978; Sargent & Mountford 1979, 1980, 1981) deals with a particular BR Region (Southern and Western, of shorter track lengths, being combined). These were surveyed successively during the field seasons of 1977-1980. The interim reports give detailed species information and describe the development and modification of sampling and analysis. A stratification of BR land was introduced during the survey (Sargent & Mountford 1980), and previously surveyed sites were ascribed to this stratification *post hoc*. During 1981, some areas of Eastern, Southern and Western Regions were revisited, enabling an analysis of changes that had taken place to be made, and allowing some previously undersampled areas to be visited.

In this final report, information from all Regions is pooled and analysed. Some general principles are drawn and an attempt is made to answer the questions posed. All plant species and vegetation types found and identified are catalogued. The reader is referred to previous reports for information about animals on railway land. It was not possible, within the resource, to sample populations systematically, and, although all species identified were recorded, no attempt to analyse what are effectively no more than field notes has been made.

2 SPECIES AND HABITATS

2.1 Introduction

Much of the interest in railway botany has been in the study of adventive plants. Whilst describing the flora of Thalkirchen Station (near Munich), Kreutzpointner (1876) gave the earliest account of the introduction of alien species with rail traffic. Thellung (1905) showed that a large proportion of introductions into Switzerland were associated with the railway (which, at that time, carried the greater bulk of goods), although Leymann (1895) had earlier recognised that railways were also interesting from the point of view of the native flora. Working in Latvia, he noted certain meadow species growing along embankments where they had been transported with sod, or soil, during construction. He was able to predict the origin of ballasting materials by the plants he found. Matthies (1925) made an important contribution to railway botany by considering the effects of construction, management, aspect and slope on the distribution of species. Much recent floristic work in Europe has followed this approach (eg Lejmbach *et al* 1965; Lienenbecker & Raabe 1981; Niemi 1969; Westhoff 1964). The literature has been reviewed by Muehlenbach (1979), who also gives a very detailed account of the adventive flora of the St Louis (Missouri) railway yards and tracks.

In Britain, 2 important studies have been made. Dony (1955, 1974) describes the flora of railway lines in Bedfordshire, paying particular attention to adventives and to plants introduced with shoddy for the Luton wool industry, whilst Messenger (1968) has made a careful study of the flora of the railway in Rutland.

Additionally, the majority of County Floras (especially in England and Wales) cite plants from railway habitats. A literature search has been made and a list of all plants recorded from active (lines in use at present) BR land compiled. This list has been compared with species found during the current ITE/NCC BR land survey (Tables 2.3 and 2.4).

1932 phanerogams (including aggregates, species, subspecies and varieties) have been described from BR land. 611 of these are unique to the literature, 807 were confirmed during survey and 214 are newly reported. Cryptogams had been less thoroughly described, and, of the 323 species (pteridophytes and bryophytes only) given in Table 2.4, 52 occur in the literature only, whilst a further 94 records were confirmed during survey and 177 new species have been added to the list. This rather more than doubles the number of cryptogams previously known to occur on railway land.

The majority of records has been stored in a machine-readable form, and computer-generated lists of vascular species were sent to all Botanical Society of the British Isles (BSBI) recorders within whose Vice Counties sampling sites were located. Many recorders kindly checked the lists and marked new Vice County, or 10 km^2, records where appropriate. Where these records have been confirmed, they are given in Tables 2.3 and 2.4.

More than 200 vascular species gave rise to one or more new 10 km records, whilst there are 49 Vice County records (1st or 2nd) and one species new to the United Kingdom (*Hieracium zygophorum*; Sell & West 1980). Additionally, much helpful and interesting information based on local knowledge was received.

This Section begins with a description of railway habitats. Species are then related to the habitats in which they are preferentially found, and the Section concludes with a comparison between survey and County Flora records.

Particular attention is paid to plants growing along the cess (permanent way), as BR safety regulations prevented their systematic recording and hence numerical classification and description (Section 3). Detailed observations were, however, made.

2.2 Habitats

2.2.1 The railway cess

The railway cess is strictly defined as the freely draining area of cindery material over which ballast (the track bed) and rails are laid. The cinder is usually exposed between tracks and in station and shunting yards. For the purpose of this discussion, the sense has been extended to include all engineered railway habitats in which desiccation limits the development and diversity of the flora. These are the stressed habitats (*sensu* Grime 1979) and include, together with cinder, ballast (*in situ* and discarded along verges), masonry and rock cuttings.

Ballast is composed of rock chippings, not usually more than 10 cm (4 inches) in diameter in any one plane. Until recently, limestone was used in some areas; however, attrition levels became unacceptable and granite is now preferred. Ballast underlying rails usually becomes polluted with plant (and sometimes domestic) litter, and with oily and nitrogenous wastes from trains. There is a gradual accretion of fine particled material amongst the chips. Drainage becomes impeded, and, for safety reasons, the ballast is replaced every few years. Spent material is tipped on to adjacent verges.

The term 'masonry' here includes tunnel mouths, bridges, platforms, buildings, and concrete posts and sleepers. Particularly in East Anglia, where natural rock outcrops are scarce, these areas provide habitats which support interesting additions to the flora (Walters 1969; Dony 1974).

Rock cuttings expose a wide variety of surfaces. Where the material is soft or unstable, as with chalk or some shales and sandstones, cuttings are engineered at less than 90°. Elsewhere, the walls may approach vertical. Marked differences are observed between predominantly northern and southern aspects.

As along sand/shingle foreshores, particle size, and hence water retention capacity (Fuller 1975), has a major effect on the kinds of plants that become established. Brandes (1979) has investigated the colloidal capacity of soil samples from railway stations in Eastern Saxony (DDR), and is able to show correlation with vegetation. Hard vertical rock cuttings clearly retain very little water, whilst softer, rotting, or more sloping surfaces have a higher capacity. Newly laid ballast is engineered to be very freely draining. Niemi (1969) has shown comparatively high maximum temperatures and wide diurnal fluctuations on a Macadamised track bed in Finland. It is very likely that a considerable amount of condensation occurs when ballast cools at night. Along verges, spent ballast has a mulching effect, the surface layer inhibiting evaporation from below. The material is often tipped on to existing vegetation, and a damp, nutrient-rich soil may be formed from the dead and decaying plants beneath. The flora in these areas is strongly influenced by the depth of ballast, although the proportions of smaller-particled, organic and chemical materials present will also determine which kinds of plant become established.

Drainage through cinder along the track may become impeded by accumulation of plant litter. In railway yards, cinder is sometimes admixed with brick and rubble, as well as organic materials and oily pollutants. Yards often become compacted by trampling and vehicular movement, and, despite the larger sized fraction, will retain water more efficiently than the looser packed cinder along tracks.

Detailed edaphic measurements are required to expand these observations.

The water balance of the cess is altered when plants become established. Rail traffic safety requires that the track is freely draining and that sight lines are kept open (C Beagley, BRB HQ, personal communication). The track bed and a restricted area of adjacent verge are therefore sprayed with chemical weed killer. This is done annually in early summer from especially adapted trains run by BR or under contract with Chipmans Chemical Co Ltd or Fisons Pest Control Ltd. Vegetation in railway yards is more often controlled by manual application of herbicide - sprays or granules. A list of herbicides currently authorised for use on BR land is given in Table 2.1.

Thus, in many cases, the vegetation on the cess is subject to radical disturbance (management) as well as water stress.

TABLE 2.1 BR approved weedkillers

Verges - Selective	Track, Cess, Yards - Total
Weedkillers approved for use on BR land, 1982	
Picloram	Atrazine
Garlon	Simazine
Diuron	Aminotriazol
2,4-D	Bromacil
Krenite	Sodium Chlorate
	Diuron
	Picloram
	2,4-D
	MCPA
	2-3-6 TBA
Weedkillers discontinued	
2-4-5T	Dalapon
	Borax

2.2.2 Verges

Verges comprise cuttings (positive slopes from the railway line), embankments (negative slopes), and flats. Drainage ditches have been dug at the base of most embankments, whilst cuttings drain more frequently into concrete channels or conduits adjacent to the cess. In some areas, borrow pits, now flooded were dug to provide additional material for embankment building. The construction of slopes is described in the interim report 'The history of the railway formations' (Sheail 1979).

The essential distinction between sloping formations is in the excavation of cuttings and the engineering of embankments, which were built with introduced materials. The difference is reflected in the soil composition and structure: cuttings usually have a mineral soil, characteristic of local drift or solid geological conditions, whilst organic (nitrogenous and oily) train wastes drain on to embankments (and flats). In neither case has the time elapsed since building (very approximately, 100 years) been sufficient for soil profiles to develop fully. The microclimate of embankments in Finland has been investigated by Suominen (1969), who showed that seasonal and diurnal temperature fluctuations were greatest at the top of slopes, where the soil was also most freely draining. The microclimate is modified down slope where the vegetation becomes increasingly closed. Comparable studies have not been made along flat verges or cuttings, although Dony (1974) has shown that a more diverse flora develops on south-facing slopes.

In Britain, spent ballast is tipped on to embankments (and sometimes on flats or cuttings if the slope is not too great). In addition to obvious mechanical disturbance and the removal of sites available for establishment, accumulation of ballast influences the temperature and drainage of the soil, and hence the composition and structure of the vegetation (Section 3).

Verge management has been discussed in several of the interim reports (eg 1977; 1979), and the discontinuance of traditional hand maintenance methods, scything, cutting, controlled burning, was a prime motive for this research: the implication being that the fine, species-rich grassland, likely to have developed after 100 years of such management, was at risk. Since the early 1960s, BR policy has been to cut and clear verges only where a hazard exists, although, recently, labour released by cut-backs in expansion and electrification has been deployed to verge maintenance (C Beagley, personal communication). In particular, scrub and woodland have been cleared from main line cuttings where accumulation of leaf litter on rails has interfered with traction and braking.

A narrow strip (generally less than 3 m) adjacent to the track bed is, however, usually sprayed annually by train with selective herbicides (Table 2.1). The growth retardant Krenite (carbamoyl-phosphonate) was introduced for the purpose during 1980, but has met with little favour, as the cost of running additional spray trains in late summer, when the chemical is most effective, is inhibitive. Until recently, 2-4-5T was used to help control brushwood (usually thorn, ash and bramble), but this is now banned and Picloram and Garlon applied instead.

Ditches are usually more carefully maintained, because the stability, and hence safety, of line depends on adequate drainage. Boundary hedges are also looked after to prevent casual straying by animals or trespassing. In some areas, following complaints from local farmers, rabbit-proof fencing has been installed.

In general, the maintenance of main and overhead electrified lines is of a higher standard than that of branch lines. Cuttings are more frequently cleared than embankments, because of the dangers of falling trees/branches and of leaf litter accumulating on the lines. Trees are encouraged along embankments, where they help stabilise the slope, and have sometimes been planted for this purpose after construction.

2.3 Floristics

Tables 2.3 (phanerogams) and 2.4 (cryptogams) list all species found during the survey and mentioned in the literature search (bibliography, p 64). The nomenclature follows Flora Europaea (vascular plants) or Smith (1978; bryophytes), and the order is as in our recording method (example in Sargent & Mountford 1979), with phanerogams subdivided into grasses, forbs and woody species.

Although pteridophytes were recorded with forbs, they are here more logically placed with bryophytes. Bryological records were only kept during the final 3 years of the survey, whilst lichens, fungi and algae were not systematically recorded. Such species as the dog lichen (*Peltigera canina* (L) Wild) and the edible morel (*Morchella esculenta* L.) which occur on freely draining verges were, however, noted when seen.

Plants recorded in the survey were annotated with habitat information (Tables 2.3 and 2.4, columns 5 and 3 respectively). Each species was ascribed to one of the following classes:

B	= Ballast		**CESS**
C	= Cinder		Stressed environments subject to periodic desiccation and often to intensive management/ disturbance.
M	= Masonry		
R, RC	= Rock, rock cuttings		
YDS	= Yards, station or shunting		
E	= Epiphytic (not included in analysis in Figure 2.1)		
CUT	= Cuttings	SLOPES	**VERGES**
EMB	= Embankments		Environments supporting closed vegetation. Previously scythed/cleared/burnt annually, now sporadically managed. Freely draining to aquatic.
EMB/DIT	= Footings	DITCHES	
DIT	= Ditches		
V	= Verges (indifferent)		

The general category 'verges' was used for plants which showed no distinct preference, or which occurred too infrequently to classify with accuracy. Very often the distinction between well-drained cuttings and embankments becomes obscure.

All phanerogams observed on BR land have been classified further by life cycle (Table 2.3, column 2), distinction being made between annuals and biennials or perennials (following Clapham *et al* 1962).

The proportions of species of different life forms and cycles occurring in the generalized categories, cess and verges are shown in Figure 2.1. The cess flora is discussed first, and the verges are described subsequently.

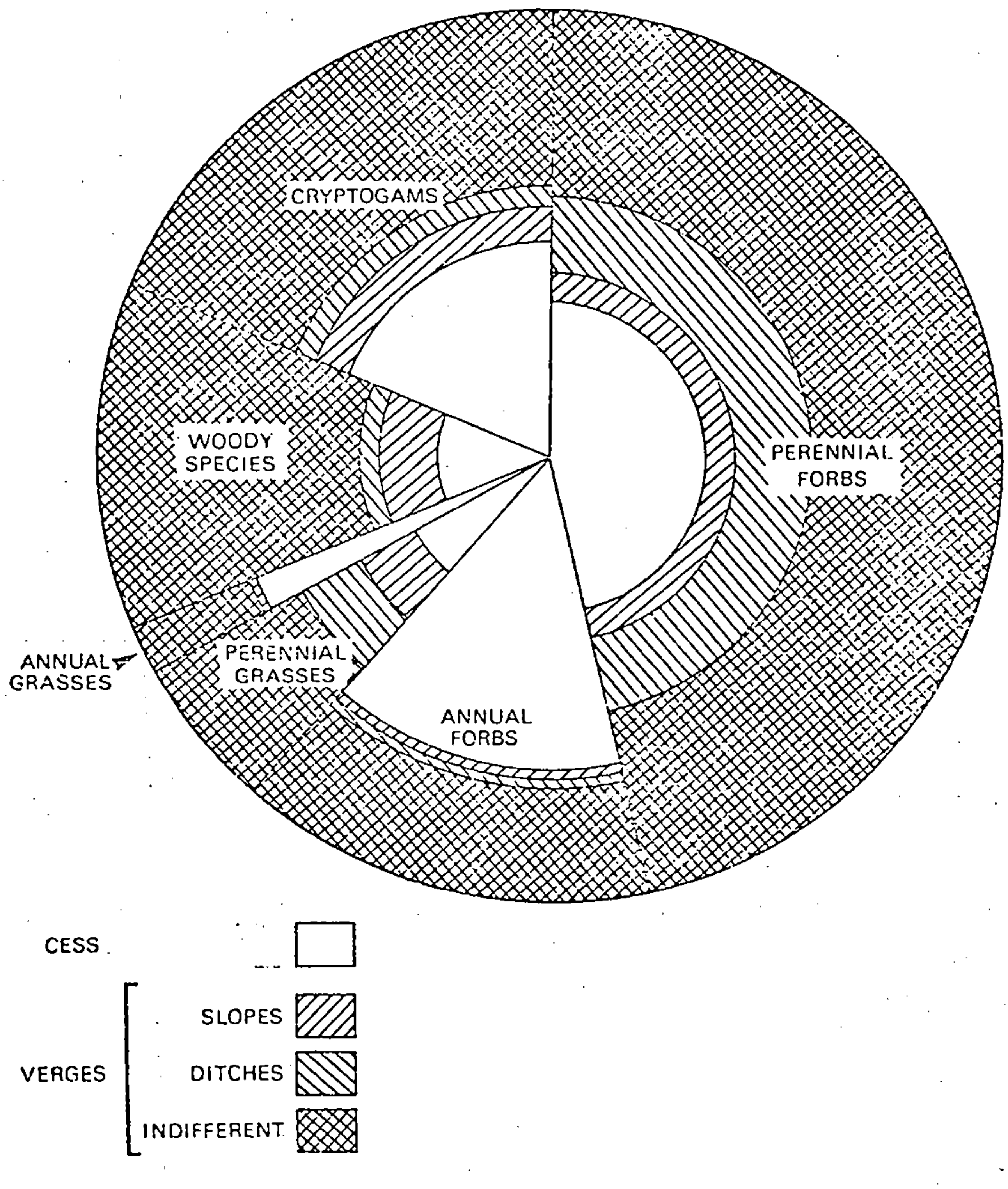
2.3.1 The cess flora

Annuals and cryptogams, 23% of which occur preferentially on the cess (Figure 2.1) are discussed before the less commonly found perennials and woody species. A large proportion of the plants growing on the cess are not native (Figure 2.2), and the section concludes with a discussion about introductions.

2.3.2 Annual species on the cess

Several strategies are adopted by annual plants growing on the cess. Winter annuals are particularly abundant: they are able to complete their life cycles before chemical spraying takes place in early spring. During the desiccating months of high summer, these plants are in a dormant (seed) phase. The most frequent of the winter annuals along cindery verges and track margins are

FIGURE 2.1 The distribution of plants with different strategies within different railway habitats. Each 13.62 mm^2 within the circle represents one species. 1% of species occupies 1.77 cm^2. Total species = 1296.



Erophila verna (flowers March - June) and *Arabidopsis thaliana* (April - May). *Valerianella locusta* (April - June) is also characteristic.

Senecio viscosus (July - September), on the other hand, germinates and flowers after the tracks have been sprayed. This plant is abundant along the cess in late summer and Vice County (93) and 10 km square records indicate that it is actively extending its range into Scottish Region. Another successful tactic is shown by such plants as *Myosotis arvensis* and *Cerastium glomeratum*, which 'hedge their bets' by flowering (and sometimes germinating) from April to September. *S. viscosus* and *A. thaliana* are considered outstanding 'railway species' (*sensu* Almquist 1957), occurring in the category of species mentioned most often in the literature and recorded at more than 5% of survey sites (Table 2.2).

Several local or rare annuals occur on BR land. These include *Dianthus armeria* (July - August), *Linaria supina* (June - September) and *Geranium rotundifolium* (June - July). Although it is recognised that spraying maintains an open, non-competitive habitat, it is clearly very important, if the plants are to survive in this habitat, that the event should be carefully timed. *Chaenorhinum minus* was found considerably less frequently during the survey than would be expected from the large number of records in the literature (Table 2.2). *C. minus* is an annual plant usually found on cinder in, or close to, the track bed. Although it flowers from May to October its life cycle is characterised by spring germination (Arnold 1981), and it seems probable that a large proportion of plants are unable to set seed before being killed by herbicide. In the United States, where spraying usually occurs later in the year, *C. minus* is becoming extremely widespread on railway land (Arnold 1981; Muehlenbach 1980).

A group of annuals, more usually associated with sand dunes and shingle, are also found along the cess. In some cases, these will have spread inland along railway lines, dispersal being helped by traffic. *Cerastium semidecandrum* and *Mysotis ramossissima* occur quite commonly. More rarely, *Erodium cicutarium* and *Anthriscus caucalis* are found. A very small population of *Cochlearia danica* was seen in Eastern Region (Hertfordshire - confirmation of old record) where it was growing in the spray shadow cast by a discarded sleeper. A single site was also found inland on London Midland Region (B125, Snowford Junction), where the plants occurred on an unsprayed siding. It is likely that these are islands - or remnants of a once more continuous population - which spread from coastal areas.

On the less rigorously sprayed and often more compact cinder of yards and sidings, annual grasses, including *Vulpia bromoides*, *V. myuros* and *Aira caryophyllea* (both flowering May - July), occur and are frequently associated with acrocarpous bryophytes and *Cladonia* spp. Where there is more trampling, *Sagina apetala* and *Poa annua* become common.

The most commonly occurring annual on the ballasted track bed is *Geranium robertianum*, which elsewhere is found on shingle as well as in woods and along hedgerows. It is generally frequent on railway land and is an early coloniser of ballast when spraying has been interrupted. *Linum catharticum* grows on cinder, ballast and freely draining verges. It was also recorded from ledges in siliceous rock cuttings in west Scotland, and is clearly not restricted to the calcareous habitats where it is found more generally.

Grime (1979) has shown that the annual strategy is adapted to stressed environments. His findings support the observations that a large proportion of annuals on BR land grow preferentially on the cess.

2.3.3 Cess cryptogams

The life cycle and the habit of some cryptogams also enable successful growth on the cess. Certain acrocarpous, endohydric bryophytes are abundant on cinder. These tolerate desiccation and wide diurnal and seasonal fluctuations in temperature (Richardson 1981). *Funaria hygrometrica* is particularly widespread (Table 2.2), occurring on a great majority of sites. *Bryum argenteum*, *B. caespiticium* and *B. capillare* are also very common, as are *Ceratodon purpureus*, *Barbula convoluta*, *B. unguiculata* and *Polytrichum juniperinum*. It was expected to find the sand dune colonising *Tortula ruraliformis*, but this species proved surprisingly uncommon.

Where drainage is impeded, the thallose hepatic *Marchantia polymorpha* becomes frequent, whilst, in the high rainfall areas of the upland north and west, a very wide variety of bryophytes, including *Dicranella palustris*, *Dicranum scoparium* and *Polytrichum formosum*, occur on cinder track margins. In these areas, *B. argenteum* becomes quite rare.

Horsetails are also common on cinder margins. Their rhizomes penetrate the soil deeply, and the plants show considerable resistance to herbicide (Sargent & Mountford 1979). *Equisetum arvense* is particularly widespread on lines in England and Wales, where its distribution is probably only limited by the dependence of the gametophyte (haploid generation) on adequate surface water for development and fertilisation. In Scottish Region, *E. palustre* and *E. sylvaticum* share the same habitat.

Few cryptogams survive on ballast on the track bed unless regular management is interrupted. Discarded (and hence no longer sprayed) material is colonised by crustose lichens (especially in the west and north), and by acrocarpous bryophytes including *Tortula muralis*, *Grimmia pulvinata*, and, less frequently, *Orthotrichum diaphanum*. *Barbula unguiculata* and others of the cinder group (above) also colonise spent ballast, and *Racomitrium canescens* is frequently found in upland regions.

Where ballast is shaded, pleurocarps occur more often, and, under the 'summer canopy' of rosebay, nettle or false oat grass, *Brachythecium rutabulum* almost invariably covers the stone chips. It is often only absent at, and may be used as an indicator of, sites which have recently been burnt. *Laphocolea bidentata* is a very common associate of *B. rutabulum*.

An interesting bryophyte of the cess in Scottish Region is *Tetraplodon mnioides*. This species was found luxuriantly covering a sheep lying near the track, on to which the sheep had evidently strayed and been killed by a train.

Because resources were limited, it was only possible to record bryophytes systematically from within quadrats. This meant that railway masonry was not adequately explored. However, some rock cuttings were quadratted, and more obvious species on walls and bridges were noted. Bryophytes were almost invariably more luxurious and frequent on north, than on south,facing cutting walls. *Barbula* spp., *Homalothecium sericeum* and *Campylium chrysophyllum* were amongst those species found often in chalk cuttings, whilst *Trichostomun crispulum*, *Seligera calcarea* and *Tortella tortuosa* occurred more frequently on limestone. *Eucladium verticillatum* was noted under the arches of more than one bridge, growing on damp lime-containing mortar.

A greater variety of species were observed on siliceous cuttings, with *Grimmia*, *Tortula* and *Isothecium* spp. being especially common, except on sandstone where *Dicranella heteromalla* became ubiquitous. On flushed or dripping walls, larger foliose hepatics, including *Diplophyllum albicans* and *Gymnocolea inflata*, were often found, whilst the more local *Odontoschisma denudatum* was recorded from Baron Wood (B178), on wet sandstone.

Asplenoid ferns, including *Asplenium trichomanes*, *A. ruta-muraria* and *Ceterach officinarum*, were occasional on rock and masonry. All masonry ferns were less frequent than the literature (especially Walters 1969; Dony 1974) might suggest, possibly because of the complete decline of steam locomotion, which must have produced considerable condensation on tunnel mouths, bridges and platforms, favouring the gametophyte, and hence establishment of such species. *Asplenium viride* was found at one site (R203, Woo Dale).

2.3.4 Cess perennials and woody species

Perennials and woody species occur infrequently on systematically managed areas of the cess (see, however, *Equisetum arvense* above) although plants rooted on the verge may spread runners on to the track margin, where there is less competition. *Potentilla reptans*, *Fragaria vesca* and bramble (*Rubus fruticosus* spp.) were particularly often observed, and the habit is shared by *Hieracium pilosella* and *Ajuga reptans*, which may also successfully produce overwintering rosettes.

These plants are among the early colonisers of spent ballast tips, where, however, false oat grass (*Arrhenatherum elatius*) is very effective. False oat grass is the most common plant of BR land. It is known as a coloniser of limestone scree (Pfitzenmeyer 1962) and of onshore shingle banks (R Fuller, ITE, personal communication). It often forms more or less pure stands on ballast discarded one or two years previously. Adjacent to woodland, or an established source, bramble becomes very competitive, whilst, if the ballast includes a high proportion of cinder or fine grained material, *Chamerion angustifolium* (rosebay) and *Senecio jacobaea* (ragwort) colonise successfully. In upland areas of Scottish Region, where false oat and bramble are not found, colonisation is usually by ragwort. Some crucifers establish on this matrix: in London Midland Region, *Lepidium heterophyllym* was found frequently, whilst *Sinapis*, *Diplotaxis*, *Draba* and *Sisymbrium* spp. are common.

As with seaside annuals, habitat similarities encourage some sand dune and shingle perennials to move inland. *Carex arenaria* has a new Vice-County record for Herefordshire, where it was found growing on a cindery track margin. Both *C. arenaria* and *Saxifraga granulata* were found growing on a cindery track margin on the down side (away from the coast) only of a line in west Scotland, some 16 km (10 miles) inland from a known coastal site. The spread of propagules had presumably been assisted by rail traffic. On less thoroughly managed track beds, a more varied flora has survived. A particularly good example is found on the Isle of Wight, where spray trains are not used. Much of the line has been closed, but the remaining 11 miles between Ryde and Shanklin are maintained manually. The ballast is of small shingle. *Chaenorhinum minus* is frequent on the track and *Senecio squalidus*, having crossed the Solent, has become well established. (The verge flora is also of interest and includes *Pulmonaria longifolia* and *Orobanche hederae*). Spray trains are also absent from the west Wales coast line, being unable, for safety reasons, to cross the causeway at Barmouth. The track flora is not outstanding, although some interesting coastal species occur, including *Catapodium marinum* and *Vicia sylvatica*.

Elsewhere, less used branch lines tend to be of interest. In Southern and Western Regions, *Primula vulgaris*, *Viola riviniana* and *Lathyrus* spp. are often found on the cess, whilst *Epilobium lanceolatum*, *Barbarea verna* and *Linaria repens* occasionally occur. At one site on limestone in north Wales (B180, Graig Fawr), plants growing on the ballast included *Silene nutans*, *Helianthemum canum*, *Minuartia verna* and *Geranium sanguineum*. Although still officially listed as active, this quarry line is seldom used - except as a public footpath!

A small group of perennials with Crassulacean acid metabolism are characteristic of the water-stressed track margin. These include *Sedum reflexum*, *S. acre* and *S. telephium*. *S. roseum* is also common in Scottish Region.

Although many species may germinate on water-stressed ballast and cinder, and up to 22 species have been recorded within one 2 m square quadrat R261, Rigmoor) in early summer, the majority of plants are extremely stunted, and it is clear that the survival rate is low. Where drainage is impeded, however, and water-retaining organic matter accumulates, successional stages from a ruderal tall herb community towards birch and sallow scrub are observed (eg R185, Derby Airport; R282/B200, Bogside). This is particularly characteristic of little used areas of railway yards. Many of the more common species are those most often described in Floras (Table 2.2).

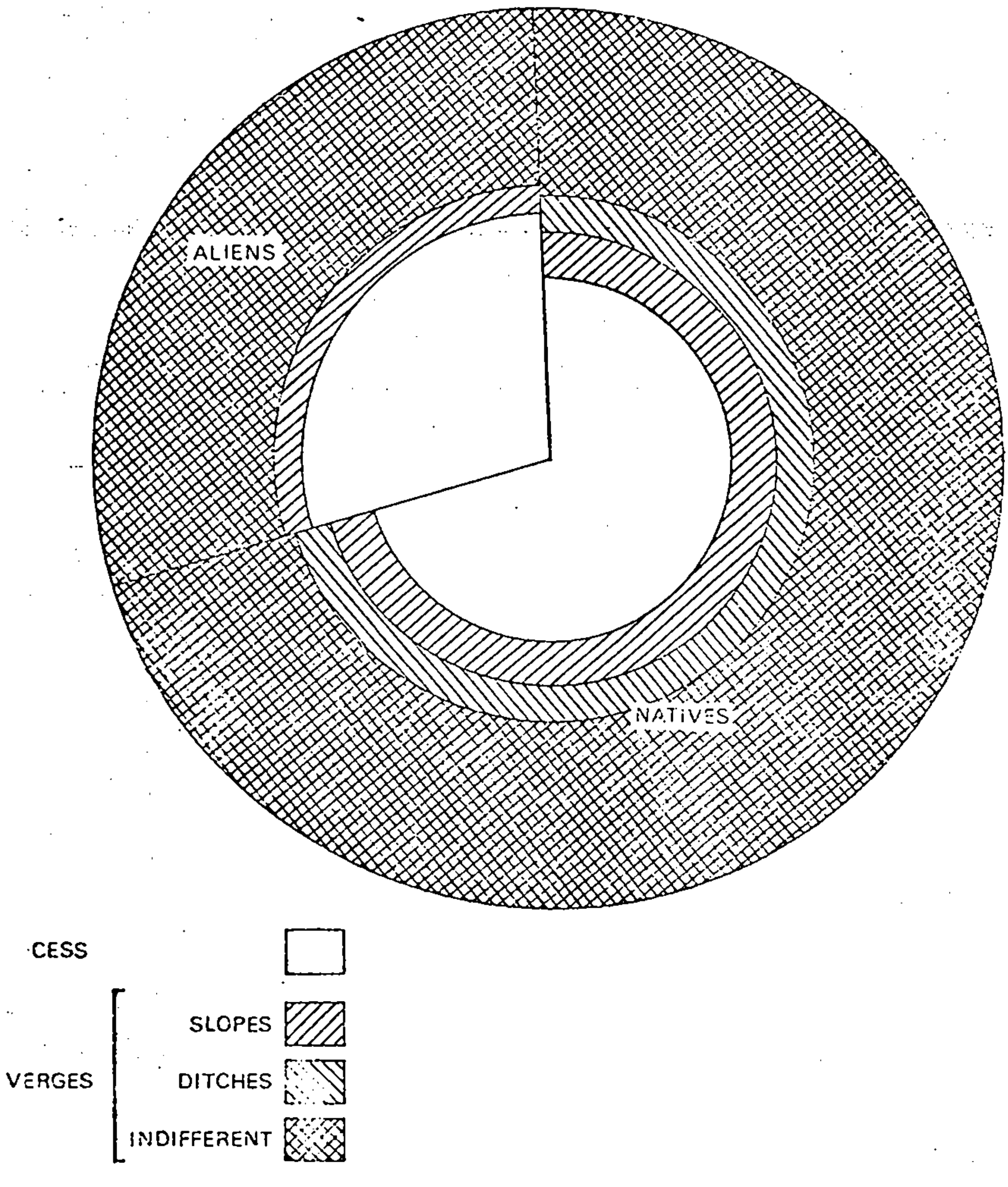
2.3.5 The verge flora

The composition of the verge flora is outlined in Figure 2.1. It is dominated by native perennial species, and includes comparatively few ruderal, annual or alien taxa. The majority of cryptogams are pleurocarpous or epiphytic. Much of the BR verge supports a closed vegetation (*sensu* Grime 1979) of false oat/fescue grasslands, with finer-leaved or species-rich facies occurring on mineral cutting soils, and coarser forms with broad-leaved grasses, and dock, nettle, thistle, rosebay and invasive bramble on embankment slopes. The vegetation at the top of such slopes and on many flat areas adjacent to the track bed is open and disturbed by the tipping of spent ballast (see above). Scrub invasion is widespread (proportions of defined vegetation types are given in Section 3 of this report) and in some areas, particularly towards the west coast and in steep cuttings (where management has not proved practicable), secondary woodland has become established. K Mellanby (personal communication) has suggested that the only area in Britain where secondary woodland is still expanding is along railway verges (used and disused; see, however, Section 4). On flats and embankment slopes, sallow, hawthorn and blackthorn scrub are common, with ash (*Fraxinus excelsior*) occurring remarkably often on colonised (old) ballast tips.

The flora shows considerable regional variation, with, for example, a larger woodland component in the west, and more aquatics on the footings and ditches of embankments crossing arable land in the east.

Species-rich chalk grassland and calcicolous scrub with dogwood (*Cornus sanguinea*) and viburnum (*V. lantana* and *V. opulus*) are common in Southern Region, whilst in Scottish Region *Molinia* grassland and pinewoods occur, with the ground flora including *Vaccinium* spp. or dryopterid ferns. Railway verges provide a refuge for, and in some senses are a microcosm of, the British flora. Almost two-thirds of the native vascular species occur, with only plants such as the pasque flower (*Anemone pulsatilla*) indicative of long established vegetation (Mellanby 1981) and rare or local lowland species (although a number of such were found, Tables 2.3 and 2.4) and aquatic and montane plants being poorly represented. Further study of the bryophyte flora would almost certainly show it to be more diverse.

FIGURE 2.2 The distribution of alien (including adventive, introduced and naturalized) and native phanerogams recorded during survey within different habitats on BR land. Each 17.31 mm^2 within the circle represents one species. 1% of species occupies 1.77 cm^2. Total species = 1021.



Because the variety is so great and the bulk of objective information collected relates to the verges, verge species are not individually described, but are discussed in Section 3, in conjunction with the vegetation types of which they are indicative or characteristic. Localities and habitats of interesting or outstanding species have been detailed in the site files prepared as appendices to previous interim reports (1979; 1980; 1981). These sites are indexed in 5 BR regional appendices to this report.

2.3.6 Alien species

The proportion of alien phanerogams, 29% (Figure 2.2 from data in Table 2.4), on railway land is high. Of those recorded during the survey 32% occurred preferentially on the cess, 8% were found most often on railway slopes, whilst 60% showed an indifferent distribution, or were recorded too infrequently to classify accurately. Only 15% of native plants were found more often on the cess than elsewhere.

The introduction of plants along railway lines has been well studied (p 4 ; Muehlenbach 1979). Particular attention has been paid to the origins of plants and to the goods or packaging materials with which propagules were transported. Species were, for example, classified into citrus, wheat or wool aliens (Thellung 1919), with provenances, respectively, from around the Mediterranean, North America or the Antipodes (Meyer 1931; Kreh 1960). In Britain, Dony (1955) described a flush of shoddy aliens on railway lines in Bedfordshire shortly after the Second World War, when little labour had been available for track management. Many of these were ephemeral (Dony 1974). With the decline of the Luton wool industry and the introduction of chemical herbicides, most aliens have been lost and are now primarily of historical interest. Comparatively few ephemeral or adventive plants were recorded during the survey. Crop species were occasionally noticed, although agricultural seed is seldom now transported by rail. The majority of aliens are species which are physiologically adapted to the hot and desiccating cess, and which have taken advantage of the comparative lack of competition in this open environment.

Many such aliens are garden escapes ("ferroviatic ergasiophygophytes"!); some have been shaken loose from goods or packaging during transport; others casually discarded from carriage windows or dropped by birds perching on associated telegraph wires. Turbulence from rail traffic (first described by Matthies 1926, and recently studied by Arnold 1981) has helped dispersal of some introductions (eg *Senecio squalidus*, Kent 1957; 1960; 1964), whilst others may have become temporarily attached to rolling stock. *Buddleja davidii* is wind-dispersed and rapidly colonises unmanaged yards in southern England, whilst the disjunct records for *Cotoneaster simondsii* in Scottish Region are almost certainly due to the spread of berries by birds. There is some evidence that *Epilobium adenocaulon* has been extending its range on BR land, whilst new Vice County records are claimed for *Barbarea intermedia* (VC 84) and *Bunias orientalis* (VC 75), indicating that these aliens are also spreading. *B. orientalis* is usually restricted to south eastern England (Perring & Walters 1962), although the Rev G Graham (personal communication) has information about a railway site in County Durham, suggesting that the plant may have spread along the east coast main line to its new sites in Scottish Region. However, Graham records that the ballast on which *B. orientalis* is growing came from Hartlepool where "many species were listed as ballast aliens in 1866 by John Hogg".

It is likely that aliens will continue to establish and spread in these stressed habitats, assuming disturbance is not too great. A first UK record has been established for *Hieracium zygophorum* (Sell & West 1980), found by a member (J O Mountford) of the survey team on a cindery track margin.

2.4 Vice County flora and survey records

The floristic tables are annotated with source information for all species taken from the literature. Where there are more than 2 sources, the total number of references is given. This number is, to some extent, an index of the "railwayness" of the plants. *Chaenorhinum minus*, for example, has been considered a typical railway species (Salisbury 1961) and is mentioned in the literature more than 40 times, although it is less frequently found at present. Almquist (1957) defined "railway species" as those plants which "occur remarkably often in the railway flora, or show a preference for, or are locally exclusive to, such a flora" (translated in Niemi 1969). To examine this idea further, an index of the frequency with which species were found during the survey was prepared and a comparison made between the frequency of our observations and the literature records. In making such a comparison the null hypothesis was that species would occur equally frequently in both datum sets.

A total of 901 species was common to survey and literature. All species recorded by us are annotated with one of the following symbols (Tables 2.3, 2.4, columns 4,2 respectively):

R = Rare, found in <1% of random sites or during the subjective (Biological Interest, Section 4) survey only

O = Occasional, found in 1-2% of random sites

C = Common, found in >2-5% of random sites

VC = Very common, found in >5-20% of random sites

U = Found in >20% of random sites

TABLE 2.2 Railway species common to survey and literature

The Table groups, by frequency class, the 896 species common to survey and literature: the large aggregates of *Bryum bicolor*, *Hieracium*, *Rosa canina*, *Rubus fruticosus* and *Taraxacum officinale* which were not identified to species level are omitted. The data are reduced from Tables 1.3 and 1.4, where information about the status of all other species observed less frequently on BR land may be found.

SURVEY SITES	LITERATURE RECORDS > 20	11-20	≤ 10
>20%	*Chamerion angustifolium*	*Equisetum arvense* *Festuca rubra* *Heracleum sphondylium* *Lathyrus sylvestris*	*Arrhenatherum elatius* *Brachythecium rutabulum* *Bryum argenteum* *Ceratodon purpureus* *Cirsium arvense* *Crataegus monogyna* *Dactylis glomerata* *Funaria hygrometrica* *Galium aparine* *Hedera helix* *Holcus lanatus* *Lophocolea bidentata* *Plantago lanceolata* *Poa pratensis* *Rumex acetosa* *Urtica dioica*
5-20%	*Arabidopsis thaliana* *Leucanthemum vulgare* *Linaria vulgaris* *Senecio viscosus*	*Cardamine hirsuta* *Centaurea nigra* *Daucus carota* *Erophila verna* *Fragaria vesca* *Hypericum perforatum* *Lotus corniculatus* *Potentilla reptans* *Tussilago farfara* *Vicia cracca*	31 Species including: 13 Forbs 6 Grasses 5 Woody species 5 Bryophytes (cess acrocarps) 2 Ferns (ground-growing)
<5%	*Cardaria draba* *Chaenorhinum minus* *Convolvulus arvensis* *Diplotaxis muralis* *Echium vulgare* *Fragaria x ananassa* *Lathyrus latifolius* *Linaria repens* *Medicago sativa* *Reseda lutea* *Reseda luteola* *Senecio squalidus* *Valerianella locusta* *Vulpia bromoides* *Vulpia myuros*	103 Species including: 91 Forbs 6 Ferns 3 Grasses 1 Woody species No Bryophytes	712 Species The bulk of less common railway plants recorded by the literature and us. Mainly grassland species and individuals of well-drained soil and cinder.

The hypothesised equivalents between literature and survey records were:

Literature		Survey
1-2	=	R
3-5	=	O
6-10	=	C
11-20	=	VC
>20	=	U

The degree of correspondence in frequency class between coincident literature and survey records is low (x^2 = 118.75, p<0.1). The cases when the survey and County Floras correspond are fewer (316, 35%) than those where the survey (287, 32%) or the Floras (293, 33%) recorded relatively more, ie 65% of frequencies did not correspond.

This lack of correspondence could suggest that the selected frequency categories are not equivalent. However, lack of correspondence would give a bias in one direction only, not the observed, extensive spread in both directions.

In Table 2.2, species in the 2 most frequent classes from each source are compared. Residual data, 877 species, are broadly categorised rather than named.

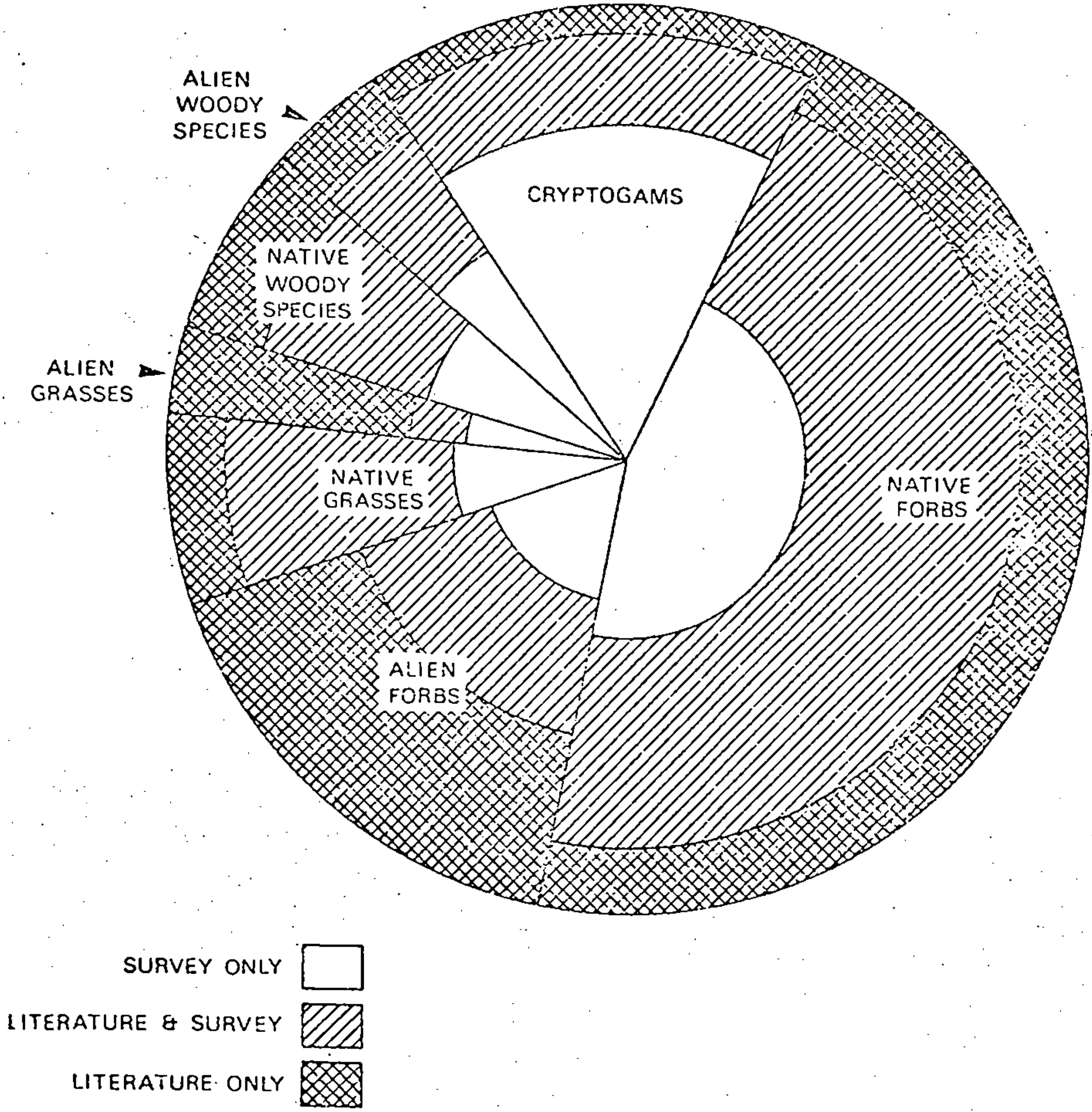
There are 19 species common to the 2 highest frequency classes. They are generally plants of freely-draining grassland, although there is a bias towards ruderals in the literature group. *Chamerion angustifolium* is clearly the "railway species" (*sensu* Almquist) *par excellence*.

The discrepancies within and between the classes are due, in part, to the differing scopes of investigations. Restricted access (BR land is private property and trespassing is dangerous and carries the risk of a substantial fine) has limited much previous botanical work to station and shunting yards, whilst the present remit (with co-operation from BR) has been to survey rural railway verges.

However, several of the plants, which were recorded during survey less frequently than expected, are declining because of changing railway management practices. *Chaenorhinum minus* (p. 10) and *Convolvulus arvensis* are good examples. *C. arvensis* is abundant on the Isle of Wight railway where spray trains are not in use. With the passing of steam, many saxicolous ferns have become less widespread on railway masonry. Other plants, eg *Senecio squalidus* and *Diplotaxis muralis*, have had their dispersal along railway lines well documented (Kent 1957, 1960, 1964; Powell 1931), and may consequently have been rather more zealously included, or overrated, in County Floras, whilst a further group, including *Reseda* spp. and *Vulpia* spp., are more characteristic of cinder flats and railway yards than of the rural verges on which the survey was focused.

Examination of the full list (Tables 2.3, 2.4; Figure 2.3) of plants occurring more frequently in the literature shows that there is a general bias towards introduced and naturalised species and towards some taxonomically difficult

FIGURE 2.3 The proportions of phanerogams and cryptogams found on BR land during the survey and reported in the literature. The species data are given in Table 2.3 and 2.4. Each 9.03 mm^2 within the circle represents one species. 1% of species occupies 1.77 cm^2. Total species = 1955.



groups which have been the particular interest of one or more authors. There is also a tendency for larger, or more showy plants, eg *Verbascum* spp. and *Melilotus* spp. which may be seen from railway carriage windows, to be more thoroughly documented. Railway coverage tends to be more extensive in Floras of southern and eastern Britain, and there is some emphasis on plants with such a preferred distribution within this area, eg *Kickxia* spp. and *Lactuca*. This may, however, also be due to the comparative continentality of the railway environment.

In the survey, on the other hand, more emphasis is placed on grassland and woodland species, and systematic recording produced many more records for inconspicuous and common plants. In particular, no bryophytes have more than 4 literature records and several grassland species very commonly found during survey, eg *Eurynchium praelongum, Rhyncostegium confertum, Rhytidiadelphus squarrosus* and *Plagiomnium undulatum*, are not mentioned at all.

41% of all non-rare grasses were recorded more frequently during survey (*Arrhenatherum elatius* occurred at >70% of random sites), whilst much higher abundance is assigned to species of *Carex* (19 out of 23 non-rare), *Juncus* (9 out of 11), *Luzula* (all 4 non-rare) and *Rumex* (5 out of 9).

Plants whose range seems to be actively expanding are also more highly rated in the survey, eg *Epilobium brunnescens, E. adenocaulon, Cotoneaster simonsii* and *Rhododendron ponticum*.

The species list for the survey shows that BR land includes more, and varied, grassland, woodland and moorland than an inspection of County Floras, biased toward station yards and the railway cess, would suggest.

TABLE 2.3 Higher plants on British Rail land

The Table combines information from a literature search for species recorded growing in railway habitats with a complete list of plants found during the BR survey. The sources (or number of sources, where there are more than 2) are given for each species from the literature, whilst survey plants are annotated with habitat and frequency information. Status and life cycles are noted (see text - for discussion). The plants are listed-alphabetically, although, following our recording procedures, grasses and woody plants are separated from forbs. Keys to abbreviations and to the literature searched will be found following Table 2.4.

GRASSES

Species	Status	Life Cycle	Frequency Recorded During Survey	Habitat	VC Records	Flora Records
Agrostis avenacea	INT	P				BEDS
Agrostis canina/vinealis		P	O	V	O	3
Agrostis gigantea		P	O	V		6
Agrostis lachnantha	INT	P				BEDS
Agrostis scabra	INT	P				SURREY
Agrostis stolonifera		P	C	V	O	7
Agrostis curtisii		P	O (WR)	CUT/V		
Agrostis capillaris		P	VC	CUT/V		8
Aira caryophyllea		A	O	C		14
Aira praecox		A	C	C	O	7
Alopecurus geniculatus		P	R	DIT		TEVIOT
Alopecurus myosuroides		A	R	V		4
Alopecurus pratensis		P	C	V		5
Ammophila arenaria		P	R	YDS	O	WARWKS
Anthoxanthum odoratum		P	VC	V	O	7
Anthoxanthum puelii	INT	A				S. LANCS
Apera interupta		A				RUTLAND
Apera spica-venti		A	R (ER)	C		5
Arrhenatherum elatius		P	U	V		10
Avena fatua	NAT	A	R	B		7
Avenula pratensis		P	O	V	O	5
Avenula pubescens		P	C	V/C	O	11
Beckmannia eruciformis	INT					MONMOUTH
Brachypodium pinnatum		P	C (ER)	CUT/V	O	9
Brachypodium sylvaticum		P	C	V		6
Briza maxima	INT	A	R	B		BERKS
Briza media		P	O	V		5
Briza minor	INT	A				SUSSEX
Bromus arvensis var velutinus	INT	A				SUSSEX
Bromus commutatus		A/B				DERBYS
Bromus diandrus	INT	A				3
Bromus erectus		P	C	V	44(2),45(3),O	14
Bromus erectus var villosus		P				SUSSEX
Bromus inermis	INT	P	R	V	7(3),O	4
Bromus lepidus	INT	A/B				3
Bromus madritensis	INT	A				4
Bromus madritensis var ciliatus	INT	A				BEDS
Bromus molliformis	INT	A				BEDS
Bromus hordaceus sl		A/B	O	V		
Bromus hordaceus ss		A/B				7
Bromus hordaceus var contractus		A				LEICS, RUTLAND
Bromus hordaceus var leiostachys		A				GLOUCS
Bromus x pseudothominii		A				5
Bromus racemosus		A/B	R	V		MDDX
Bromus ramosus		P	O	V	O	4
Bromus rigidus	INT	A				ESSEX
Bromus rubens	INT	A				BEDS, MORAY
Bromus secalinus	NAT	A/B				HERTS, S. LANCS
Bromus sterilis		A/B	O	V/C		5
Bromus willdenowii	INT	A		V		3
Cortaderia selloana	INT	P	R(WR)	YDS		

Species	Status	Life Cycle	Frequency Recorded During Survey	Habitat	VC Records	Flora Records
Calamagrostis canescens		P	R (ER)			3
Calamagrostis epigejos		P	O	DITCH/V		6
Catabrosa aquatica		P				3
Chloris truncata	INT	P				BEDS
Chloris virgata	INT	P				BEDS, SOMERSET
Cynodon dactylon	NAT	P	R (WR)	V		
Cynosurus cristatus		P	O	V	O	3
Cynosurus echinatus	INT	A				NOTTS, GLOUCS
Dactylis glomerata		P	U	V		9
Dactyloctenium radulans	INT	P				BEDS
Danthonia decumbens		P	O (LMR, ScR)	CUT/V		5
Deschampsia caespitosa		P	C	EMB/DIT/V		7
Deschampsia flexuosa		P	C	CUT/V/C		5
Desmazeria marina		A	R (LMR)	M		MERION
Desmazeria rigida		A	R	C		17
Desmazeria rigida x D marina		A				MERION
Digitaria sanguinalis	INT	A				4
Eleusine indica	INT	A				BEDS
Elymus caninus		P	R	V	O	TEVIOT, RUTL
Elymus farctus		P	R	V		
Elymus repens		P	VC	EMB/V		6
Eragrostis cilianensis	INT	P				BEDS, YORKS
Eragrostis dielsii	INT	P				BEDS
Eragrostis parviflora	INT	P				BEDS
Festuca arundinacea		P	C	V/C	O	7
Festuca arundinacea subvar orientalis		P				WILTS
Festuca gigantea		P	O	V		3
Festuca heterophylla	INT	P				WARWKS
Festuca longifolia	NAT	P	R	V	32 (2)	8
Festuca ovina		P	C	V	O	5
Festuca ovina var hispidola		P				BEDS
Festuca ovina ssp tenuifolia		P	R	V	O	3
Elymus pycnanthus		P	R	V		
Festuca pratensis		P	R	V		5
Festuca rubra		P	U	V	O	13
Festuca rubra ssp commutata		P	R	V		3
Festuca rubra var barbata		P				ESSEX
Festuca rubra var glaucescens		P				NORFOLK
Festuca rubra var megastachya		P				WILTS
Festuca vivipara		P	O (LMR/ScR)	V		
X Festulolium loliaceum		P				RUTL
Glyceria fluitans		P	R	DIT		DERBYS
Glyceria maxima		P	C	EMB/DIT/V		DERBYS
Glyceria plicata		P	R	DIT		GLOUCS
Holcus lanatus		P	U	V		9
Holcus mollis		P	VC	V	O	5
Hordeum distichon	INT	A				MORAY
Hordeum hystrix	INT	A				BEDS
Hordeum leporinum	INT	A				BEDS
Hordeum marinum		A	R	V/C		BEDS
Hordeum murinum		A	O	B		6
Hordeum secalinum		P	R (ScR)	V		MDDX
Hordeum vulgare	INT	A	O	V	O	MDDX, LEICS
Koeleria macrantha		P	O	V		BEDS, WARWKS
Koeleria phleoides	INT	A				BEDS
Hordelymus europaeus		P	R	V		

GRASSES

Species	Status	Life Cycle	Frequency Recorded During Survey	Habitat	VC Records	Flora Records
Leymus arenarius		P	R	V/C		S. LANCS
Lolium perenne ssp multiflorum	INT	A/B				6
Lolium perenne ssp perenne		P	O	V		5
Lolium perenne var sphaerostachyum		P				LEICS
Lolium p perenne x L. p multiflorum		A/P				GLOUCS
Lolium temulentum	INT	A				BEDS
Melica uniflora		P	O	V		
Melica nutans		P	R (WR/ER)	V		MONM
Milium effusum		P	R	V		SUSSEX
Molinia caerulea		P	C (ScR)	V		4
Nardus stricta		P	O (LMR/ScR)	V/C		3
Panicum psilopodium	INT	P				GG
Phalaris arundinacea		P	C	DIT/V		GG
Phalaris arundinacea var arundinacea		P				TEVIOT
Phalaris arundinacea var picta	INT	P				TEVIOT
Phalaris canariensis	NAT	A	R	B		DERBYS, LEICS
Phalaris paradoxa var appendiculata	INT	A				BEDS
Phleum pratense ss		P	O	V		5
Phleum pratense ssp bertolonii		P	R	V		7
Phleum bertolonii var stolonifera		P				GLOUCS
Phragmites australis		P				4
Phragmites communis		P	C (ER)	EMB/DIT/V		
Poa angustifolia		P	VC	V	27(3), 45, 46(2), 52, 62, 67, 68, 96, 0	10
Poa annua		A	O	V/C		5
Poa chaixii	NAT	P	R (SR)	CUT		
Poa compressa		P	C	V/C/R(	O	13
Poa nemoralis		P	C	V	O	3
Poa palustris	NAT	P				ESSEX, MDDX
Poa pratensis ss		P	U	CUT/V		10
Poa subcaerulea		P	C (ScR)	V		5
Poa trivialis		P	VC	V	O	7
Puccinellia distans		P	O	EMB/DIT		
Puccinellia fasciculata		P				LONDON
Puccinellia maritima		P	O	V/C		
Rhynchelytrum villosum	INT	A				BEDS
Secale cereale	INT	A				MORAY
Setaria italica	INT	A				BEDS
Setaria lutescens	INT	A				4
Setaria verticillata	INT	A				BEDS
Setaria viridis	INT	A				SUSSEX, L'POOL
Trachynia distachya	INT					BEDS
Tragus australiensis	INT	P				BEDS
Tragus berteronianus	INT	P				BEDS
Tragus koeleroides	INT	P				BEDS
Tragus racemosus	INT	P				BEDS
Triticum aestivum	INT	A	R	B		KIRK
Trisetum flavescens		P	C	V/C		9
Vulpia bromoides		A	C	V/C	O	21
Vulpia ciliata	INT	A				SUSSEX
Vulpia megalura	INT	A				3
Vulpia membranacea		A	R (WR)	V/C		ESSEX
Vulpia myuros		A	O (WR)	V/C	O	28
Vulpia unilateralis		A				DERBYS
Sesleria caerulea		P	O(MR)	CUT		
Spartina anglica		P				
Spartina x townsendii		P	R	DIT		

Species	Status	Frequency Recorded During Survey	Habitat	VC Records	Flora Records
Acer campestre		C	V		3
Acer platanoides	INT	O	V	O	1
Acer pseudoplatanus	NAT	C	V		3
Aesculus hippocastanum	INT	O	V		3
Ailanthus altissima	INT				LONDON
Alnus glutinosa		O	DIT		TEVIOT, GG
Arctostaphylos uva-ursi		R. Sc.R	CUT		
Berberis vulgaris		R	V		RUTL
Betula pendula		VC	V		5
Betula pubescens		C	V	O	6
Bryonia dioica		O	V		3
Buddleja davidii	NAT	O SR, WR	YDS		6
Calluna vulgaris		O (C, Sc.R)	V		8
Calystegia-sepium ssp pulchra	INT	O	YDS		7
Calystegia sepium ssp		C	V/C/B		4
Calystegia sepium f roseata					LONDON
Calystegia sepium sspsilvatica	NAT	R	YDS		8
Calystegia soldanella	INT	R, WR	V		
Carpinus betulus		R	V		3
Clematis vitalba		C	V		
Colutea arborescens	NAT	R		O	9
Cordyline australis	INT	O	YDS		
Cornus sanguinea		C	V		4
Cornus sericea	NAT	R, Sc.R	YDS		MORAY
Corylus avellana		C	V		5
Cotoneaster horizontalis	NAT	R	M	O	SURREY
Contoneaster microphyllus	NAT	R	CUT		6
Cotoneaster simonsii	NAT	O	YDS		TEVIOT
Crataegus laevigata		O	V		RUTL
Crataegus x medium					RUTL
Crataegus monogyna		U	V		8
Cytisus davidii	INT				GG
Cytisus multiflorus	INT				SURREY
Cytisus scoparius		C	V		19
Daphne laureola		R	V		RUGBY
Empetrum nigrum		O	V		
Erica cinerea		O	V		3
Erica lusitanica	INT	R, WR	V		
Erica tetralix		C	V		TEVIOT, GG
Euonymus europaeus		R, WR	V		
Escallonia macrantha	NAT	R	CUT		
Ficus carica	INT	R	CUT		5
Frangula alnus		R	V		
Fraxinus excelsior		VC	V, B		7
Gaultheria shallon	INT	R, Sc.R	CUT		
Genista anglica		R	V		DERBYS, TEVIOT
Genista tinctoria		R, ER, WR	V (CUT)		6
Hedera helix		U	V		6
Hippophae rhamnoides	NAT	O	YDS	76(2)	MORAY
Humulus lupulus		O	V	O	3
Hydrangea sp.	INT	O	YDS	O	
Hypericum calycinum	NAT	R	V	O	5
Hypericum hircinum	NAT	O	YDS		3
Abies grandis	'NAT	R	V		
Castanea sativa	NAT	R	V		
Chamaecyparis lawsoniana	INT	R	V	O	
Halimione portulacoides		R	V		

WOODY SPECIES

Species	Status	Frequency Recorded During Survey	Habitat	VC Records	Flora Records
Ilex aquifolium		C	V		3
Juglans regia	INT	R, WR	V		4
Juniperus c communis		R, ScR	CUT		HERTS
Laburnum anagyroides	NAT	R	V	2	5
Lavatera arborea		R	V	0	
Larix decidua	NAT	O	V	0	3
Ligustrum ovalifolium	INT	R	YDS	78, 0	
Ligustrum vulgare		C	V	0	7
Lonicera periclymenum		C	V		4
Lupinus arboreus	NAT	O	V	0	4
Lycium barbarum		O	M		5
Mahonia aquifolium	NAT	O	V		5
Malus sylvestris		R	V	0	6
Malus sylvestris ssp mitus	NAT	O	V		DERBYS
Ononis repens		O	V	0	17
Ononis spinosa		R	V		8
Parthenocissus quinquefolia	INT				NORFOLK, BERKS
Parthenocissus tricuspidata	INT	R, WR	M		
Parthenocissus vitacea	INT				ESSEX
Picea abies	INT	R	V		3
Picea sitchensis	INT	R	V	0	
Pinus sylvestris	INT	O	V		4
Pinus radiata	INT	R, WR	V	0	
Pinus nigra	INT	R, LMR	V		
Populus alba	INT	R	V		3
Populus x canadensis	INT	O	V	0	WARWKS, TEVIOT
Populus x canadensis var serotina	INT	O	V		GLOUCS
Populus canescens					DERBYS
Populus x gileadensis	INT	R, WR	V	0	
Populus nigra					BEDS
Populus nigra var italica	INT				WARWKS
Populus tremula		C	V		3
Potentilla fruticosa					GLOUCS
Prunus avium		R	V		3
Prunus cerasifera	INT	R	V		RUTL
Prunus cerasus	INT				ESSEX, S. LANCS
Prunus domestica	INT	O	V	0	4
Prunus laurocerasus	INT	O	V	0	GC/SOMERSET
Prunus padus		R	V		SUSSEX, TEVIOT
Prunus spinosa		O	V		5
Prunus spinosa var macrocarpa					GLOUCS
Pseudotsuga menziesii	INT	R, WR,	EMB	0	
Pyrus pyraster		R	V	5 (3)	ESSEX, SUSSEX
Quercus cerris	INT	C	V		3
Quercus ilex	NAT	R	V	0	MDDX
Quercus petraea		C	V	0	3
Quercus robur		VC	V		5
Quercus x rosacea		R	V		LEICS
Myrica gale		R	V		
Philadelphus coronarius	INT	R	YDS		SOMERSET
Pyracantha coccinea	INT				SUSSEX
Rhus typhina	INT	R	V		

WOODY SPECIES

Species	Status	Frequency Recorded During Survey	Habitat	VC Records	Flora Records
Rhamnus catharticus		R	V		3
Rhododendron ponticum	NAT	O	CUT		MORAY
Ribes nigrum		R	V	O	WARWKS, MDDX
Ribes rubrum		O	V	O	3
Ribes sanguineum	NAT	R	YDS		4
Ribes uva-crispa		R	V	O	4
Robinia pseudoacagia	INT				LONDON, MDDX
Rosa afzeliana					MORAY
Rosa arvensis		C	V		3
Rosa blanda					L'POOL
Rosa canina ss		O, SR Sc.R	V		
Rosa coriifolia					MORAY
Rosa dumalis					TEVIOT
Rosa canina sl		VC	V		LEICS, MORAY
Rosa dumetorum var typica					STAFFS, GLOUCS
Rosa micrantha					ESSEX
Rosa x molliformis					MORAY
Rosa pimpinellifolia		O	V		TEVIOT
Rosa rubiginosa	NAT	O Sc.R	V		3
Rosa rugosa		O	V		
Rosa sherardii		O	V		TEVIOT
Rosa tomentosa		R	V	45 (2)	3
Rosa stylosa		R	V	54	
Rosa villosa ss		C	V		5
Rosa villosa var mollis					STAFFS, MORAY
Rubus caesius		O	V	75	6
Rubus caesius x r ulmifolius					GLOUCS
Rubus cambrensis					GLOUCS
Rubus conjugans					MORAY
Rubus discolor					MDDX
Rubus dumetorum					3
Rubus echinatoides					WARWKS
Rubus falcatus					RUTL
Rubus fruticosus sl		U	V,C,B		19
Rubus gratus		Sc.			S. LANCS
Rubus idaeus		C (VC,SR)	V,B		6
Rubus iodnephes					LONDON
Rubus latifolius					MORAY, GG
Rubus leptothyrsos (R. danicus)					MORAY
Rubus parviflorus	INT				SURREY
Rubus polyanthemus					LEICS
Rubus radula					LEICS
Rubus rhombifolius					DEVON
Rubus saxatilis		R	V		
Rubus scaber					STAFFS
Rubus scissus					DERBYS, MORAY
Rubus sublustris					DERBYS
Rubus thyrsiger					DEVON
Rubus ulmifolius		R	V		WILTS
Ruscus aculeatus		R	V		
Salix alba		O (C,WR)	DIT		RUTL, TEVIOT
Salix x ambigua					S. LANCS
Salix aurita		C	V		3
Salix caprea		VC	V	O	7
Salix x capreola					ESSEX, HAYLEY
Salix cinerea ssp oleifolia		C	V		9
Rubus dissectifolius	NAT	R	V		
Rubus spectabilis	NAT	R	V		

WOODY SPECIES

Species	Status	Frequency Recorded During Survey	Habitat	VC Records	Flora Records
Salix daphnoides	NAT				S. LANCS, MORAY
Salix decipiens		R	V		NOTTS
Salix fragilis		C	DIT	0	
Salix x laurina		R, LMR	CUT		
Salix x meyerana					NOTTS
Salix nigricans					TEVIOT
Salix pentandra		R,Sc.R	DIT		TEVIOT, GG
Salix phylicifolia		R,Sc.R	V		MORAY
Salix purpurea		R	V	0	4
Salix x reichardtii					DURHAM
Salix repens ssp repens		O	V		
Salix repens ssp argentea		R	V/C		MORAY
Salix x rubens					SUSSEX
Salix x sericans					GLOUCS, TEVIOT
Salix x smithiana					6
Salix x strepida					MORAY
Salix x tenuifolia					TEVIOT
Salix triandra		R	DIT		ESSEX
Salix triandra var hoffmaniana					RUGBY
Salix viminalis		O	DIT	0	5
Sambucus canadensis	NAT				DERBYS
Sambucus ebulus					CAMBS, ESSEX
Sambucus nigra		C	V		
Sambucus nigra var laciniata					SUSSEX, MORAY
Sambucus nigra var viridis					MORAY
Sambucus racemosa	NAT				TEVIOT, GG
Sorbus aria ss		O	V		RUTL, TEVIOT
Sorbus aucuparia		C	V		4
Sorbus latifolia ss		R, LMR	CUT		MORAY
Spartium junceum	INT	R, ER			GLOUCS, MDDX
Sorbus intermedia		R	V	63	
Spiraea douglasii	INT				GG
Spiraea salicifolia	NAT	O	V		4
Symphoricarpos rivularis	NAT	O	V	0	8
Syringa vulgaris	NAT	O	V	32(2), 0	RUTL, GG
Tamarix gallica		R	V		
Tamus communis		C	V		4
Taxus baccata		O	V		GLOUCS
Tilia cordata		O	V		
Tilia platyphyllos		R, WR	V		
Tilia x vulgaris	NAT	R, ER	V		RUTL, TEVIOT
Ulex europaeus		C	V		12
Ulex gallii		O	V		LEICS
Ulmus carpinifolia		C	V	0	GLOUCS, HAYLEY
Ulmus glabra		C	V	0	TEVIOT, GG
Ulmus x hollandica . var vegeta	NAT				WARWKS
Ulmus plotii					GLOUCS
Ulmus procera		R	V		
Vaccinium myrtillus		C	V		NORFOLK, TEVIOT
Vaccinium vitisidaea		R	V		
Viburnum lantana		C	CUT	0	5
Viburnum opulus		C	V	0	5
Vinca major	INT	R	V		5
Vinca minor	NAT	O	V		3
Vitis vinifera	INT				BERKS
Sorbus lancastriensis		R, LMR	R		
Vaccinum oxycoccus		R, Sc.R	V		

FORBS

Species	Status	Life Cycle	Frequency Recorded During Survey	Habitat	VC Records	Flora Records
Abutilon theophrasti	INT	A				YORKS
Acaena novae-zealandiae	NAT	P				BEDS
Achillea millefolium		P	VC	V		10
Achillea ptarmica		P	C	V		7
Achillea tomentosa	INT	P				GLOUCS
Acinos arvensis		A	O	V	O	12
Aconitum compactum	INT	P				GG
Aconitum napellus sl		P	O	V	O	DERBYS, MORAY
Adoxa moschatellina		P	C	V		TEVIOT, MORAY
Aegopodium podagraria	NAT	P	C (LMR, SR)	EMB, B		TEVIOT
Aethusa cynapium		A	O	V		3
Agrimonia eupatoria		P	C	EMB, DIT, V		8
Agrimonia procera		P				WILTS
Agrostemma githago	NAT	A				MORAY
Ajuga reptans		P	C	CUT, V, B		4
Alchemilla filicaulis ssp vestita		P	R	V		5
Alchemilla glabra		P	C	CUT, V		TEVIOT, GG
Alchemilla xanthochlora		P	O	CUT, V		3
Alchemilla vulgaris sl		P				SUSSEX
Alisma plantago aquatica		P	R (ER)	DIT		SUSSEX
Alliaria petiolata		B	C	V		6
Allium oleraceum		P				WARWKS
Allium scorodoprasum		P	R (LMR)	V		
Allium triquetrum	NAT	P	R	V		
Allium ursinum		P	O	V		TEVIOT
Allium vineale		P	O	V		7
Allium vineale var compactum		P				NORFOLK, PEMBROKE
Allium vineale var vineale		P				WILTS, GLOUCS
Althaea rosea	INT	B	R	V		4
Alyssum alyssoides	INT	A				7
Alyssum argenteum	INT	A				WILTS
Amaranthus hybridus var chlorostachys	INT	A				BEDS
Amaranthus retroflexus	INT	A				5
Amaranthus thunbergii	INT	A				BEDS
Ambrosia artemisifolia	INT	A				WILTS
Ambrosia trifida	INT	A				S. LANCS
Ammi majus	INT	A				3
Amsinckia hispida	INT	A				S. LANCS
Amsinckia intermedia	NAT	A	R	C		LEICS
Amsinckia lycopsoides	INT	A				DERBYS
Anacamptis pyramidalis		P	O	CUT	O	7
Anagallis arvensis		A	C	B		
Anagallis arvensis ssp arvensis		A	R	B		GG
Anagallis arvensis ssp arvensis var coerulea		A				MORAY
Anagallis arvensis ssp foemina		A				DERBYS, GG
Anagallis tenella		P	O	V		
Anaphalis margaritacea	NAT	P	R	V		7
Anchusa arvensis		A/B	C	CUT		5
Anchusa officinalis	INT	A				SUSSEX, LOND
Anemone nemorosa		P	C	V		4
Angelica archangelica	NAT	P				SUSSEX, LEICS
Angelica sylvestris		P	VC	V/EMB/B	O	TEVIOT, GG
Acanthus mollis	INT	P	R	V	22	
Achillea distans spp tanacetifolia	INT	P				SOMERSET
Alchemilla alpina		P	R	U		

FORBS

Species	Status	Life Cycle	Frequency Recorded During Survey	Habitat	VC Records	Flora Records
Anthemis arvensis		A	O	V/C		4
Anthemis cotula		A	O	V/C		S. LANCS, MORAY
Anthemis cupiana	INT	A	R (WR)	V/C		
Anthemis tinctoria		B/P				5
Anthemis tinctoria var discoidea		B/P				SURREY
Anthriscus caucalis		A	R (ER)	B		5
Anthriscus cerefolium	NAT	A				BERKS
Anthrisucs sylvestris		B/P	VC	V, EMB		9
Anthyllis vulneraria		P	C	V, CUT		
Anthyllis vulneraria ssp vulgaris		P				S. LANCS
Anthyllis vulneraria ssp vulneria var vulneraria		P				MORAY
Anthyllis vulneraria ssp carpatica var pseudovulneraria		P				MORAY
Anthyllis vulneraria ssp lapponica var lapponica		P				MORAY
Antirrhinum majus		P	O	V		13
Aphanes arvensis ss		A	O	V	O	5
Aphanes microcarpa		A	O	V	O	MDDX, MORAY
Apium graveolens		B				S. LANCS
Apium nodiflorum		P	O	DIT		DERBYS, RUTL
Aquilegia vulgaris	NAT	P	C	V	O	12
Arabidopsis thaliana		A	VC	C/V	O	22
Arabis caucasica	NAT	P	O	C/V		3
Arabis hirsuta		B/P	C	C/V	O	7
Arctium lappa		B	O	V/EMB		
Arctium minus sl		B	C	V/EMB		TEVIOT
Arctium minus ssp minus		B	R	V/EMB		RUTL, MDDX
Arctium minus ssp pubens		B	R	EMB		RUTL
Arenaria leptoclados		A	O	C	O	18
Arenaria serpyllifolia		A	C	C/V	O	13
Armeria m maritima		P	O	R/M		BEDS
Armoracia rusticana	NAT	P	C	V		11
Artemisia absinthium		P	O	C/V		11
Artemisia biennis	INT	B				WILTS
Artemisia maritima		P	R	C		
Artemisia verlotorum	INT	P				4
Artemisia vulgaris		P	C	C/V		11
Arum maculatum		P	C	V		RUTL, HAYLEY
Aruncus sp	INT	P				GG
Asparagus officinalis		P	O	V		8
Asphodelus tenuifolius	INT	P				DEVON
Aster laevis	NAT	P	R	V		MORAY
Aster lanceolatus	NAT	P	R	YDS		4
Aster macrophyllus	NAT	P	R	V	68	CLYDE
Aster novae-angliae	NAT	P	O	V		ESSEX
Aster novi-belgii	NAT	P	C	V	O	12
Aster tripolium		P	R (LMR)	EMB		
Astragalus cicer	INT	P				GG
Astragalus danicus		P	R (ScR)	V		
Astragalus glycyphyllos		P	R	CUT		3
Astragalus odoratus	INT	P				NOTTS
Astrantia major	NAT	P				DERBYS, MDDX
Arenaria balearica	NAT	P	R	M		SUSSEX

FORBS

Species	Status	Life Cycle	Frequency Recorded During Survey	Habitat	VC Records	Flora Records
Atriplex eardleyae	INT	P				DERBYS, MDDX
Atriplex glabriuscula		P	R	C/V		
Atriplex halimus	NAT	P				SUSSEX
Atriplex hastata		A	O	C/V		LEICS
Atriplex hortensis	INT	A		C		LEICS
Atriplex littoralis		P	R	C		
Atriplex patula		A	R	C		RUTL, TEVIOT
Atriplex semibaccata	INT	A				BEDS
Atropa bella-donna		P	O	V		6
Axyris amaranthoides	INT	P				LOND
Ballota nigra		P	C	CUT/V		3
Barbarea intermedia	INT	B	O	C/V	84	6
Barbarea verna	INT	B	R	C/V	44(5)	12
Barbarea vulgaris		B/P	O	C/V		6
Barbarea vulgaris f divaricata		B/P				GLOUCS
Bellis perennis		P	C	V		5
Bergenia crassifolia	INT	P				ESSEX
Berteroa incana	NAT	P				3
Berula erecta		P				RUTL
Beta trigyna	NAT	A				BERKS
Beta vulgaris ssp maritima		A	O	V		MERIONS
Beta v vulgaris	NAT	A				HAYLEY
Betonica officinalis		P	C	CUT/V		RUTL, HAYLEY
Bidens bipinnata	INT	A				BEDS
Bidens frondosa	INT	A				BEDS
Bidens tripartita		A	R	V		
Bifora radians	INT	P				LEICS
Bilderdykia aubertii	NAT	P	R	YDS		
Bilderdykia dumetorum		P				SOMERSET
Blackstonia perfoliata		A	O	CUT/V		11
Borago officinalis	NAT	A				ESSEX, SUSSEX
Brassica elongata	INT	B/P				GLOUCS
Brassica griquana	INT					BEDS
Brassica juncea	INT	A				3
Brassica napus	INT	A/B	O	V		3
Brassica nigra		A	C	V		3
Brassica oleracea	INT	B/P	O	V	44 (2)	LONDON, KIRK
Brassica rapa	INT	A/B	O	V		GLOUCS, WARWKS
Brassica rapa ssp campestris		B	R	B		GLOUCS
Brassica rapa sssp campestris briggsii	INT	A				GLOUCS
Brassica tourneforti		A				MORAY
Bunias erucago	INT	A/B				BEDS
Bunias orientalis	INT	B/P	O	C/V	75	11
Bunium bulbocastanum		P	R	V		
Bupleurum rotundifolium		A				RUGBY
Cakile maritima		A				WARWKS
Calamintha sylvatica ssp ascendens		P	R	V	44, 0	5
Calamintha nepeta		P				ESSEX
Calendula arvensis	INT	P				LEICS
Calendula officinalis	INT	P	R	V		LOND
Callitriche hamulata		P	R	DIT		
Callitriche intermedia		P	R	DIT		
Callitriche obtusangula		P	R	DIT		
Callitriche stagnalis		A/P	R	DIT		
Calotis cuneifolia	INT	?				BEDS
Calotis hispidula	INT	?				BEDS

FORBS

Species	Status	Life Cycle	Frequency Recorded During Survey	Habitat	VC Records	Flora Records
Calotis lappulacea	INT	?				BEDS
Caltha palustris		P	O	DIT		TEVIOT
Camelina microcarpa	INT	A				BEDS
Camelina sativa	NAT	A				4
Campanula alliariifolia	NAT	O	R	YDS		SURREY, SOMERSET
Campanula glomerata		P	O	V		5
Campanula latifolia		P	R	V		3
Campanula lactiflora	INT	P	R	YDS		
Campanula medium	NAT	B	O	V	O	5
Campanula patula		B/P	R	V		SURREY, MONM
Campanula persicifolia	NAT	B				WARWKS, SUSSEX
Campanula rapunculoides	INT	P	R	V		15
Campanula rapunculus	INT	B				3
Campanula rotundifolia		P	C	V/C/R		7
Campanula trachelium		P	R	V		3
Cannabis sativa	INT	A				3
Capsella bursa-pastoris		A/B	C	V		4
Cardamine amara		P	O	V		TEVIOT
Cardamine flexuosa		A/P	C	C/V		RUTL, TEVIOT
Cardamine hirsuta		A	VC	C/V	O	11
Cardamine impatiens		A/B				GLOUCS
Cardamine pratensis		P	C	C/DIT		6
Cardaria draba	INT	P	O	C/V	O	23
Cardaria draba ssp chalepensis	INT	P				LINCS
Carduus crispus		B	C	V		4
Carduus nutans		B	O	V		7
Carduus x orthocephalus		B				DERBYS, ESSEX
Carduus tenuiflorus		A/B	O	V	53	3
Carex acuta		P				S. LANCS, SURREY
Carex acutiformis		P	O	EMB/DIT	75, 97	TEVIOT, MORAY
Carex arenaria		P	C	C/V	43	3
Carex binervis		P	O (ScR)	V		GLOUCS, TEVIOT
Carex caryophyllea		P	C	C/V	68, O	4
Carex curta		P	R (ScR)	V		
Carex demissa		P	O	V		WILTS, TEVIOT
Carex digitata		P	R	V		MONM
Carex disticha		P				GLOUCS, TEVIOT
Carex divisa		P	R (SR)	V		
Carex divulsa		P				GLOUCS
Carex echinata		P	O (ScR)	V		GLOUCS
Carex extensa		P	R	V		
Carex flacca		P	C	C/V		7
Carex hirta		P	C	C/V		6
Carex hirta var hirtiformis		P				GLOUCS
Carex laevigata		P				TEVIOT
Carex limosa		P	R	DIT		
Carex lepidocarpa		P	O	V		
Carex muricata		P	O	V		
Carex muricata ssp leersii		P				GLOUCS
Carex muricata ssp muricata		P	R	V		WARWKS, RUGBY

FORBS

Species	Status	Life Cycle	Frequency Recorded During Survey	Habitat	VC Records	Flora Records
Carex nigra		P	C	V		3
Carex otrubae		P	R	V		
Carex ovalis		P	O	V		TEVIOT
Carex pallescens		P	O	V		GLOUCS, TEVIOT
Carex panicea		P	O	V/EMB		3
Carex paniculata		P	O (ER)	V/EMB		
Carex pauciflora		P	R (ScR)	V		
Carex pendula		P	O	DIT		
Carex pilulifora		P	O (ScR)	V		
Carex x pseudoaxillaris		P				WILTS
Carex pseudocyperus		P	O	DIT		
Carex remota		P	R	EMB/DIT		
Carex riparia		P	O	DIT	O	
Carex rostrata		P	O (ScR)	V		TEVIOT
Carex spicata		P	R	CUT		7
Carex sylvatica		P	O	V		HAYLEY
Carlina vulgaris		B	O	V	O	7
Carpobrotus edulis	NAT	P				DEVON
Carthamus lanatus	INT	A/B				BEDS
Carum carvi	INT	B	R	V		7
Carum verticillatum		P	R (ScR)	V		
Caucalis latifolia	INT	A				S. LANCS, GLOUCS
Caucalis platycarpos	NAT	A				3
Caucalis platycarpos var muricata	NAT	A				GLOUCS
Centaurea aspera	NAT	P				S. LANCS
Centaurea calcitrapa	NAT	B				BEDS
Centaurea cyanus		A				4
Centaurea melitensis	INT	A				GLOUCS
Centaurea montana	NAT	P	O (ScR)	V		3
Centaurea nigra sl		P	VC	V		13
Centaurea nigra ssp nemoralis		P	O	V	O	ESSEX
Centaurea repens	INT	P				HEREF
Centaurea scabiosa		P	C	V	O	17
Centaurea solstitialis	INT	A				BEDS
Centaurium erythraea		A	O	CUT/V		7
Centranthus ruber	NAT	P	C	M/R/V		17
Cephalanthera damasonium		P	R (WR)	V		
Cephalanthera longifolia		P				MERION
Cephalaria gigantea	INT	P	R	V		DERBYS, GG
Cerastium arvense		P	O	CUT		7
Cerastium brachypetalum	NAT	A	R (LMR)	CUT		BEDS
Cerastium diffusum		A	O	V	68,0	19
Cerastium fontanum ssp glabrescens		P	VC	V		
Cerastium fontanum ssp triviale		P	R	V		7
Cerastium fontanum ssp triviale pentandrum		P				WILTS
Cerastium glomeratum		A	C	V	O	7
Cerastium pumilum		A	O	V		7
Cerastium semidecandrum		A	O	C/V	O	9
Cerastium tomentosum	NAT	P	O	V	O	6

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Species	Status	Life Cycle	Frequency Recorded during Survey	Habitat	VC Records	Flora Records
Chaenorhinum minus		A	C	V/C		44
Chaerophyllum temulentum		B	O	V		5
Chamaemelum nobile		P				KIRK
Chamerion angustifolium		P	U	V/C/B		22
Cheiranthus cheiri	NAT	P	R	V		8
Chelidonium majus		P	O	V		BEDS
Chenopodium album		A	O	V		4
Chenopodium album var viridescens		A				LEICS
Chenopodium bonus henricus		A	O	C/V		
Chenopodium carinatum	INT	A				BEDS
Chenopodium cristatum	INT	A				BEDS
Chenopodium glaucum		A				LOND, YORKS
Chenopodium hybridum		A				3
Chenopodium murale		A				4
Chenopodium opulifolium	NAT	A				YORKS
Chenopodium polyspermum		A	R	V		WILTS
Chenopodium pratericola	INT	A				YORKS
Chenopodium probstii	INT	A				BEDS
Chenopodium pumilum	INT	A				GG
Chenopodium rubrum		A	R	V		4
Chenopodium rubrum var blitoides		A				LOND, MDDX
Chenopodium urbicum		A				YORKS
Chrysanthemum segetum		A	O	V		
Chrysosplenium alternifolium		P	R (ScR)	V		
Chrysosplenium oppositifolium		P	O	V		TEVIOT
Cicerbita macrophylla	NAT	P				3
Cichorium intybus		P	O	V		14
Circaea lutetiana		P	C	V		WARWKS
Cirsium acaulon		P	O	CUT	O	7
Cirsium acaulon f caulescens		P	R (LMR)	CUT		SUSSEX
Cirsium arvense		P	U	V, EMB		9
Cirsium arvense var incanum	INT	P				3
Cirsium arvense var setosum	INT	P				6
Cirsium dissectum		P				GLOUCS
Cirsium eriophorum ssp britannicum		B	O	V	O	6
Cirsium heterophyllum		P	C	V		6
Cirsium palustre		B	C	V,/EMB	O	6
Cirsium tuberosum		P				GLOUCS
Cirsium vulgare		B	VC	V, EMB		9
Cirsium vulgare var hypoleucon		B				YORKS
Cladium mariscus		P	R	DIT		
Clinopodium vulgare		P	C	V, CUT	O	11
Clinopodium vulgare var ovatum		P				GLOUCS
Cochlearia anglica		A				DEVON
Cochlearia danica		A	O	C		15
Cochlearia officinalis sl		BP	O	C/V		
Cochlearia pyrenaica		B/P	R (LMR)	R		
Coeloglossum viride		P	R (LMR)	V		
Conium maculatum		B	O	V		ESSEX, TEVIOT
Conopodium majus		P	C	V		3
Conringia orientalis	INT	A/B				WILTS, GLOUCS
Convallaria majalis		P	R	V		DERBYS, MONM
Convolvulus arvensis		P	C	V, B		21
Coriandrum sativum	INT	A				BEDS
Corispermum leptopterum	INT	P				WARWKS
Coronilla varia	NAT	P	R	V		13

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Species	Status	Life Cycle	Frequency Recorded During Survey	Habitat	VC Records	Flora Records
Coronopus didymus	INT	A/B	R	C/V		4
Coronopus squamatus		A/B	R	C/V		
Corrigiola litoralis	INT	A				3
Corydalis claviculata		A	R	V		ESSEX
Corydalis lutea	NAT	A	O	V		MDDX
Cosmos bipinnatus	INT	P				LONDON
Cotula australis	INT	P				BEDS
Crepis biennis		B	C	V	44 (2)	9
Crepis capillaris		A	C	C/V		12
Crepis capillaris var diffusa		A				LEICS
Crepis capillaris var glandulosa		A				MORAY
Crepis nicaeensis	INT	B				WARWKS, RUGBY
Crepis paludosa		P	R(ScR)	V		TEVIOT
Crepis setosa	INT	A/B				LEICS
Crepis vesicaria ssp haenseleria	INT	B	C	V	O	18
Crithmum maritimum		P				SUSSEX
Crocosmia x crocosmiflora	NAT	P	C	V		KIRK
Cruciata laevipes		P	O	V		7
Cuscuta epithymum		A	R	V	27	BEDS
Cymbalaria muralis	NAT	P	C	R/M		3
Cynoglossum officinale		B	O	V		ESSEX, SUSSEX
Dactylorhiza fuchsii		P	C	V/CUT		8
Dactylorhiza incarnata		P				S. LANCS
Dactylorhiza maculata		P	C	V		
Dactylorhiza maculata ssp ericetorum		P	O	V/CUT		GLOUCS, TEVIOT
Dactylorhiza praetermissa		P	O	V/CUT	O	MDDX
Dactylorhiza purpurella		P	O (ScR)	V/CUT		4
Dactylorhiza x venusta		P				TEVIOT
Datura stramonium	NAT	P				3
Daucus carota		B	VC	V	75,78, O	15
Delphinium ambiguum	NAT	P	O	V	O	4
Delphinium orientale	INT	P	R	V		BERKS
Descurainia sophia		A	R	C/V		4
Dianthus armeria		A/B	R (WR, LMR)	C/V		4
Dianthus barbatus	INT	P	R	V		LONDON
Dianthus caryophyllus	NAT	P				KIRK
Dianthus deltoides						SUSSEX, TEVIOT
Dianthus gratianopolitanus		P				GLOUCS
Dianthus plumarius	NAT	P				GLOUCS
Dicentra eximia	INT	A				CLYDE
Digitalis lutea	INT	B				SURREY
Digitalis purpurea		B	C	V		7
Diplotaxis muralis	NAT	A/P	O	CUT/R		26
Diplotaxis muralis f caulescens	NAT	A/P				4
Diplotaxis tenuifolia		P	R	V		15
Dipsacus fullonum		B	C	V		6
Dipsacus pilosus		B				MONM
Doronicum pardalianches	INT	P	R (LMR)	V		4
Draba incana		B/P	R (LMR)			
Draba muralis		A/B	O (ScR)	C		4
Drosera anglica		P	O (ScR)	V		
Drosera rotundifolia		P	O (ScR)	V		

Species	Status	Life Cycle	Frequency Recorded During Survey	Habitat	VC Records	Flora Records
Echinops bannaticus	INT	P				MORAY
Echinops exaltatus	INT	P				8
Echium vulgare		B	O	V	0	21
Eleocharis palustris		P	R	DIT		
Eleogiton fluitans		P				NOTTS
Elodea canadensis	NAT	A				DERBYS
Elsholtzia cristata	INT	?				YORKS
Endymium hispanicus	NAT	P	O	V		3
Endymion non-scriptus		P	C	V	0	3
Epilobium adenoculon	INT	P	C	V	0	
Epilobium ciliatum	NAT	P	C	V	0	14
Epilobium ciliatum x E montanum		P				KIRK
Epilobium ciliatum x E obscurum		P				KIRK
Epilobium x aggregatum		P				3
Epilobium brunnescens	INT	P	O	R/CUT		
Epilobium hirsutum		P	C	DIT/EMB	0	7
Epilobium lanceolatum		P	C (WR)	C/V	45	9
Epilobium x limosum		P				WARWKS
Epilobium montanum		P	VC	V		6
Epilobium x mutabile		P				LOND, MDDX
Epilobium nerterioides	INT	P				6
Epilobium obscurum		P	O	V/DIT		4
Epilobium palustre		P	O	V/DIT		TEVIOT
Epilobium parviflorum		P	O	V/DIT	0	6
Epilobium par x E. roseum		P				GLOUCS
Epilobium roseum		P	O	V		11
Epilobium tetragonum		P	C	V	0	8
Epipactis atrorubens		P	R (LMR)	V		
Epipactis helleborine		P	R	V		DERBYS, GLOUCS
Epipactis palustris		P	R	V		3
Erigeron acer		A/B	O	V/C	0	17
Erigeron annuus	INT	A				RUTL
Erigeron bonariensis	INT	A				BEDS
Erigeron canadensis	INT	A	O	V/C	0	18
Erinus alpinus	NAT	P	R (LMR)	R		S. LANCS, YORKS
Eriophorum angustifolium		P	O (ScR)	V		LONDON, RUGBY
Eriophorum vaginatum		P	C (ScR)	V		TEVIOT
Erodium cicutarium		A	C	V		11
Erodium cygnorum	INT	A				GLOUCS
Erodium moschatum		A				BEDS
Erophila spathulata		A				WILTS, MDDX
Erophila verna		A	VC	V/C	0	19
Eruca sativa	INT	P				3
Erucastrum gallicum	INT	A				SOMERSET
Eryngium campestre		P				BERKS
Erysimum cheiranthoides	INT	A	R	V		12
Erysimum virgatum	INT	A				YORKS
Eupatorium cannabinum		P	C	EMB/DIT		WILTS
Euphorbia amygdaloides		P	O	V	52	CARNS
Euphorbia cyparissias	NAT	P	O	C/V		16
Euphorbia esula sl	NAT	P	O	C/V		12
Euphorbia exigua		A	R	C		6
Euphorbia exigua var retusa		A				SUSSEX
Euphorbia helioscopia		A	R (WR)	C		TEVIOT
Euphorbia lathyrus		B	R	V		RUTL
Euphorbia peplus		A	O	C/V		RUTL

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Species	Status	Life Cycle	Frequency Recorded During Survey	Habitat	VC Records	Flora Records
Euphorbia platyphyllos		A				WARWKS, GLOUCS
Euphorbia uralensis	NAT	P	R	C/V		
Euphrasia anglica		A	R	V		
Euphrasia brevipila		A	R	V		TEVIOT, GG
Euphrasia borealis		A	R	V		
Euphrasia confusa		A	R	V		DURHAM
Euphrasia micrantha		A	R	V		TEVIOT
Euphrasia nemorosa		A	C	V		6
Euphrasia nemorosa var calcarea		A				NORFOLK
Euphrasia nemorosa x E pseudokerneri		A				SURREY, LOND
Euphrasia officinalis agg		A	O	V		
Euphrasia rostkoviana		A	R (LMR)	YDS		
Fagopyrum esculentum	INT	A				LEICS, YORKS
Fagopyrum tataricum	INT	A				YORKS
Falcaria vulgaris	NAT	B/P				6
Filaginella uliginosum		A	O	V		3
Filago germanica		A	O	V		
Filago lutescens		A				ESSEX
Filago vulgaris		A				5
Filipendula ulmaria		P	VC	EMB/DIT	O	7
Filipendula ulmaria var denudata		P				SUSSEX
Filipendula vulgaris		P	O	V		8
Foeniculum vulgare		P	O	V		16
Fragaria x ananassa	NAT	P	C	V	O	26
Fragaria moschata	NAT	P				5
Fragaria vesca		P	VC	V/B/C		14
Fumaria bastardii		A				ESSEX, SUSSEX
Fumaria capreolata		A	R	V		
Fumaria densiflora		A				ESSEX
Fumaria muralis ssp boraei		A	C	V		SUSSEX
Fumaria officinalis		A	O	V		7
Fumaria officinalis var elegans		A				LEICS
Fumaria purpurea		A				TEVIOT
Galanthus nivalis		P	R	V		3
Galega officinalis	INT	?	R	V		5
Galeopsis angustifolia		A				6
Galeopsis bifida		A	C	V	106	3
Galeopsis speciosa		A	O	V		3
Galeopsis tetrahit sl		A	C	V	O	TEVIOT, GG
Galinsoga ciliata	INT	A				BEDS, ESSEX
Galinsoga parviflora	INT	A				ESSEX, BERKS
Galium album		A	R	V		
Galium aparine		A	U	V		7
Galium boreale		P	R (ScR)	V		MORAY
Galium cruciata		P	C	V		
Galium mollugo sl		P	C	V		8
Galium mollugo var dumetorum		P				GLOUCS
Galium mollugo ssp erectum		P	R	CUT		9
Galium mollugo ssp mollugo		P	C	V		6
Galium odoratum		P	O	V		GG
Galium palustre		P	O	DIT	O	TEVIOT
Galium parisiense ssp anglicum		A				NORFOLK/SUSSEX
Galium pomeranicum		P	R	V		
Galium pumilum		P	R	V		
Galium saxatile		P	C	V		3

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Species	Status	Life Cycle	Frequency Recorded During Survey	Habitat	VC Records	Flora Records
Galium spurium var vaillanti		A				SUSSEX
Galium tricornutum		A				3
Galium uliginosum		P				TEVIOT
Galium verum		P	C	V		11
Gentianella amarella ss		B	C	V		3
Gentianella campestris		A/B	O	V		MONM
Geranium columbinum		A	R	V	O	11
Geranium dissectum		A	C	V		8
Geranium endressii	NAT	P				TEVIOT
Geranium endressii x G versicolor	NAT	P				TEVIOT
Geranium lucidum		A	C	V		BERKS, TEVIOT
Geranium molle		A	C	V	O	5
Geranium phaeum	NAT	P	R	V		
Geranium pratense		P	C	V		14
Geranium pusillum		A	R	V		4
Geranium pyrenaicum		P	O	V	O	20
Geranium pyrenaicum var pallida		P	R	V		NORFOLK
Geranium robertianum		A/B	VC	V/C/B		9
Geranium rotundifolium		A	O	C/V		7
Geranium sanguineum		P	O	V	O	3
Geranium sylvaticum		P	C	V	O	3
Geranium versicolor	INT	P	R	V		
Geum x intermedium		P	R	V		TEVIOT
Geum rivale		P	C	V		TEVIOT, GG
Geum urbanum		P	C	V		5
Gladiolus segetum	INT	P	R	V		
Glaucium corniculatum	INT	A				3
Glaucium flavum		B/P	R	V		SUSSEX
Glaux maritima		P	R	V		
Glechoma hederacea		P	C	V		6
Goodyera repens		P	R	V		
Groenlandia densa		P				LEICS
Gunnera tinctoria	INT	P				TEVIOT
Gymnadenia conopsea		P	O	V	O	5
Helianthemum canum			R (LMR)	V		
Helanthemum nummularium		P	O	V		4
Helianthus annuus	INT	A	R	V		ESSEX, LOND
Helianthus decapetalus	INT	P				ESSEX
Helianthus diffusus	INT	P				S. LANCS
Helianthus rigidus	INT	P				ESSEX, MDDX
Helianthus tuberosus	INT	P				LOND
Helleborus foetidus		P				WILTS, DEVON
Helleborus viridis ssp occidentalis		P				TEVIOT
Hemerocallis sp		P	R	V		
Hemerocallis fulva	INT	P				SUSSEX
Heracleum mantegazzianum	NAT	B	O	V		3
Heracleum sphondylium		B	U	V/EMB		10
Heracleum sphondylium var angustifolium		B				ESSEX, SUSSEX
Herniaria cinerea	INT	A/P				STAFFS
Herniaria glabra		A/P				ESSEX
Herniaria hirsuta	INT	A/P				CHESHIRE
Hesperis matronalis	NAT	B/P				5
Hibiscus trionum	INT	P				CHESH, YORKS

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Species	Status	Life Cycle	Frequency Recorded During Survey	Habitat	VC Records	Flora Records
Hieracium agg		P	VC	V		5
Hieracium amplexicaule		P				S. LANCS
Hieracium calcaricola		P	R	V		SURREY
Hieracium cambricogothicum		P				CSABF
Hieracium cheriense		P				CSABF/SUSSEX
Hieracium chloranthum		P				MORAY
Hieracium cinderella		P				CSABF
Hieracium decolor		P				STAFFS
Hieracium diaphanoides		P	R	V		NOTTS, GLOUCS
Hieracium diaphanum		P	R	V		11
Hieracium eupreges var glabratum		P				YORKS
Hieracium exotericum	INT	P	R	C		7
Hieracium grandidens	INT	P				SOMERSET
Hieracium hjeltii		P				CSABF
Hieracium latobrigorum		P				MORAY
Hieracium lepidulum		P				3
Hieracium maculatum		P	R	C		10
Hieracium pachyphylloides		P				CSABF
Hieracium patale		P				CSABF
Hieracium pellucidum		P				BEDS, SUSSEX
Hieracium perpropinquum		P	R	V		11
Hieracium praecox		P				LOND
Hieracium pulmonarioides		P				S. LANCS
Hieracium rigens		P				4
Hieracium salticola		P				6
Hieracium scotostichum		P	R	V		SURREY, SCABF
Hieracium severiceps		P	R	V		CHESHIRE
Hieracium strictiforme		P				MORAY
Hieracium strumosum		P	O	V		15
Hieracium subamplifolium	INT	P				SOMERSET
Hieracium suberocatum		P				MORAY
Hieracium sublepistoides		P				3
Hieracium trichocaulon		P	R	V		5
Hieracium umbellatum		P	R	CUT		8
Hieracium vagum		P	R	V		12
Hieracium vulgatum		P	O	V	O	10
Hieracium zygophorum	INT	P	R	C	1ST UK RECORD	
Himantoglossum hircinum		P				WILTS, SUSSEX
Hippocrepis comosa		P	R (LMR)	V		
Hirschfeldia incana	INT	A	O	V/C		BEDS, SUSSEX
Hornungia petraea		A	R	V		DERBYS, PEMBS
Honkenya peploides		P	R	V		
Hottonia palustris		P				SUSSEX
Hydrocotyle vulgaris		P	O	V/DIT		
Hyoscyamus niger		A/B				6
Hypericum androsaemum		P	O	V		
Hypericum x desetangsii		P				TEVIOT
Hypericum hirsutum		P	C	V/DIT		8
Hypericum humifusum		P	C	V/C		6
Hypericum maculatum ssp obtusiusculum		P	C	V		7
Hypericum montanum		P	O	V		5
Hypericum perforatum		P	VC	V		14
Hypericum perforatum var angustifolium		P				YORKS
Hypericum pulchrum		P	C	V		4
Hypericum tetrapterum		P	C	V		8

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Species	Status	Life Cycle	Frequency Recorded During Survey	Habitat	VC Records	Flora Records
Hypochoeris glabra		A	O	V		BEDS
Hypochoeris radicata		P	C	V		7
Iberis amara		A	R	V		3
Iberis umbellata	INT	A/B				BEDS, MONM
Illecebrum verticillatum		A				DERBYS
Impatiens glandulifera		A	O	DIT		5
Impatiens capensis		A				MDDX
Impatians noli-tangere		A				SUSSEX
Impatiens parviflora		A	O	V	O	DURHAM
Inula conyza		B/P	C	V	O	9
Inula crithmoides		P				DEVON
Inula helenium	INT	P				6
Iris foetidissima		P	R	V		
Iris germanica	INT	P	O	V		3
Iris pseudacorus		P	C	V/DIT		TEVIOT, GG
Iris sp	INT	P	O	V		GG
Isolepis setacea		A	R	V		S. LANCS
Jasione montana		B	C	V/CUT		
Juncus acutiflorus		P	C	V		TEVIOT
Juncus acutus		P	R	C		
Juncus articulatus		P	C	V		3
Juncus bufonius		A	C	V		RUTL, TEVIOT
Juncus bulbosus ss		P	O	V		GLOUCS
Juncus compressus		P	C	V		GLOUCS
Juncus effusus		P	C	V		RUTL, TEVIOT
Juncus effusus var congestus		P				DERBYS
Juncus gerardii		P	R	DIT		
Juncus inflexus		P	C	V		3
Juncus kochii		P	R	V/DIT		S. LANCS
Juncus maritimus		P	R	DIT		
Juncus squarrosus		P	VC	V/DIT		GLOUCS, ESSEX
Juncus subuliflorus		P				TEVIOT, GG
Juncus tenuis	NAT	P	O	V/C		MORAY
Kickxia elatine		A				6
Kickxia spuria		A				6
Knautia arvensis		P	C	V/CUT		15
Kniphofia sp	INT	P	R	V		
Kochia scoparia	INT	A				YORKS
Lactuca serriola		B	O	V		9
Lactuca virosa		A/B	R	V		7
Lagarosiphon major	NAT	P				DERBYS
Lamiastrum galeobdolon		P	O	EMB/DIT		S. LANCS, KIRK
Lamium album		P	C	V		11
Lamium album f roseum		P				LEICS
Lamium amplexicaule		A	O	YDS		7
Lamium hybridum		A	O	YDS	O	3
Lamium maculatum	INT	P	O	YDS		ESSEX
Lamium purpureum		A	O	V		6
Lappula echinata	INT	A				GLOUCS, DEVON
Lapsana communis		A	C	V		6
Lapsana intermedia	INT	A/P				BEDS
Lasiospermum pedunculare	INT	?				BEDS
Lathyrus aphaca		A				3
Juncus subnodulosus		P	R	DIT		

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Species	Status	Life Cycle	Frequency Recorded During Survey	Habitat	VC Records	Flora Records
Lathyrus grandiflorus	INT	P				SURREY
Lathyrus hirsutus		A				3
Lathyrus latifolius	NAT	P	C	V/C	0	23
Lathyrus montanus		P	O	V	0	6
Lathyrus odoratus	INT	P	R	V		
Lathyrus nissolia		A	O	V		9
Lathyrus palustris		P	R	V		
Lathyrus pratensis		P	U	V		13
Lathyrus sylvestris		P	O	V		11
Lathyrus tuberosus	NAT	P	R	V		9
Lavatera arborea		B	O	V	0	MERION
Legousia hybrida		A				RUTL
Lemna minor		A	O	DIT		
Lemna polyrhiza		A				GLOUCS
Lemna trisulca		A	R	DIT		
Leontodon autumnalis		P	C	V		6
Leontodon hispidus		P	C	V	0	11
Leontodon taraxacoides		P	C	V		4
Lepidium campestre		A/B	O	V		10
Lepidium graminifolium	INT	P				S. LANCS
Lepidium heterophyllum		P	C	C/V	0	16
Lepidium hyssopifolium		P				BEDS
Lepidium latifolium		P	R	V		4
Lepidium neglectum	INT	A/B				GLOUCS
Lepidium ruderale		A/B	R	V		8
Lepidium sativum	INT	A				BEDS,STAFFS
Lepidium virginicum	INT	A/B				S. LANCS, SUSSEX
Leucanthemum maximum	INT	P	R	YDS	0	5
Leucanthemum vulgare		P	VC	V	0	25
Lilium sp	NAT	P	R	V		
Lilium pyrenaicum	NAT	P	R	V		TEVIOT
Limonium humile		P	R	V		
Limonium vulgare		P	R	V		
Linaria dalmatica		P	R	V		3
Linaria x dominii	INT	P				S. LANCS
Linaria purpurea	INT	P	O	V		
Linaria repens		P	C	C/V	0	31
Linaria x sepium		P	O	V		10
Linaria supina		A	R (WR)	C/V		DEVON, CARMS
Linaria vulgaris		P	VC	C/V	0	28
Linaria vulgaris var peloria		P				PEMBS
Linaria vulgaris var prostrata		P				DEVON
Linum bienne		A/P	R	V		WILTS
Linum catharticum		A	C	C/V/R	0	10
Linum usitatissimum	NAT	A				3
Listera ovata		P	C	V	78, 0	8
Lithospermum arvense		A				5
Lithospermum officinale		P	O	V		3
Lobularia maritima	NAT	A/P	R	V		3
Logfia minima		A	R	V		7
Lotus corniculatus		P	VC	V		13
Lotus tenuis		P				12
Lotus uliginosus		P	C	V	0	5
Lunaria annua	INT	B	R	V	0	ESSEX

FORBS

Species	Status	Life Cycle	Frequency Recorded During Survey	Habitat	VC Records	Flora Records
Lupinus nootkatensis	NAT	R	O	V		MORAY
Lupinus polyphyllus	INT	P	O	V	93, 0	9
Luzula campestris		P	C	V	0	5
Luzula luzuloides	NAT	P				HEREF, DEVON
Luzula multiflora		P	C	V	0	GLOUCS, TEVIOT
Luzula pilosa		P	C	V		WARWKS, TEVIOT
Luzula sylvatica		P	C	V		SUSSEX, TEVIOT
Lychnis flos-cuculi		P	R	V		TEVIOT
Lychnis coronaria		P	R	V		
Lycopersicum esculentum	INT	A				3
Lycopus europaeus		P	O	DIT		
Lysimachia nemorum		P	O	V		TEVIOT
Lysimachia nummularia		P	O	V		WARWKS, MDDX
Lysimachia punctata	INT	P				GG
Lysimachia vulgaris		P	O	DIT		DERBYS
Lythrum hyssopifolia		A				BEDS
Lythrum portula		A				WILTS
Lythrum salicaria		P	C	DIT		MONM
Madia capitata	INT	A				BEDS
Malva ambigua	INT	P				LEICS
Malva moschata		P	O	V		11
Malva moschata var heterophylla		P				GLOUCS
Malva neglecta		A	O	V		6
Malva pusilla	INT	A				SURREY, LOND
Malva sylvestris		P	C	V		3
Marrubium vulgare		P				BEDS
Matricaria matricarioides		A	C	C/V		6
Matricaria recutita		A	C	C/V		4
Matthiola incana		A/P				SURREY
Meconopsis cambrica		P	R	C/V	75, 0	
Medicago arabica		A	O	C/V		8
Medicago aschersoniana	INT	A				BEDS
Medicago falcata	INT	P	R	V		4
Medicago laciniata	INT	A				SURREY, WARWKS
Medicago lupulina		A	C	V		11
Medicago lupulina var scabra		A				MDDX
Medicago lupulina var unguiculata		A				LOND
Medicago lupulina var willdenoniana		A				WILTS, SUSSEX
Medicago minima		A				BEDS, WARWKS
Medicago minima var viscida		A				BEDS
Medicago polymorpha		A				8
Medicago sativa	NAT	P	O	V		21
Medicago tribuloides		P				BEDS
Medicago x varia		P				4
Melampyrum cristatum		A				ESSEX, HAYLEY
Melampyrum pratense		A	O	V		
Melilotus alba	NAT	A/B	O	V		19
Melilotus altissima		B	O	V	0	15
Melilotus indica	NAT	A	O	V		13
Melilotus officinalis	NAT	B	O	V	0	18
Melissa officinalis	NAT	P				4
Mentha aquatica		P	O	DIT		

FORBS

Species	Status	Life Cycle	Frequency Recorded During Survey	Habitat	VC Records	Flora Records
Mentha arvensis		P	C	V		TEVIOT, GG
Mentha arvensis var brevidens		P				SUSSEX
Mentha longifolia		P	O	V		3
Mentha longifolia var horridula		P				LONDON
Mentha longifolia var mollisima		P				GLOUCS
Mentha x niliaca var alopecuroides		P	R	V		5
Mentha x piperita		P				BERKS
Mentha x piperita var piperita		P				DURHAM
Mentha x piperita not hirsuta		P				MORAY
Mentha rotundifolia		P	R	V		3
Mentha scotica		P				GG, MORAY
Mentha x smithiana		P				NORFOLK
Mentha spicata	NAT	P	R	C	O	6
Menyanthes trifoliata		P	R	DIT		GLOUCS
Mercurialis annua		A	R	V		3
Mercurialis annua var ambigua		A				SUSSEX
Mercurialis perennis		P	C	V		4
Mimulus cupreus	NAT	P	R	DIT		
Mimulus guttatus	NAT	P	R	DIT		S. LANCS, GLOUCS
Mimulus luteus	NAT	P	R	DIT		TEVIOT
Minuartia hybrida		A	O	C/V	O	14
Minuartia hybrida var laxa		A				GLOUCS
Minuartia verna		P	R (LMR)	C/V		
Misopates orontium		A	R	V		GLOUCS
Moehringia trinervia		A	C	V	O	RUTL, WILTS
Moenchia erecta		A				S. LANCS
Monolepis nutalliana	INT	?				BEDS
Monotropa hypopitys sl		P				GLOUCS
Montia fontana		A/P	R	V		
Montia perfoliata	INT	A/P	O	V/B	99	BEDS, LEICS
Montia sibirica		A/P	R	V		
Muscari armeniacum	INT	P				BEDS
Muscari atlanticum		P				MDDX
Mycelis muralis		P	C	V		6
Myosotis arvensis		A	C	V/C	O	8
Myosotis laxa		A	O	V		TEVIOT
Myosotis discolor		A	O	V		8
Myosotis ramosissima		A	O	V/C	O	8
Myosotis scorpioides		P	O	V		DERBYS, TEVIOT
Myosotis secunda		P	R	V		TEVIOT
Myosotis sylvatica		P	R	V		5
Myosoton aquaticum		P	R	V		
Myriophyllum alterniflorum		P	R	DIT		
Myrrhis odorata		P	C	V/EMB		8
Narcissus x biflorus		P	R	V	O	
Narcissus hipanicus	INT	P				MDDX, KIRK
Narcissus majalis		P				KIRK
Narcissus pseudonarcissus		P	R	V		TEVIOT, MDDX
Narthecium ossifragum		P	O (ScR)	V		
Nasturtium officinale sl	INT	P	R	V		
Nepeta cataria		P				3
Neslia paniculata	NAT	A				4
Nasturtium microphylia		P				MORAY, GG
Nasturtium nasturtium aquticum		P	R	DIT		RUTL, TEVIOT
		P				
Nasturtium sylvestris		P	R	DIT		RUTL, ESSEX

FORBS

Species	Status	Life Cycle	Frequency Recorded During Survey	Habitat	VC Records	Flora Records
Nuphar lutea		P				DERBYS, NOTTS
Odontites verna		A	O	V	O	5
Odontites verna ssp serotina		A	R	V		GLOUCS
Oenanthe aquatica		P	R	DIT		
Oenanthe crocata		P	O	EMB/DIT		
Oenanthe lachenalii		P	R	DIT		
Oenanthe silaifolia		P	R (ER)	DIT		
Oenothera biennis	NAT	B	O	C/V		20
Oenothera erythrosepala	NAT	B	R	C/V	O	15
Oenothera laciniata	INT	B				S. LANCS
Oenothera parviflora	INT	B/P				4
Oenothera renneri	INT	B				GG
Oenothera rubricaulis	INT	B				DERBYS, RUTL
Oenothera stricta	INT	A/B				BEDS, MERION
Omalotheca sylvaticum		P	R	V		WILTS, SUSSEX
Onobrychis viciifolia		P	O	V/CUT		10
Onopordum acanthium		B	R	V		9
Ophrys apifera		P	O	V/CUT		9
Ophrys insectifera		P				3
x Orchigymnadenia heinzeliana		P				S. LANCS, TEVIOT
Orchis mascula		P	C	V/CUT		STAFFS, DEVON
Orchis morio		P	O	V/CUT		5
Origanum vulgare		P	C	V/CUT		15
Ornithopus perpusillus		A	O	V/CUT		4
Ornithogalum umbellatum		P	O	V		MORAY
Orobanche elatior		A/P	R	V	O	7
Orobanche minor		A/P	R	V	O	8
Orbanche purpurea		A/P				DERBYS, NORFOLK
Oxalis acetosella		P	C	V		TEVIOT, GG
Oxalis articulata	INT	P	R	V		MORAY
Oxalis corniculata	INT	A/P	R	V		BERKS
Oxalis stricta	INT	P	R	V		3
Paeonia officinalis	INT	P				KIRK
Papaver argemone		A	R	C/V		14
Papaver dubium		A	O	C/V	O	16
Papaver hybridum		A				BEDS
Papaver lecoqii		A	R	C/V		4
Papaver orientale	INT	A	R	C		GG/SUSSEX
Papaver rhoeas		A	C	C/V		7
Papaver rhoeas ssp **hoffmanianum**		A				WILTS
Papaver somniferum	INT	A	O	C/V	O	6
Parnassia palustris		P	R	V		
Parietaria judaica		P	O	M		3
Pastinaca sativa		B		V		15
Pedicularis sylvatica		P	O	V		TEVIOT
Pentaglottis sempervirens	NAT	P	R	V		5
Petasites albus	INT	P				MORAY
Petasites fragrans	NAT	P	R	V		8
Petasites hybridus		P	C	EMB/DIT		6
Petrorhagia nanteuilii		A				SUSSEX
Petroselinum crispum	NAT	B	R	V		BERKS, KIRK
Petroselinum segetum		B	R	V		3
Phyteuma spicatum		P				WARWKS
Phyteuma tenerum		P				LOND
Picris echioides		A/B	O	YDS		6
Orobanche hederae			R	V		

FORBS

Species	Status	Life Cycle	Frequency Recorded During Survey	Habitat	VC Records	Flora Records
Picris hieraciodes		B/P	C	V	68 (2), 0	19
Pilosella aurantiaca sl	NAT	P	O	YDS		4
Pilosella aurantiaca ssp aurantiaca	NAT	P				6
Pilosella aurantiaca ssp brunnecrocea	NAT	P	O	C	93, 0	13
Pilosella caespitosa	NAT	P	O (SR)	C		MORAY
Pilosella caespitosa ssp colliniforme	NAT	P	O (SR)	C		CSABF
Pilosella flagellaris	NAT	P				CSABF, GG
Pilosella officinarum		P	C	V		10
Pilosella officinarum var concinnatum		P				LEICS
Pilosella offininarum var nigrescens		P				GLOUCS
Pilosella officinarum ssp micradenia		P				MORAY
Pilosella officinarum ssp trichostoma		P				MORAY
Pilosella officinarum ssp trichoscapa		P				MORAY
Pilosella praealta	NAT	P				CSABF
Pilosella praealta ssp arvorum	NAT	P				BERKS, WILTS
Pilosella praealta ssp spraguei	NAT	P				HERTS
Pilosella stolonifera		P				MORAY
Pimpinella major		P	O	V	68	3
Pimpinella saxifraga		P	C	V	0	11
Pinguicula lusitanica		P				PEMBS
Pinguicula vulgaris		P	O	V		TEVIOT
Plantago coronopus		B	O	C	0	LONDON, MDDX
Plantago indica	INT	P				S. LANCS, GLOUCS
Plantago lanceolata		P	U	V		8
Plantago major		P	O	B	0	4
Plantago maritima		P	R	CUT		
Plantago media		P	O	CUT		4
Platanthera bifolia		P				SUSSEX
Plantanthera chlorantha		P	O	CUT		4
Polemonium caeruleum		P				DURH, MORAY
Polygala calcarea		P	R	CUT		
Polygala serpyllifolia		P	O	V		3
Polygala vulgaris		P	O	V		11
Polygonatum x hybridum	INT	P				KIRK, GG
Polygonatum multiflorum		P	R	V		DURHAM, MORAY
Polygonum amphibium		P	O	DIT		ESSEX, SURREY
Polygonum amphibium var terrestre		P				WILTS
Polygonum arenastrum		P	O	YDS	0	4
Polygonum aviculare ss		A	O	B	0	5
Polygonum bistorta		P	O	V		6
Polygonum bungeanum	INT	P				YORKS
Polygonum convolvulus var subulatum		A				LOND
Polygonum compactum		P				MORAY
Polygonum hydropiper		A	O	DIT		TEVIOT
Polygonum lapathifolium		A	R	B		RUTL, GLOUCS
Polygonum minus		A				S.LANCS
Polygonum nodosum		A	R	B		
Polygonum persicaria		A	O	B		6
Polygonum persicaria var ruderale		A				SUSSEX
Polygonum polystachyum	NAT	A	R	YDS		DEVON, DURHAM
Polygonum raii		A				S. LANCS
Polygonum rurivagum		A				BERKS
Potamogeton friesii		P	R	DIT		
Potamogeton natans		P	R	DIT		DERBYS
Potamogeton polygonifolius		P	R	DIT		
Potentilla anglica		P	O	C		7

FORBS

Species	Status	Life Cycle	Frequency Recorded During Survey	Habitat	VC Records	Flora Records
Potentilla anserina		P	O	B		6
Potentilla argentea		P				RUTL, SUSSEX
Potentilla erecta		P	VC (ScR)	VC		6
Potentilla erecta x p anglica		P				SUSSEX
Potentilla intermedia	NAT	B/P				SURREY
Potentilla x italica		P	R	V		WILTS
Potentilla x mixta		P				3
Potentilla norvegica	NAT	A/B	R	B		7
Potentilla palustris		P	R	DIT		
Potentilla recta	NAT	P	R	V		MDDX, SUSSEX
Potentilla reptans		P	VC	V		15
Potentilla sterilis		P	C	V		9
Potentilla tabernaemontani		P				KIRK
Poterium polygamum	NAT	P	R	V		11
Poterium sanguisorba		P	C	CUT		14
Primula elatior		P				HAYLEY
Primula farinosa		P	R (LMR)	V		S. LANCS
Primula veris		P	C	CUT	O	18
Primula veris x p vulgaris		P	R	CUT		6
Primula vulgaris		P	C	V		16
Primula vulgaris var alba		P				TEVIOT
Prunella vulgaris		P	O	V		4
Pulicaria dysenterica		P	O	V		DERBYS, HAYLEY
Pulmonaria longifolia		P	R	V		
Pulmonaria officinalis		P				DERBYS, WILTS
Pyrola minor		P	R (LMR/ScR)	V		SUSSEX
Pyrola rotundifolia		P	R (LMR)	V		SUSSEX
Ranunculus acris		P	C	V		8
Ranunculus aquatilis		A/P	R	DIT	O	MERION
Ranunculus arvensis		A				S. LANCS
Ranunculus auricomus		P	R	V		RUTL, TEVIOT
Ranunculus baudotii		P				DEVON
Ranunculus bulbosus		P	O	CUT		6
Ranunculus ficaria		P	C	V		3
Ranunculus flammula		P	O	DIT		TEVIOT
Ranunculus hederaceus		A/P	R	DIT		MERION
Ranunculus parviflorus		A				MONM, GLOUCS
Ranunculus repens		P	C	V		7
Ranunculus sardous		A				MDDX
Ranunculus sceleratus		A	R	DIT		TEVIOT
Ranunculus trichophyllus		P	R	DIT		
Raphanus maritimus		B/P	O	V		SUSSEX
Raphanus raphanistrum		A	R	B		3
Rapistrum perenne	NAT	P				BEDS
Rapistrum rugosum	NAT	P				PEMB/LEICS
Rapistrum rugosum ssp orientale	NAT	P				BEDS
Rapistrum r rugosum	NAT	P				STAFFS, WARWKS
Reseda alba	INT	A/P				4
Reseda lutea		B/P	O	V	O	24
Reseda luteola		B	O	C		23
Reynoutria cuspidatum	NAT	A	O	YDS	O	13
Reynoutria sachalinense	NAT	A	R	YDS		SURREY, DEVON

FORBS

Species	Status	Life Cycle	Frequency Recorded During Survey	Habitat	VC Records	Flora Records
Rheum sp	INT	P	O	V		RUTL, MORAY
Rhinanthus minor sl		A	O	V		7
Rhynchosinapis cheiranthos	INT	P	O	C		6
Ricinus communis		P				CLOUCS
Romulea columnae		P				DEVON
Rorippa amphibia		P	R	DIT		
Rorippa austriaca	NAT	P				SURREY, LOND
Rorippa islandica		A/B	R	B		5
Rubia peregrina		P	R	CUT		
Rumex acetosa		P	U	V		8
Rumex acetosella ss		P	C	C	O	11
Rumex acetosa var multifidus		P				SUSSEX
Rumex alpinus	INT	P				MORAY
Rumex x arnottii		P	R	YDS	93	
Rumex brownii	INT	P				BEDS
Rumex conglomeratus		P	C	V		
Rumex crispus		P	C	V	O	7
Rumex cristatus	INT	P				ESSEX
Rumex cristatus x R crispus	INT	P				ESSEX
Rumex cristatus x R obtusifolius	INT	P				ESSEX
Rumex hydrolapathum		P	O	DIT	O	
Rumex longifolius		P	O	V	O	
Rumex maritimus		A/B				DERBYS
Rumex obtusifolius		P	O	V		5
Rumex patientia	INT	P				SURREY
Rumex patientia ssp orientalis	INT	P				MDDX
Rumex pulcher		P	R	YDS		
Rumex pulcher var divaricutus	INT	P				BEDS
Rumex sanguineus		P	C	V	O	RUTL, TEVIOT
Rumex scutatus	NAT	P	R (LMR)	R		S. LANCS
Rumex tenuifolius		P	R	C		4
Sagina apetala		A	O	C	O	14
Sagina ciliata		A	O	C		15
Sagina ciliata var filicaulis		A				3
Sagina maritima		A	R	M		SUSSEX
Sagina nodosa		P	R	V		
Sagina procumbens		P	C	C		6
Sagina subulata		P				DERBYS, MORAY
Salicornia europaea		A	R	DIT		
Salsola kali		A				WARWKS
Salsola pestifer	INT	A				4
Salvia horminoides		P	O	V		8
Salvia pratensis		P	R	CUT	O	
Salvia officinalis	INT	P				S. LANCS
Salvia verticillata	NAT	P	R	C		9
Salvia virgata	INT	P				DEVON
Samolus valerandi		P	R	DIT		RUTL
Sanguisorba officinalis		P	C	V		15
Sanicula europaea		P	O	V		
Saponaria officinalis		P	O	YDS		13
Saxifraga aizoides		P	R	CUT		
Saxifraga hypnoides	NAT	P	R	M		
Saxifraga spathularis x S umbrosa	NAT	P	O	V		4
Saxifraga stellaris		P	R	CUT		
Saxifraga tridactylites		A	O	C		
Scabiosa atropurpurea	INT	P				SUSSEX
Scabiosa columbaria		P	O	CUT		TEVIOT, LEICS

FORBS

Species	Status	Life Cycle	Frequency Recorded During Survey	Habitat	VC Records	Flora Records
Scandix ibericum	INT	A				GLOUCS
Scandix pecten-veneris		A				4
Schkuhria pinnata	INT	A				BEDS, GLOUCS
Schkuhria pinnata var abrotanoides	INT	A				GLOUCS
Schkuhria pinnata var typica	INT	A				GLOUCS
Scirpus caespitosus		P	O	V		
Scirpus lacustris		P	R	DIT		DERBYS
Scirpus maritimus		P	O	DIT		
Scirpus sylvaticus		P				BERKS
Scirpus tabernaemontani		P	R	DIT		DERBYS
Scleranthus annuus		A/B				3
Scrophularia auriculata		P	O	DIT	88	WILTS
Scrophularia nodosa		P	O	V		
Scrophularia scorodonia		P	O	V	44, 0	
Scrophularia vernalis	INT	B/P				WESTM
Scutellaria galericulata		P	R	DIT		
Scutellaria minor		P	R	V		
Sedum acre		P	O	C	0	17
Sedum album	NAT	P	R	C	65, 0	5
Sedum anglicum		P	O	R/C		ESSEX, TEVIOT
Sedum dasyphyllum	NAT	P				GLOUCS
Sedum forsteranum		P	R	M		ESSEX, KIRK
Sedum reflexum	NAT	P	O	C/R	0	5
Sedum rosea		P	O	C		
Sedum spurium	INT	P	R	C		3
Sedum telephium		P	C	V		10
Selinum carvifolia var autumnale		P				GLOUCS
Senecio aquaticus		B	R	DIT	0	RUTL, GLOUCS
Senecio erucifolius		P	C	V	0	12
Senecio inaequidens	INT	P				BEDS
Senecio jacobea		B/P	VC	V		9
Senecio x londinensis		P				6
Senecio squalidus	NAT	A	C	C/B	0	32
Senecio sylvaticus		A	O	V		5
Senecio viscosus		A	VC	C	93, 0	35
Senecio vulgaris		A	C	B		8
Senecio vulgaris var hibernicus		A	R	B		13
Serratula tinctoria		P	O	V	0	8
Sherardia arvensis		A	R	C		5
Sherardia arvensis var hirsuta		A				DEVON
Sherardia arvensis var mutica		A				DEVON
Sida rhombifolia	INT	P				YORKS
Sideritis montana	INT	P				S. LANCS, GLOUCS
Silaum silaus		P	C	V		7
Silene alba		P	C	V		12
Silene conica		A				GLOUCS
Silene cretica	•INT	P				WARWKS
Silene dioica		B/P	C	V		6
Silene gallica sl		A	R	C		3
Silene gallica var anglica		A	R	C		SUSSEX, WESTM
Silene gallica var quinquevulnera	INT	A				NORFOLK, L"POOL
Silene x intermedia		P	C	V		5
Silene maritima		P	O	V		3
Silene noctiflora		A				4
Silene nutans		P	R (LMR)	C		HERTS, GLOUCS
Silene tatarica	INT	P				S. LANCS

FORBS

Species	Status	Life Cycle	Frequency Recorded During Survey	Habitat	VC Records	Flora Records
Silene vulgaris		P	C	V	O	18
Silene vulgaris var pubescens		P				SUSSEX, L'POOL
Silybum marianum	NAT	A/B	R	C		3
Sinapis alba	NAT	A	R	C		3
Sinapis arvensis		A	O	V		3
Sison amomum		B	O	V	O	5
Sisymbrium altissimum	INT	A	O	C		11
Sisymbrium irio		A				BEDS
Sisymbrium officinale		A	O	V		5
Sisymbrium orientale	INT	A	O	C	O	19
Smyrnium olusatrum	NAT	B	O	V		BERKS, MONM
Solanum dulcamara		P	C	V		6
Solanum dulcamara var villosissimum						LOND, MDDX
Solanum nigrum		A	R	B		4
Solanum sarrachoides	INT	A				NORFOLK, GG
Solanum sisymbrifolium	INT	A				YORKS
Solanum trifolorum	NAT	A				NORFOLK
Solanum tuberosum	INT	A	O	B		RUTL
Soleirolia soleirolii	NAT	P	R	M		NORFOLK
Solidago canadensis	NAT	P	O	YDS		15
Solidago gigantea	NAT	P				6
Solidago virgaurea		P	O	V		8
Sonchus arvensis		P	O	V		7
Sonchus asper		A	C	B		6
Sonchus oleraceus		A	C	B	O	8
Sparganium emersum		P				DERBYS, MORAY
Sparganium erectum		P	R	DIT		
Spergula arvensis		A	O	C		3
Spergula arvensis var sativa	INT	A				GLOUCS
Spergularia media		P	R	DIT		
Spergularia marina		P	R	DIT		
Spergularia rubra		A/B	R	C	O	9
Spiraeia oleracea	INT	A				ESSEX
Spiranthes spiralis		P				SUSSEX
Stachys x ambigua		P				MERION, SUSSEX
Stachys annua	NAT	A				WARWKS, SUSSEX
Stachys arvensis		A	R	V		3
Stachys palustris		P	O	EMB		TEVIOT, MORAY
Stachys sylvatica		P	C	V		6
Stellaria alsine		P	O	DIT		TEVIOT, GG
Stellaria graminea		P	C	V		8
Stellaria holostea		P	C	V		7
Stellaria media		A	C	V		5
Stellaria neglecta		A/P	R	V		GLOUCS
Stellaria pallida		A	R	C		RUTL
Suaeda maritima		A	R	DIT		
Succisa pratensis		P	O	V		5
Symphytum asperum	NAT	P				WARWKS S. LANCS
Symphytum grandiflorum	NAT	P	R	EMB		
Symphytum officinale		P	O	V		3
Symphytum orientale	NAT	P	R	V		SURREY, MDDX
Symphytum tuberosum		P	O	EMB		GLOUCS, MORAY
Symphytum x uplandicum	NAT	P	O	V		6

FORBS

Species	Status	Life Cycle	Frequency Recorded During Survey	Habitat	VC Records	Flora Records
Tagetes minuta	INT	A				BEDS
Tanacetum parthenium	NAT	P	O	C	O	5
Tanacetum vulgare		P	O	V		16
Taraxacum adamsii		P				MORAY
Taraxacum brachyglossum		P				WARWKS
Taraxacum bracteatum		P				MORAY
Taraxacum cyanolepis		P				MORAY
Taraxacum dahlstedtii		P				MORAY
Taraxacum duplidens		P				MORAY
Taraxacum eximium		P				MORAY
Taraxacum faeroense		P				MORAY
Taraxacum hamatum		P				HAYLEY, MORAY
Taraxacum hemipolyodon		P				MORAY
Taraxacum laetifrons		P				HAYLEY
Taraxacum laevigatum sl		P	O	V	O	6
Taraxacum landmarkii		P				MORAY
Taraxacum longisquameum		P				MORAY
Taraxacum maculigenum		P				MORAY
Taraxacum marklundii		P				MORAY
Taraxacum naevosiforme		P				MORAY
Taraxacum nordstedtii		P				MORAY
Taraxacum officinale sl		P	C	V		12
Taraxacum pannicum		P				MORAY
Taraxacum polyodon		P				HAYLEY, MORAY
Taraxacum sellandii		P				MORAY
Taraxacum spectabile sl		P				TEVIOT
Taraxacum sublaciniosum		P				MORAY
Taraxacum subnaevosiforme		P				MORAY
Taraxacum unguilobum		P				MORAY
Teesdalia nudicaulis		A	R	C		3
Tellima grandiflora	NAT	P	R	V		
Tetragonolobus maritimus		P	R (LMR)	V		
Teucrium chamaedrys	NAT	P	R	B		LINCS
Teucrium scorodonia		P	VC	V		5
Thalictrum aquilegifolium	INT	P				GG
Thalictrum flavum		P	R	DIT		ESSEX
Thalictrum minus sl		P	O	V		PEMB
Thalictrum minus ssp minus		P	R	V	O	
Thlaspi arvense		A/B	R	B	84 (2), O	7
Thlaspi perfoliatum		A/B				4
Thymus praecox ssp arcticus		P	O	CUT		
Thymus pulegioides		P	R	CUT	O	
Torilis arvensis		A				ESSEX
Torilis japonica		A	O	V	O	6
Torilis nodosa		A				S. LANCS
Trachystemon orientalis	NAT	P				WARWKS
Tragopogon porrifolius	INT	A/B				8
Tragopogon pratensis		A/P	C	V		16
Tragopogon pratensis spp minor		A/P	O	V		4
Tragopogon pratensis ssp orientalis	NAT	A/P				WARWKS
Tragopogon pratensis ssp pratensis	NAT	A/P				4
Trientalis europaea		P	O (SCR)	V		
Trifolium angustifolium	INT	A				BEDS
Taraxacum raunkiarii		P				MORAY

FORBS

Species	Status	Life Cycle	Frequency Recorded During Survey	Habitat	VC Records	Flora Records
Trifolium arvense		A	O	C	O	14
Trifolium aureum	NAT	A				4
Trifolium campestre		A	O	V	O	14
Trifolium dubium		A	C	C		12
Trifolium fragiferum		P	R	V		
Trifolium glomeratum		A				BEDS
Trifolium hybridum	NAT	P	R	V		7
Trifolium hybridum ssp elegans	INT	P				LOND
Trifolium incarnatum	NAT	A				BEDS
Trifolium incarnatum stramineum	INT	A				BEDS
Trifolium medium		P	C	V	O	17
Trifolium micranthum		A				3
Trifolium ochroleucon		P	R	V		ESSEX, L'POOL
Trifolium ornithopodioides		A	O	V		
Trifolium pannonicum	INT	A				S. LANCS
Trifolium patens	INT	P				LEICS
Trifolium pratense		P	C	V		10
Trifolium pratense var americanum	INT	P				CARMS
Trifolium pratense var sativum	NAT	P				KIRK
Trifolium repens		P	C	V		6
Trifolium scabrum		A	R	C		GLOUCS
Trifolium squamosum		A				RUGBY
Trifolium striatum		A				5
Trifolium striatum var erectum		A				LEICS
Trifolium tomentosum	INT	A				BEDS
Triglochin maritima		P	R	DIT		
Triglochin palustris		P	R	DIT		GLOUCS, TEVIOT
Tripleurospermum maritimum ssp indorum		A	O	C		7
Tripleurospermum maritimum var salinum		B				MERION
Trollius europaeus		P	R	DIT		TEVIOT
Turritis glabra		P				3
Tussilago farfara		P	VC	V		19
Typha angustifolia		P				SUSSEX, MDDX
Typha latifolia		P	O	DIT		3
Umbilicus rupestris		P	O	R/M		
Urtica dioica		P	U	V		6
Urtica urens		A	O	C		
Utricularia vulgaris ss		A				3
Vaccaria pyramidata	INT	A				4
Valeriana dioica		P	R	V		5
Valeriana officinalis		P	O	V		6
Valeriana pyrenaica	INT	P	R	V		KIRK
Valerianella carinata		A				8
Valerianella dentata		A				3
Valerianella locusta		A	C	C	O	21
Valerianella locusta var lasiocarpa		A				WILTS
Valerianella rimosa		A				MDDX, SUSSEX
Vella annua	INT	A				BEDS
Verbascum blattaria	NAT	B				4
Verbascum lychnitis		B				3
Verbascum lychnitis var album		B				LONDON
Verbascum nigrum		B	O	V	O	11
Verbascum pulverulentum		B	O	V		4
Verbascum speciosum	NAT	B				WARWKS
Verbascum thapsus		B	O	C	O	15
Verbascum virgatum		B	R	C		6
Verbena officinalis		P	R	V		ESSEX, GLOUCS

FORBS

Species	Status	Life Cycle	Frequency Recorded During Survey	Habitat	VC Records	Flora Records
Veronica agrestis		A	R	B		WARWKS, TEVIOT
Veronica anagallis-aquatica		P	R	DIT		TEVIOT
Veronica arvensis		A	C	C		9
Veronica arvensis var nana		A				SUSSEX
Veronica beccabunga		P	R	DIT		TEVIOT, GG
Veronica chamaedrys		P	VC	V		5
Veronica filiformis	NAT	P	R	V		
Veronica longifolia	NAT	P	R	CUT		
Veronica montana		P	O	V		TEVIOT
Veronica officinalis		P	O	V		3
Veronica persica		A	O	B		3
Veronica polita		A	R	B		3
Veronica praecox		A	O	V		NORFOLK
Veronica scutellata		P				PEMBS
Veronica serpyllifolia		P	R	V		3
Veronica spicata ssp hybrida		P				S. LANCS
Veronica sublobata		A	C	V		3
Vicia bithynica		P				CLYDE
Vicia cracca		P	VC	V		14
Vicia ervilia	INT	A				LEICS
Vicia hirsuta		A	C	V	0	19
Vicia hybrida		A				LOND
Vicia lathyroides		A	O	C		3
Vicia lutea		A	R	V		3
Vicia sativa ssp nigra		A	C	V	0	17
Vicia s sativa		A	R	V		7
Vicia sepium		P	C	V		6
Vicia sepium var ochroleuca		P				WILTS
Vicia sylvatica		P	O	CUT		3
Vicia tenuifolia	NAT	P				3
Vicia tenuissima		A				GLOUCS
Vicia tetrasperma		A	R	V	67, 0	15
Vicia villosa	INT	P				BEDS, HERTS
Viola arvensis		A	R	B		9
Viola canina		P	R	V		3
Viola cornuta	NAT	P				GG, MORAY
Viola hirta		P	C	CUT	0	11
Viola lutea		P	R	V		
Viola odorata		P	O	V		7
Viola odorata var dumetorum		P	O	V		
Viola odorata var praecox		P				DEVON
Viola x permixta		P				ESSEX
Viola palustris		P	O	V		
Viola reichenbachiana		P	C	V		
Viola riviniana		P	VC	V	0	9
Viola riviniana ssp minor		P				MORAY
Viola tricolor		A/P	R	V		3
Viola tricolor ssp curtisii		P	R	V		NORFOLK
Viola x wittrockiana	INT	P	O	B	0	
Wahlenbergia hederacea		P	R	V		GLOUCS
Xanthium spinosum	NAT	A				HEREF, GLOUCS
Zanichellia palustris		P				GLOUCS, YORKS

TABLE 2.4 Cryptogams on BR land

The Table combines information from a literature search with a complete list of bryophytes and pteridophytes found growing during the survey. Lichens and algae were not systematically recorded and are not included. Keys to abbreviations and to the literature searched will be found following this Table.

BRYOPHYTES

Name	Frequency Found During Survey	Preferred Habitat	Literature Source
Acrocladium cuspidatum	C	V	
Aneura pinguis	O	V	
Aloina rigida			ESSEX
Aloina aloides var aloides	R	R/M	
Aloina aloides var ambiguum			ESSEX/NORFOLK
Amblystegium riparium	C	V	
Amblystegium serpens	C	E	BEDS, WARWKS
Amblystegium tenax	R	V	
Amblystegium varium	O	V	
Anoectangium aestivum	O (ScR)	M/R	
Anomobryum filiforme var filiforme	O	V	
Atrichum undulatum	C	C/V	WARWKS
Atrichum undulatum var minus			
Aulacomnium androgynum	C	V	BEDS, WARWKS
Aulacomnium palustre	O (ScR)	V	
Barbula convoluta	VC	C	B EDS, WARWKS
Barbula convoluta var commutata	O	C	HAYLEY
Barbula cylindrica	C	C	
Barbula fallax	C	CV	
Barbula hornschuchiana			3
Barbula recurvirostra	C	C/V	NORFOLK, S. LANCS
Barbula reflexa	O	V	
Barbula revoluta	O	R/M	S. LANCS
Barbula tophacea	R	M/R	
Barbula unguiculata	VC	C	WARWKS
Barbula vinealis	O	C	HAYLEY
Barbilophozia attenuata	O (ScR)	V	
Barbilophozia floerkii	O	V	
Bartramia pomiformis	O	V	
Blasia pusilla	R (ScR)	C	
Brachythecium albicans	C	V	WARWKS
Brachythecium glareosum	R (LMR)	V	WARWKS
Brachythecium plumosum	O (ScR)	DIT	
Brachythecium populeum	O	V	WARWKS
Brachythecium rivulare	O	DIT	
Brachythecium rutabulum	U	V	BEDS, WARWKS
Brachythecium salebrosum	O	V	WARWKS
Brachythecium velutinum	C	V	BEDS
Breutelia chrysocoma	C (ScR)	V	
Bryum algovicum var rutheanum	O	V	
Bryum alpinum	O	R/CUT	
Bryum argenteum sl	U	C	4
Bryum arg var argenteum	C	C	
Bryum arg var lanatum	O	C	WARWKS
Bryum bicolor agg.	VC	C	WARWKS
Bryum caespiticium	VC	C	3
Bryum capillare	VC	C/V	BEDS, WARWKS
Bryum donianum	O (WR)	V	ESSEX
Bryum erythrocarpum ss	O	V	WARWKS
Bryum inclinatum	O	V	WARWKS
Bryum intermedium			S. LANCS
Bryum pallens	O	C/V	

BRYOPHYTES

Name	Frequency Found During Survey	Preferred Habitat	Literature Source
Bryum rubens	O	C	NORFOLK
Bryum ruderale			ESSEX WARWKS
Bryum turbinatum			S. LANCS
Calypogeia arguta			NORFOLK, S. LANCS
Calypogeia fissa	C	R/CUT	
Calypogeia muellerana	O	R/CUT	
Calypogeia trichomanis	R (ScR)	V	
Calliergon cordifolium	O	V	
Calliergon cuspidatum	C	V	
Calliergon stramineum	R	V	
Campylium chrysophyllum	C	V	
Campylium polygamum			S. LANCS
Campylium stellatum	O	V	
Campylopus atrovirens	O	V	
Campylopus fragilis	O	V	
Campylopus paradoxus	O	V	
Campylopus pyriformis	C	V	
Campylopus subulatus	R(ScR)	V	
Cephalozia bicuspidata	C(LMR ScR)	V	WARWKS
Cephaloziella byssacea	R	V	
Cephaloziella divaricata	O	V	
Cephaloziella hampeana	O	V	HAYLEY
Ceratodon purpureus	U	C/V	3
Chiloscyphus pallescens			S. LANCS
Chiloscyphus polyanthos	O	V	
Cirriphyllum crassinervum	O	V	
Cirriphyllum piliferum	C	V	
Climacium dendroides	O	V	
Conocephalum conicum	C	C/M	
Cratoneuron commutatum	O	V/DIT	
Cratoneuron commutatum var commutatum	O	V/DIT	
Cratoneuron commutatum var falcatum	R	DIT	
Cratoneuron filicinum	R	V	ESSEX
Cryphaea heteromalla	R	E	
Ctenidium molluscum	O	V	
Dicranella heteromalla	C	V	S. LANCS
Dicranella palustris	O (ScR)	V	
Dicranella varia	C	V	3
Dicranoweissia cirrata	O	E	
Dicranum bonjeanii	C	V	
Dicranum majus	C	V	
Dicranum scoparium	C	V	WARWKS
Dicranum tauricum	R	V	
Diphyscium foliosum	R	V	
Diplophyllum albicans	C	V	
Distichium inclinatum			S. LANCS
Ditrichum flexicaule	R	V	NORFK
Drepanocladus aduncus	O	V	
Drepanocladus exannulatus	R (ScR)	V	
Drepanocladus fluitans			MDDX
Drepanocladus revolvens	O	V	
Drepanocladus uncinatus	O	V	WARWKS

BRYOPHYTES

Name	Frequency Found During Survey	Preferred Habitat	Literature Source
Encalypta streptocarpa	O	R	BERKS
Encalypta vulgaris	O	R/M	BEDS, ESSEX
Ephemerum recurvifolium			ESSEX
Eucladium verticillatum	R	R/M	
Eurynchium praelongum	U	V	
Eurynchium praelongum var praelongum	C	V	
Eurynchium praelongum var stokesii	C	V	
Eurynchium striatum	C	V	
Eurhynchium pumilum	R	V	
Eurhynchium swartzii	C	V	BEDS, ESSEX
Fissidens adianthoides	C	V	
Fissidens bryoides	C	V	
Fissidens incurvus			ESSEX
Fissidens taxifolius	VC	V	BEDS
Fontinalis antipyretica	R	DIT	
Fossombronia caespitiformis			S. LANCS
Fossombronia pusilla	O	V	
Frullania dilatata	O	E	
Frullania tamarisci	O	E	
Funaria fascicularis			S, LANCS
Funaria hygrometrica	U	C	BEDS, WARWKS
Grimmia donniana	C	R/M	
Grimmia trichophylla	C	R/M	
Grimmia pulvinata	C	R/M	HAYLEY
Gymnocolea inflata	C	V	
Gymnomitrion crenulatum	O	V	
Gymnomitrion obtusum	R	V	
Gymnostomum aeruginosum	C	R/CUT	
Gyroweisia tenuis			ESSEX, S. LANCS
Hedwigia ciliata	O	R/CUT	
Homalia trichomanoides	O	V	
Homalothecium lutescens	C	CUT	ESSEX
Homalothecium sericeum	C	CUT	
Hookeria lucens	R	V	
Hygrohypnum luridum	R	DIT	
Hylocomium splendens	C	V	
Hypnum cupressiforme sl	C	V	WARWKS
Hypnum cupressiforme var cupressiforme	C	E	
Hypnum cupressiforme var lacunosum	O	E	
Hypnum cupressiforme var resupinatum	O	E	
Hypnum jutlandicum	C (ScR)	V	
Hypnum mamillatum	O	E	
Hypnum lindbergii	O	V	
Isopterygium elegans	C	V	WARWKS
Isothecium myosuroides	C	V	
Isothecium myuros	C	V	
Jungermannia atrovirens	R	V	
Jungermannia gracillima	C	V	
Leiocolea badensis			S. LANCS
Leiocolea bantriensis			S. LANCS

BRYOPHYTES

Name	Frequency Found During Survey	Preferred Habitat	Literature Source
Leiocolea turbinata	O	V	
Leptobryum pyriforme	C	C	ESSEX
Leptodontium flexiforme LIOM	O	C/V	
Leucobryum glaucum	O	V	
Lophocolea bidentata	U	V	WARWKS
Lophocolea cuspidata	C	V/E	-
Lophocolea heterophylla	O	V/E	
Lophozia excisa			HAYLEY
Lophozia ventricosa	C	V	S. LANCS
Lunularia cruciata	O	R/M	
Marchantia polymorpha	C	C/V	
Marchantia polymorpha var aquatica			S. LANCS
Marsupella emarginata	O	V	
Metzgeria furcata	O	E	
Metzgeria fruticulosa	R	E	
Mylia tayloria	R	V	
Mnium hornum	C	V	
Mnium marginatum	O	V	S. LANCS
Mnium stellare	O	V	
Neckera complanata	O	E/V	
Odontoschisma denudatum	R	V	
Odontoschisma sphagni	R	V	
Orthodontium lineare	O	E	
Orthotrichum affine	O	E	
Orthotrichum lyellii	R	E	
Orthotrichum diaphanum	C	C/R	
Oxystegus tenuirostris	R	R/CUT	
Pellia endiivifolia	C	V	WARWKS, HAYLEY
Pellia epiphylla	C	V	
Pellia neesiana	C	V	
Phascum cervicollum			NORFOLK
Philonotis fontana	O	V	
Physcomitrium pyriforme	R	V	
Plagiomnium affine	C	V	WARWKS, HAYLEY
Plagiomnium cuspidatum	O	V	
Plagiomnium elatum	R	V	
Plagiomnium rostratum	C	V	BEDS
Plagiomnium undulatum	U	V	
Plagiochila asplenoides	C	V	
Plagiochila spinulosa	O	V	
Plagiothecium curvifolium	R	V	
Plagiothecium denticulatum	C	V	
Plagiothecium latebricola	R	V	
Plagiothecium nemorale	R	V	
Plagiothecium succulentum	O	V	
Plagiothecium undulatum	C	V	
Plectocolea obovata			S. LANCS
Pleuridium acuminatum			S. LANCS
Pleurozium schreberi	C	V	
Pogonatum aloides	O	C	
Pogonatum urnigerum	O	C	WARWKS
Pohlia annotina			S. LANCS
Pohlia carnea	C	V	BEDS
Pohlia drumondii	R	C	
Pohlia nutans	C	V	BEDS

Name	Frequency Found During Survey	Preferred Habitat	Literature Source
Polytrichum commune		V	
Polytrichum formosum	C	C/V	WARWKS
Polytrichum juniperinum	VC	C	4
Polytrichum piliferum	C	C	WARWKS
Pottia intermedia			S. LANCS
Pottia lanceolata	C	V	ESSEX, NORFOLK
Pottia truncata	C	C/V	
Preissia quadrata	O	V	
Ptilidium ciliare	R	V	
Ptilidium puccherrimum	R	E	
Ptychomitrium polyphyllum	C	R/M	WARWKS, S. LANCS
Pseudoscleropodium purum	C	V	3
Pterygoneurum ovatum			S. LANCS
Racomitrium aciculare			WARWKS
Racomitrium canescens	C	V	BERKS, WARWKS
Racomitrium fasciculare	O	V	BERKS, WARWKS
Racomitrium heterostichum	O	V	BERKS, WARWKS
Racomitrium lanuginosum	O	V	3
Rhizomnium punctatum	VC	V	
Rhodobryum roseum	O		
Rhynchostegiella tenella	C	V	
Rhynchostegium confertum	VC	V	
Rhytidiadelphus loreus	C	V	
Rhytidiadelphus squarrosus	U	V	
Rhytidiadelphus triquetrus	C	V	
Riccardia chamedryfolia			S. LANCS
Scapania compacta			NORFOLK
Scapania irrigua			S. LANCS
Scapania nemorea	O	V	S. LANCS
Scapania undulata	C	V	
Schistidium apocarpum	C	R/M	NORFOLK
Schistidium apocarpum var arocarpum			HAYLEY
Schistidium maritimum	R (LMR)	V	
Schistostega pennata			S. LANCS
Seligera calcarea	R	R/CUT	
Seligeria paucifolia			ESSEX
Sphagnum capillifolium	R	V	
Sphagnum cuspidatum	O	V	
Sphagnum fimbriatum	R	V	
Sphagnum palustre	O	V	
Sphagnum papillosum	O	V	
Sphagnum rusowii	R	V	
Sphagnum subnitens	R	V	
Sphagnum teres			S. LANCS
Taxiphyllum wissgrilli	R (LMR)	R/CUT	
Tetraphis pellucida	O	V	S. LANCS
Tetraplodon mnioides	R (ScR)	C	
Thamnobryum alopecurum	O	V	
Thuidium abietinum	R	V	NORFOLK
Thuidium tamariscinum	C	V	
Tortella tortuosa	O	R/CUT	
Tortula muralis	C	R/M	HAYLEY
Tortula muralis var aestiva			ESSEX
Tortula laevipila	O	R	
Tortula ruralis	C	R/M	BEDS, WARWKS
Tortula ruralis ssp ruraliformis	C	R/M	
Tortula subulata	O	V	
Tortula vahliana			ESSEX
Trichostomum brachydontium	O	C/V	

BRYOPHYTES

Species	Frequency Found During Survey	Preferred Habitat	Literature Source
Trichostomum crispulum	O	R	
Tritomaria quinquedentata	R	V	
Ulota bruchii	R (WR)	E	
Ulota crispa	O	E	
Weissia controversa	O	C	
Weissia longifolia	R	C	WARWKS
Weissia longifolia var longifolia	O	C	S. LANCS
Weissia microstoma			S. LANCS
Weissia squarrosa			WARWKS
Zygodon viridissimus	O	E	

PTERIDOPHYTES

Name	Frequency Found During Survey	Preferred Habitat	Literature Source
Adiantum capillus-veneris			6
Asplenium adiantum-nigrum	O	M/R	14
Asplenium ruta-muraria	O	M/R	11
Asplenium trichomanes	O	M/R	15
Asplenium viride	R	M/R	
Athyrium filix-femina	C	V	5
Blechnum spicant	O	V	TEVIOT, GG
Botrychium lunaria			DURHAM, MORAY
Ceterach officinarum	O	M/R	16
Cystopteris fragilis	R	R	13
Diphasiastrum alpinum			TEVIOT
Dryopteris carthusiana	R	V	GG, MORAY
Dryopteris x deweveri			MORAY
Dryopteris dilatata	C	V	5
Dryopteris filix-mas ss	VC	V	6
Dryopteris affinis	O	V	NORFOLK
Dryopteris villarii			DERBYS
Equisetum arvense	U	C/B/V	17
Equisetum arvense var decumbens			DEVON
Equisetum fluviatile	O	DIT	WILTS, TEVIOT
Equisetum x litorale			MORAY
Equisetum palustre	C	B/V	3
Equisetum palustre var polystachyum			WILTS
Equisetum sylvaticum	O	V	4
Equisetum telmateia	O	V	7
Equisetum variegatum	R	V	DEVON
Gymnocarpium dryopteris	O	V	3
Gymnocarpium robertianum	R	R	6
Huperzia selago	O	R/V	
Lycopodium clavatum	R	V	TEVIOT
Ophioglossum v vulgatum	O	V	3
Oreopteris limbosperma	O	V	TEVIOT
Osmunda regalis	O	DIT	S. LANCS
Phegopteris connectilis	O	V	
Phyllitis scolopendrium	C	V	14
Polypodium vulgare sl	O	V	
Polypodium vulgare ssp prionodes	R	V	4
Polypodium v vulgare	O	V	3
Polystichum aculeatum	R	V	3
Polystichum falcatum			MDDX
Polystichum setiferum	R	V	ESSEX
Pteridium aquilinum	VC	V	6
Selaginella selaginoides	O	V	

KEY TO ABBREVIATIONS

STATUS

NAT	:	NATURALISED (following Clapham *et al.* 1962)
INT	:	INTRODUCED

LIFE CYCLE

A	:	ANNUAL
B	:	BIENNIAL
P	:	PERENNIAL

FREQUENCY RECORDED DURING SURVEY

R	:	<1%
O	:	1-2%
C	:	>2-5%
VC	:	>5-20%
U	:	>20%

BRITISH RAIL REGIONS

LMR	:	LONDON MIDLAND REGION
SCR	:	SCOTTISH REGION
SR	:	SOUTHERN REGION
ER	:	EASTERN REGION
WR	:	WESTERN REGION

HABITAT PREFERENCES OBSERVED DURING SURVEY

V	:	VERGES GENERALLY
C	:	CINDER
B	:	BALLAST
YDS	:	RAILWAY YARDS
CUT	:	CUTTINGS
EMB	:	EMBANKMENTS
DIT	:	DITCHES
M	:	MASONRY
R	:	ROCK
E	:	EPIPHYTIC (CRYPTOGAMS ONLY)

RECORDS

N	:	FIRST RECORD FOR NUMBERED VICE COUNTY
N (x)	:	SECOND OR SUBSEQUENT VICE COUNTY RECORD
O	:	ONE OR MORE 10 km^2 RECORDS

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3 VEGETATION

3.1 Sampling

Objective vegetation sampling was based on a stratification of all rural BR land (Sargent 1983). The approach has been discussed in some detail in previous interim reports (Sargent & Mountford 1979, 1980) and is described only briefly here.

The rural railway network was divided into 893 measured 10 mile units. Selected geographic mapped attributes were scored, for each of these units, where they abutted on to, or were crossed by, the railway line. The information was classified using Indicator Species Analysis (Hill *et al.* 1975), a polythetic divisive method based on correspondence analysis. After inspection and some modification, the classification yielded 26 track classes (ie groups of 10 mile units). The distribution of classes within each Region is shown on the maps following page 68. Constant attributes, which are present in more than 80% of members of each track class, are given in Table 3.1. The Table is ordered using an index derived from the relative representativeness of each attribute within each track class, and is designed to show relationship between classes. There is an evident gradient between lowland south eastern and upland north western classes.

The number of units in each track class is given in Table 3.2, together with the verge area (excluding track, yards, etc). Verge width was measured at each site visited, enabling the area of each track class to be calculated. The total area of rural BR verge is 30 678 ± 4524 ha.

A total of 480 sites was distributed proportionately according to the number of members within each track class. Members to be sampled were randomly selected, and measured 100 m sampling sites (Figure 3.1) located at randomly chosen BR mile posts within the selected members. For practical purposes, sites were restricted to areas of convenient access. Four transects were measured at each site at right angles to the track, the direction which, within a short stretch of track, usually includes most variation. A number of 4 m^2 (nested 4 and 25 m^2 in woodland) quadrats, strictly proportional to the width of the verge, were distributed along each transect. Species, cover and height were recorded, and pH, slope, aspect and certain other environmental measurements taken. Species lists for entire sites were made and qualitative descriptions written. Some sites were adjudged to be of particular biological and conservation interest, and for these site files have been opened (Section 4).

3.2 Classification and ordination

From within the random stratified survey, data from 3502 stands (4 m^2 quadrats) for 667 vascular plant species were collected. Bryophytes were not recorded during the first 2 years of the survey and are therefore not included in the analysis. Plant cover was estimated visually in the field to the nearest 5%, with discrete categories being given to scores of <1% and <2%. For analysis, the information was reduced to 5 possible cover abundance states for each species.

LEGEND

TRACK CLASSIFICATION

South Eastern

Weald

Southern Chalk Uplands

Chilterns

South Western

Central Southern

South Coastal

South Midlands

Midlands and East Anglia

Eastern Lowlands

Fens

Pennine Coal Measures

Northern Sandstones

West Coastal

Lancashire Plain

Pennines

Western Coal Measures

Midland Hills

North Coast Carboniferous

Scottish Lowlands

North West Coastal

Highland Coastal

West Highlands

Central Highlands

Welsh Uplands

Igneous Coastal

SAMPLING SITES

▽ Random

○ Biological Interest

□ Cutting / Embankment

▼ Random - revisited during 1981

SITES OF PARTICULAR BIOLOGICAL INTEREST

▽ Random

○ Biological Interest

□ Cutting / Embankment

▼ Random - revisited during 1981

Cartography by the Experimental Cartography Unit

⇌ EASTERN REGION

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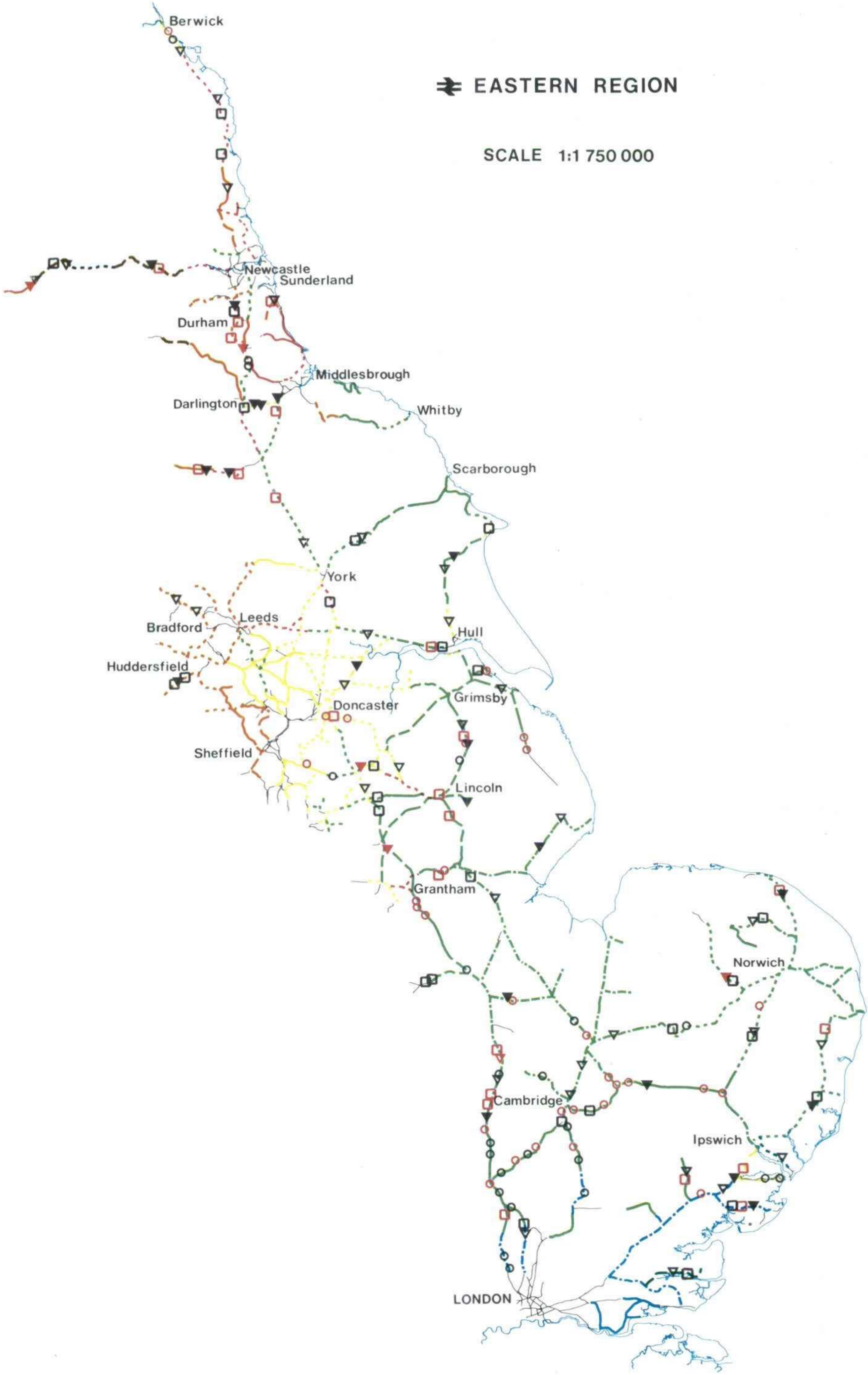
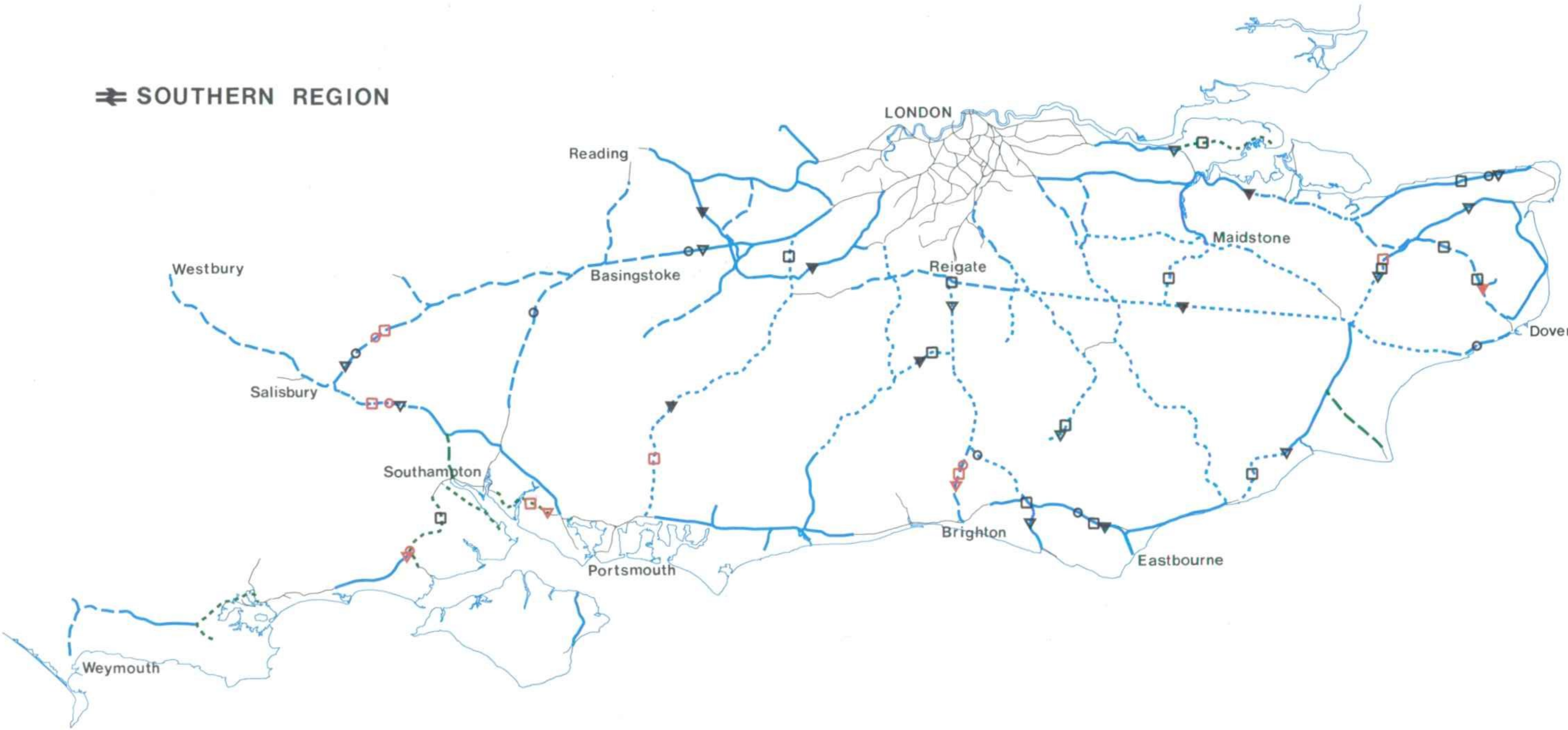
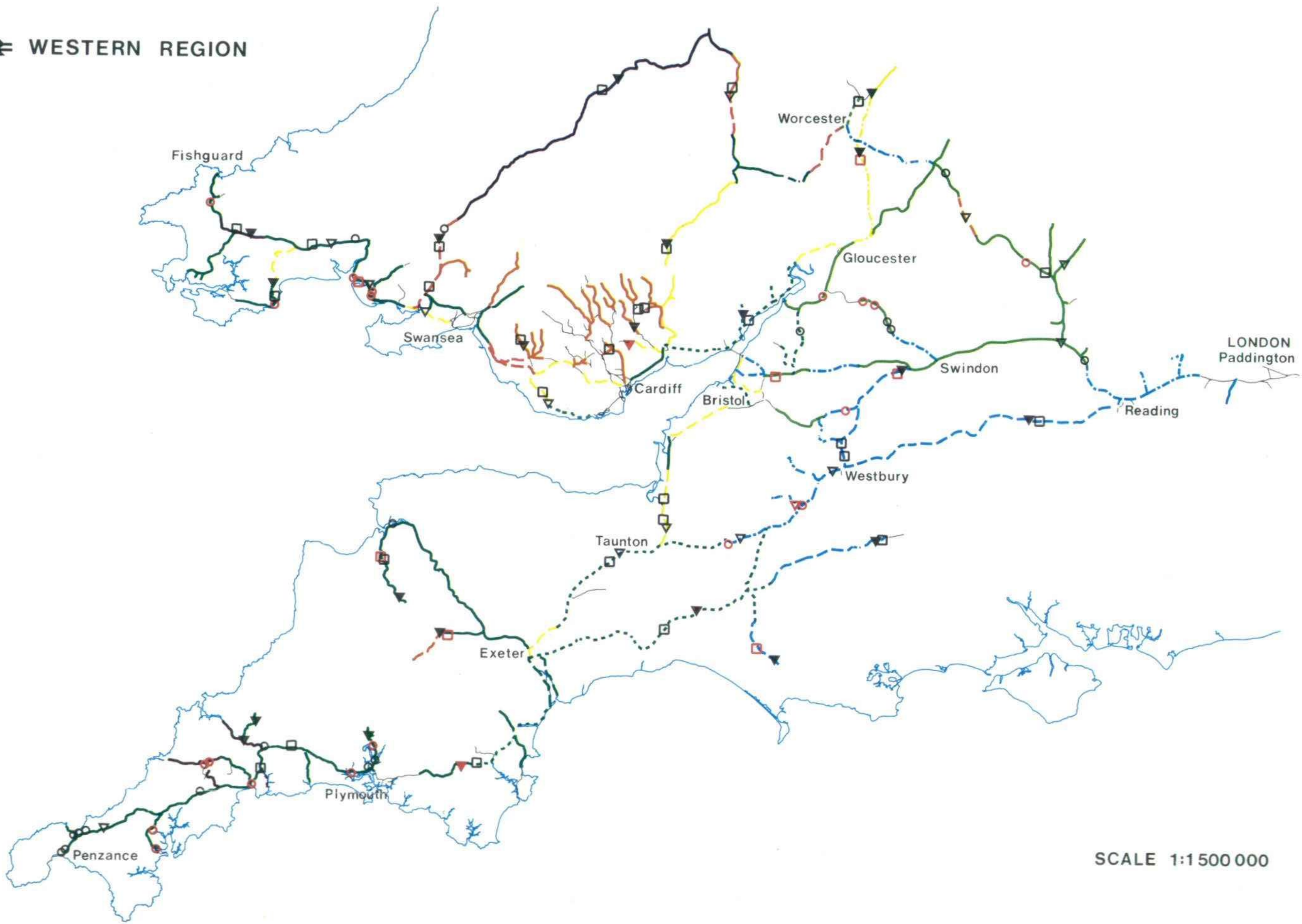


SOUTHERN REGION

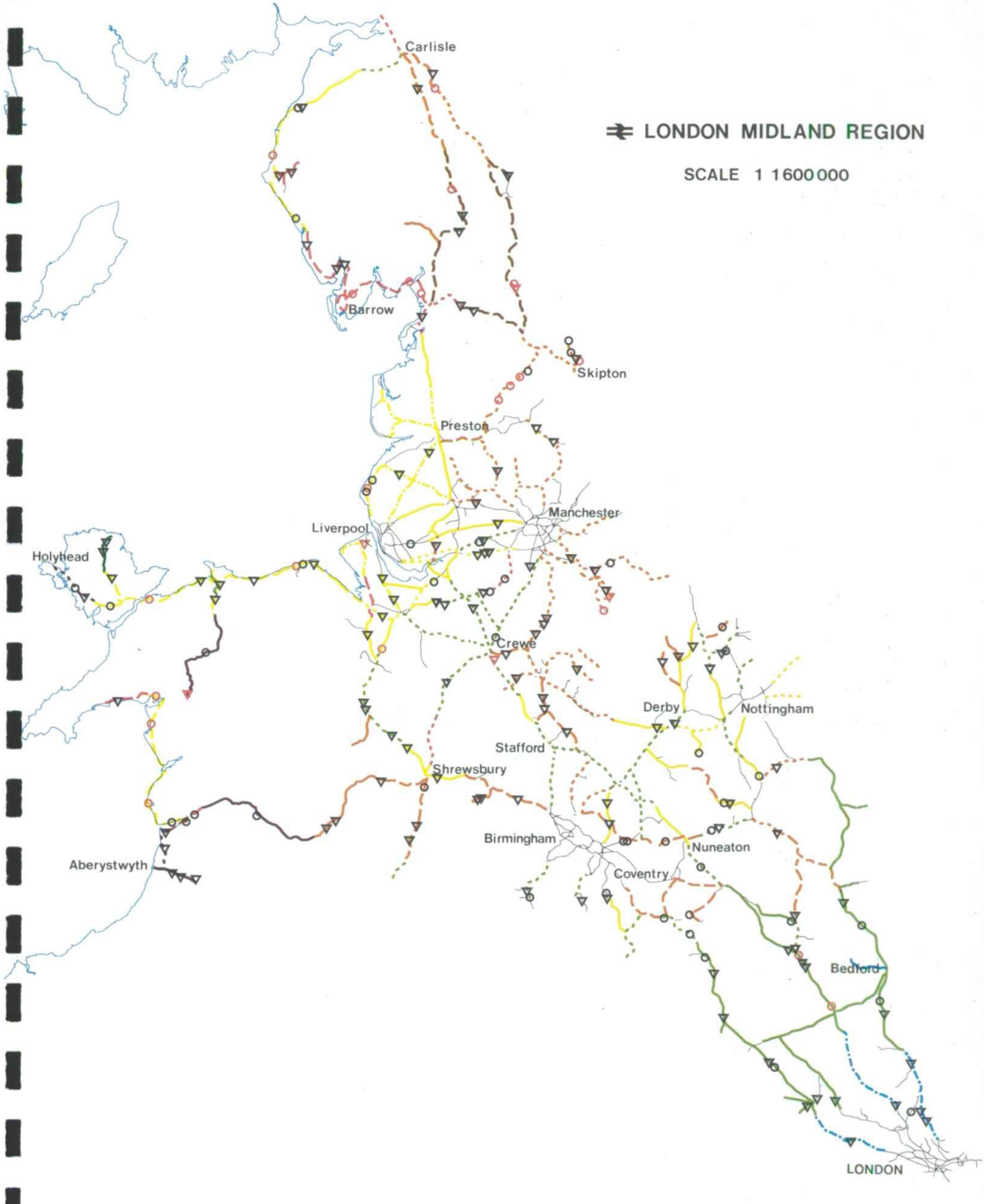


SCALE 1:1000000

WESTERN REGION



SCALE 1:1 500 000


LONDON MIDLAND REGION
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Skipton
Preston
Manchester
Liverpool
Holyhead
Crewe
Derby
Nottingham
Stafford
Shrewsbury
Birmingham
Nuneaton
Coventry
Aberystwyth
Bedford
LONDON

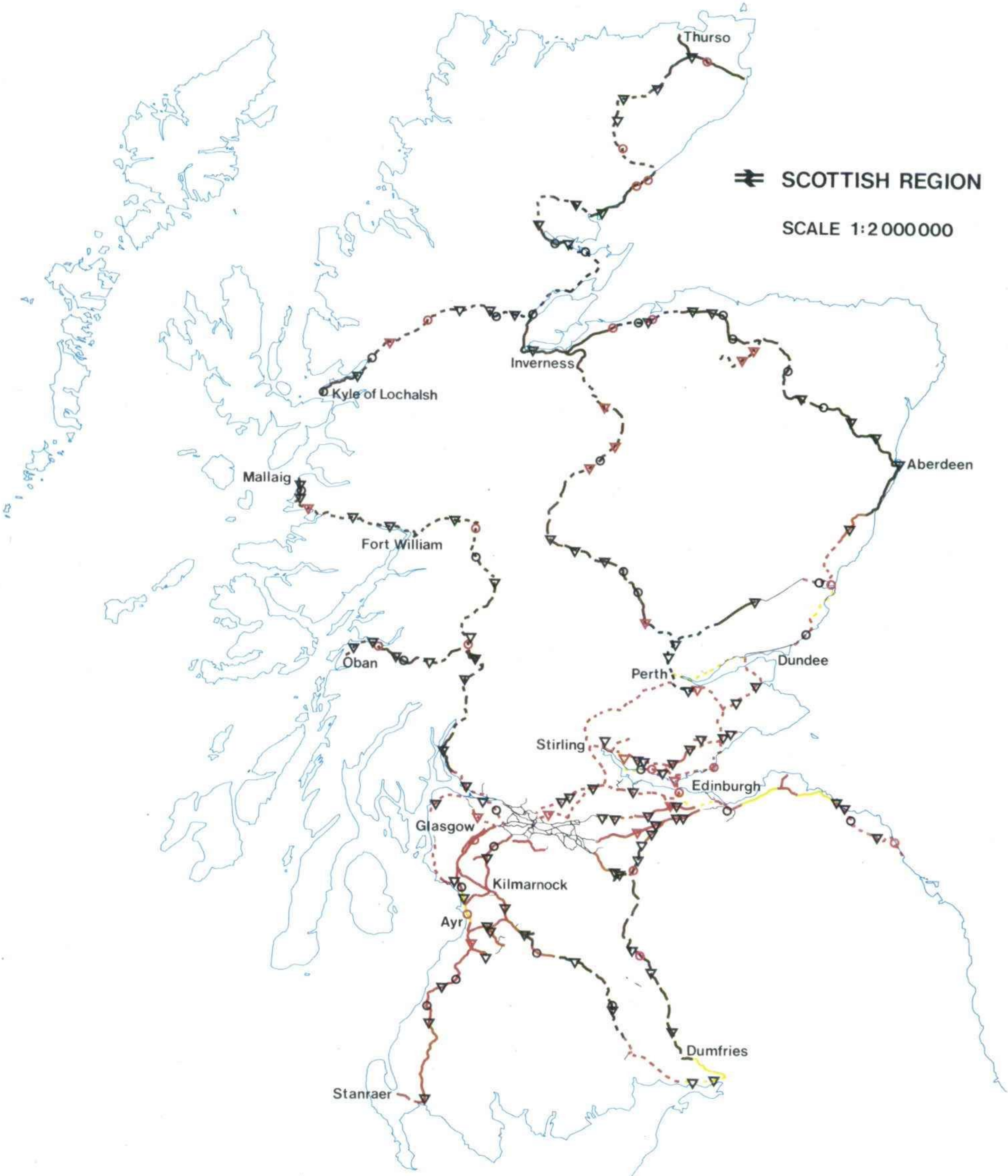

SCOTTISH REGION
SCALE 1:2 000 000
Thurso
Inverness
Kyle of Lochalsh
Aberdeen
Mallaig
Fort William
Oban
Perth
Dundee
Stirling
Edinburgh
Glasgow
Kilmarnock
Ayr
Dumfries
Stanraer

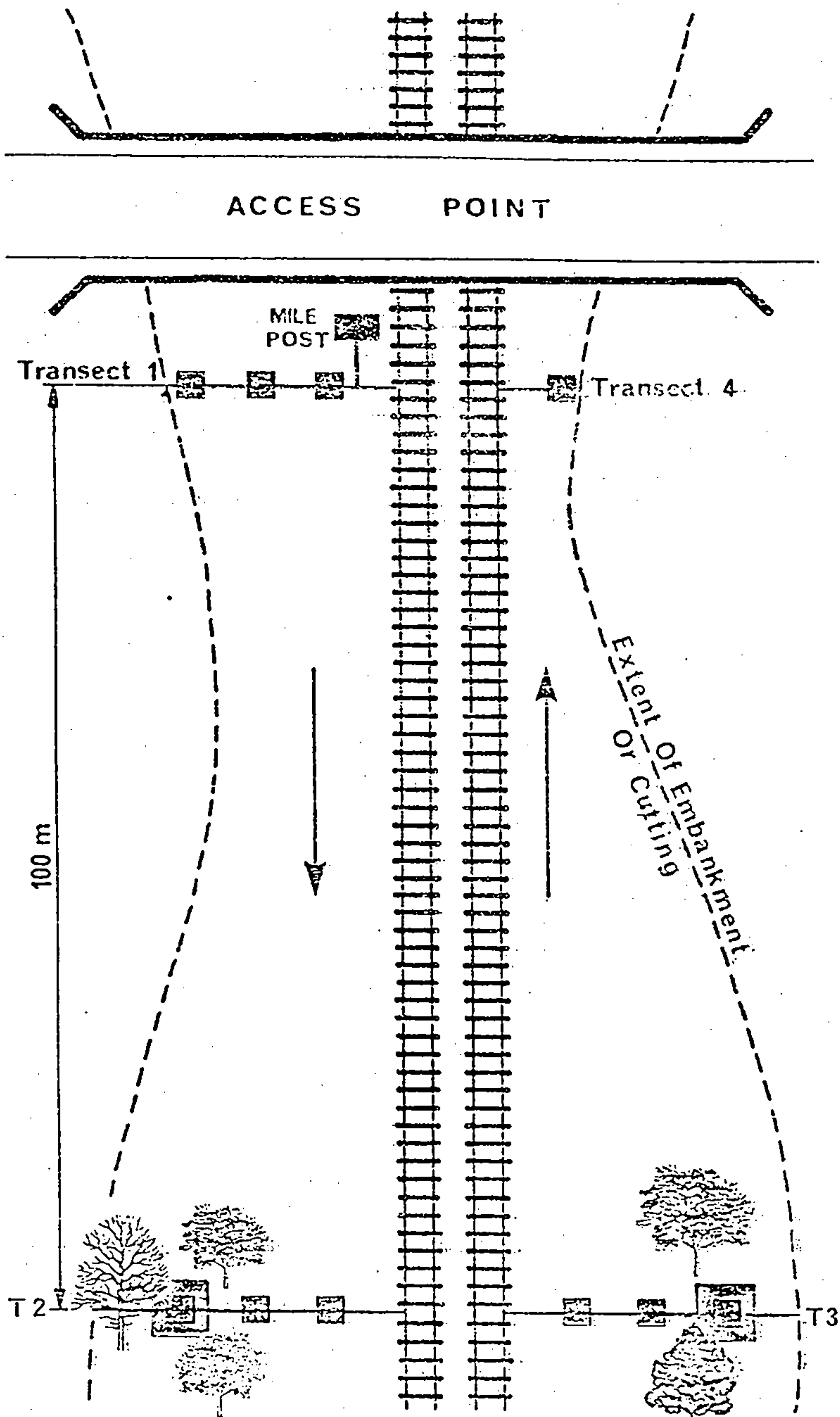
TABLE 3.1 The constant (occurring in more than 80% of members) attributes of the railway track classification. The classification depends on the distribution of 83 geographic attributes within the 899, 16·1 km (10 mile) units of rural railway verge in Britain

	Southern Chalk Uplands	South Eastern	Chilterns	South Coastal	Weald	South Midlands	Midlands & East Anglia	Northern Sandstones	Fens	Eastern Lowlands	Central Southern	South Western	West Coastal	Lancashire Plain	Pennine Coal Measures	Scottish Lowlands	Midland Hills	Pennines	Western Coal Measures	North West Coastal	North Coast Carboniferous	Welsh Uplands	Igneous Coastal	Central Highlands	Highland Coastal	West Highlands
<7.0C January	x	x			x																					
Well drained calc.-soils	x							x																		
>6.0 hrs sun July	x	x	x	x	x				x		x	x														
Chalk and oolites	x									x																
<10 days snow cover		x		x							x	x	x	x												
Electrified		x	x														x									
<400' ASL	x				x	x									x				x							
<25' ASL				x					x																	
Alluvium		x			x								x													
Drift			x	x	x					x	x	x	x					x	x			x				
Stagnogleys					x	x	x								x	x					x					
<6.0 hrs sun July						x		x		x			x	x			x									
<20 days snow cover						x	x	x	x	x					x	x					x		x			
<100' ASL								x		x	x		x	x	x					x						
Salt marsh								x																		
Bunter														x		x										
Coal measures															x			x	x		x					
<200' ASL												x			x	x				x					x	
<30 days snow cover																		x								
<6.0C January									x	x						x								x		
Non-calc. brown earths											x	x	x				x			x		x				
<5.5 hrs sun July														x	x	x	x				x					
<6.5C January																	x	x								
Carboniferous & magnesian																	x				x					
Igneous & intrusive																					x					
>400' ASL																		x						x		
Boulder clay																		x	x	x			x		x	x
Lowland podzols																								x	x	
Heath/rough pasture																			x	x				x	x	x
Single track																						x	x		x	x
Metamorphic																										x
Upland gleys																										x

TABLE 3.2 Area of rural railway verges by track class

Track Class		Area (ha)	No. Units
1	South Eastern	1 386 ± 136	41
2	Southern Chalk Uplands	1 536 ± 167	40
3	Chilterns	1 429 ± 110	32
4	South Western	960 ± 141	40
5	Central Southern	1 292 ± 339	28
6	South Coastal	104 ± 3	6
7	South Midlands	3 710 ± 603	70
8	Midlands and East Anglia	1 756 ± 143	70
9	Eastern Lowlands	1 774 ± 367	28
10	Fens	1 205 ± 307	33
11	Pennine Coal Measures	1 890 ± 225	51
12	Northern Sandstones	899 ± 99	42
13	West Coastal	1 012 ± 140	29
14	Lancashire Plain	559 ± 120	15
15	Pennines	2 217 ± 235	51
16	Western Coal Measures	840 ± 126	36
17	Midland Hills	916 ± 489	29
18	North Coast Carboniferous	759 ± 78	28
19	Scottish Lowlands	1 729 ± 141	56
20	North West Coastal	276 ± 31	16
21	Highland Coastal	879 ± 102	26
22	West Highlands	594 ± 103	24
23	Central Highlands	1 140 ± 82	38
24	Welsh Uplands	507 ± 91	18
25	Igneous Coastal	407 ± 46	16
26	Weald	902 ± 100	30
	Total	30 678 ± 4524	893

FIGURE 3.1 Generalised site diagram. The random sites are 100 m long and tied to BR mile posts. The arrows indicate the direction in which recorders walked, facing, for safety reasons, oncoming rail traffic.



<1% = 1
1-5% = 2
>5-20% = 3
>20-50% = 4
>50% = 5

The scale is weighted toward the lower end where variability is likely to be most relevant.

During classification and evaluation, these cover states were treated as "pseudospecies", *Arrhenatherum elatius*, at level 2, for example, being considered a distinct species from *A. elatius* at level 4. This gave a raw data array of 3502 x 667 x 5, or 11 679 170 components, a number too large for processing with available software and computing facilities.

A step-wise classification was therefore devised in which it was intended first to classify a stratified (by track class) random subset of data, then to ascribe the remaining data to the classification by virtue of a derived key, and subsequently to re-sort resulting major vegetation groups.

A subset of 937 samples and 442 species was taken and classified with TWINSPAN (Hill 1979a), a polythetic divisive method which groups both stands and species. The programme defines and divides with respect to a number of indicators. These indicators effectively form a key (Figure 3.2) which may be used to ascribe further information to the classification. With the data subset used, it was found that the maximum number of indicators allowed for in the programme (15) gave the least amount of misclassification (ie samples recognised by the programme as occurring in the wrong category).

The indicator species key shown in Figure 3.2 was tested by returning the 937 samples used to erect the classification through the key. Only 78% of samples went back to their original position, and the key was discarded.

A preferred method of ascribing information was found with the Czekanowski similarity coefficient. 90% of samples returned to their original or next closest position, and the remainder of the data set, 2565 samples, was ascribed to the initial TWINSPAN classification using this coefficient.

A dendrogramshowing between-group similarities with the Czekanowski coefficient is given in Figure 3.3, group average linkage is shown in the left-hand margin. At a linkage of 0.25, 4 major vegetation groups are distinguished:

1. Heath and base-poor associations

2. Grasslands

3. Tall herb and bramble

4. Scrub and secondary woodland

At a linkage of 0.3, the grasslands separate into fine leaved noda (2A) and the railway *Arrhenatherum elatius* (2B). The data set of each of these 5 major vegetation groups was reclassified with TWINSPAN, and the results of these classifications used to produce the phytosociological tables given below. Discrete vegetation groups, linking at less than 0.15, are treated independently under the heading 'miscellaneous'.

FIGURE 3.2 Key to initial TWINSPAN

Classification of 937 samples and 442 species. The key depends on the indicators defined at each level of division by the programme. See text for discussion.

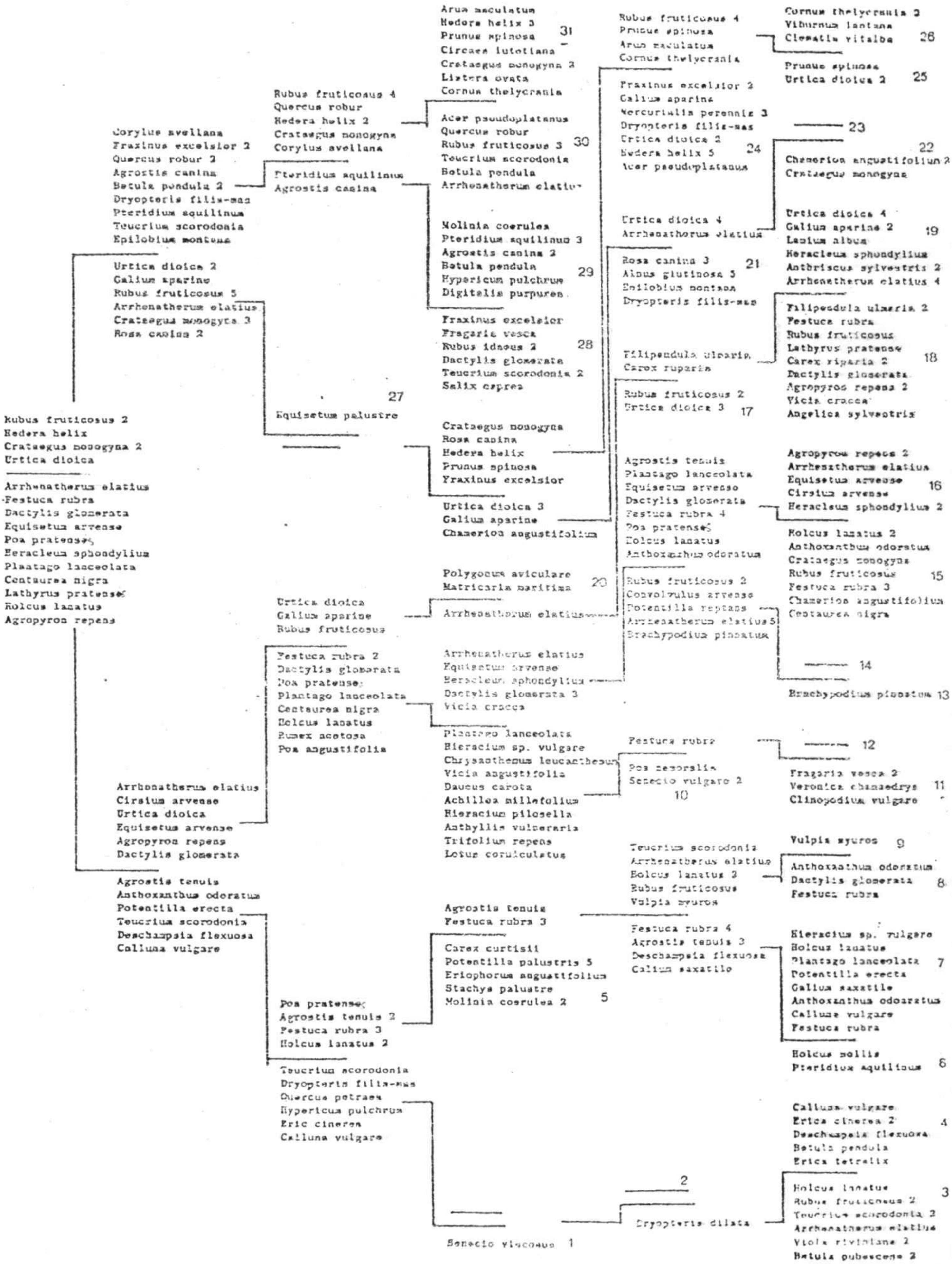


FIGURE 3.3 Average linkage between the members of the initial TWINSPAN classification (937 samples and 442 species) found using the Czekanowski similarity coefficient. 4 major vegetation groups are defined at a similarity of 0·25: 1 Heath and fern associations; 2 Grasslands; 3 Tall herb and bramble; 4 Scrub and secondary woodland. The grasslands divide into bents and fescues (2A) and false oats (2B) at a linkage of slightly less than 0·3. A group of miscellaneous noda linking at less than 0·15 occurs. The similarity coefficient was used to ascribe the remaining 2565 stands to the classification and further analysis treated the 5 vegetation groups independently.

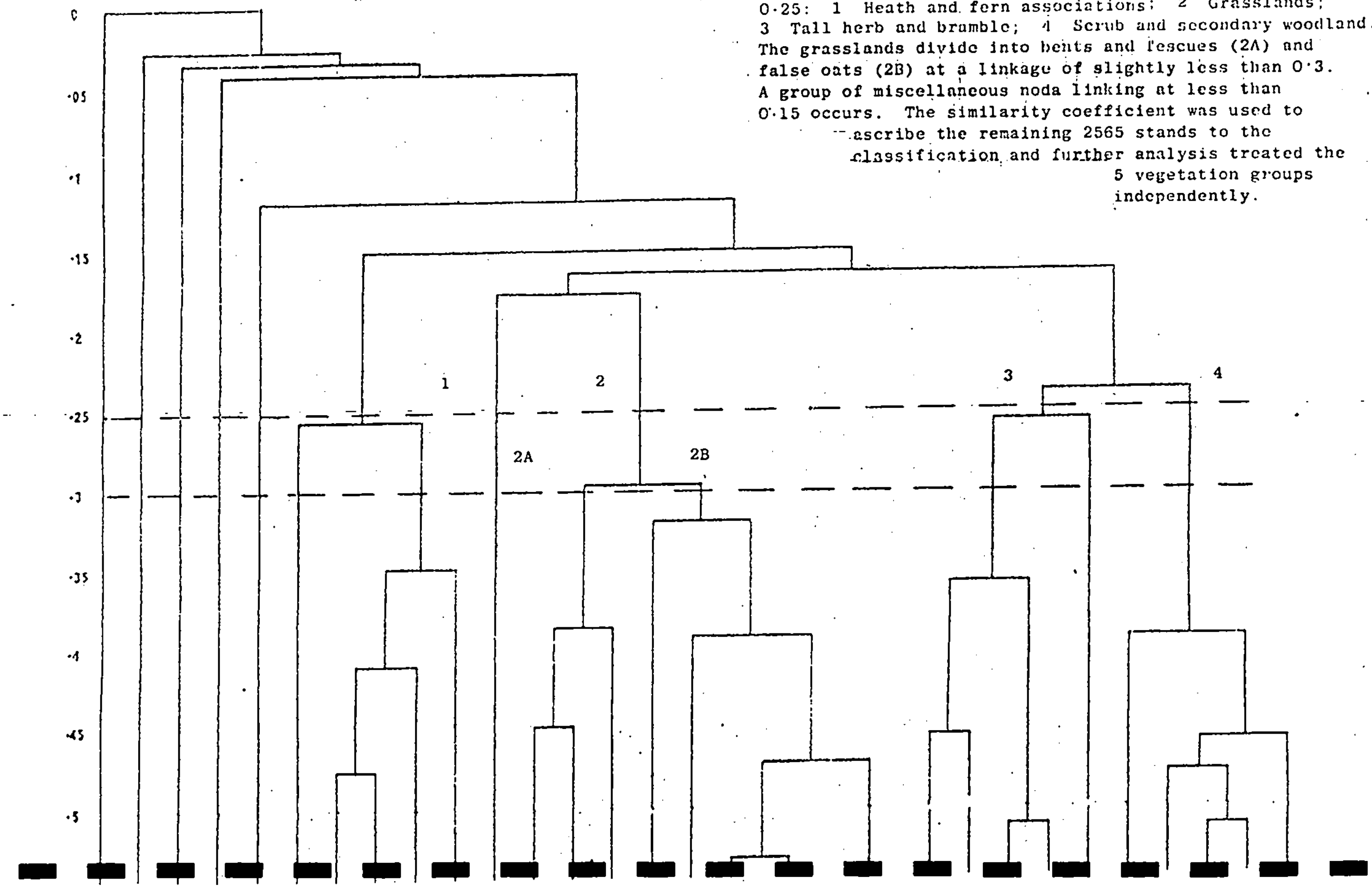
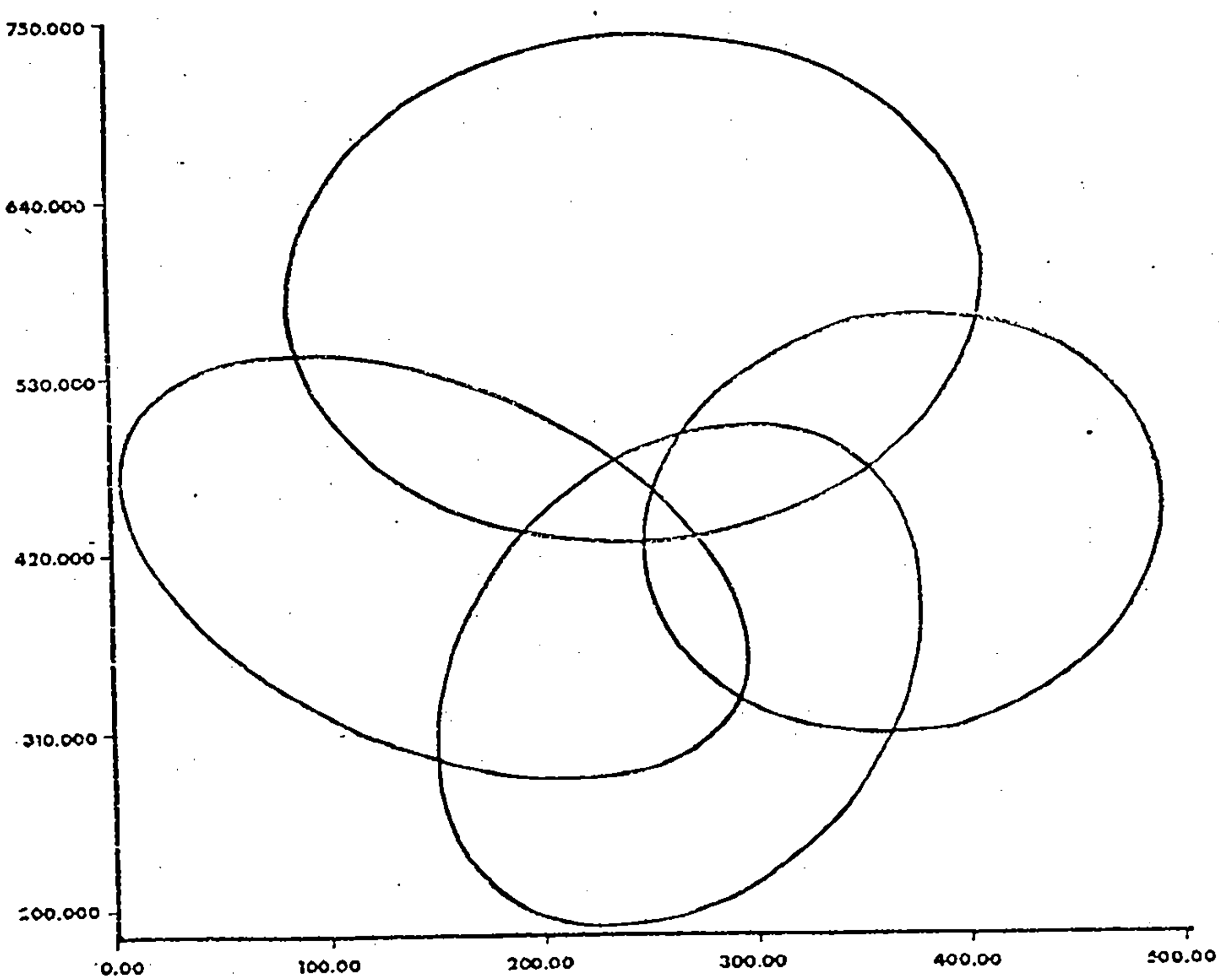


FIGURE 3.4 95% confidence ellipses enclosing the datum points of the 4 major vegetation groups on BR land as ordinated with DECORANA. The first axis (x) of ordination shows a trend of decreasing disturbance away from the origin, whilst the second (y) gives a gradient of diminishing pH and nutrient availability. The vegetation groups are:

1 Heaths
2 Grasslands
3 Tall herb and bramble
4 Scrub and secondary woodland. Data from subset of 937 samples



Ordination of the subset (937 samples) data with DECORANA (Hill 1979b) gave an extremely complicated plot, which is not reproduced here. A simplified version, showing the 4 major groups linking at 0.25, is given in Figure 3.4. 95% confidence ellipses enclose each set of datum points. Disturbance diminished away from the origin parallel with the first (x) axis of ordination. The second (y) axis shows a gradient of falling pH and nutrient availability. Other trends are obscured by the diversity of the datum set.

3.3 BR vegetation *noda*

Vegetation *noda* occurring on rural BR verges are defined with the help of 6 synoptic tables. Each table covers one of the major groups described above. The grasslands are subdivided into fine-leaved and false-oats, and the miscellaneous *noda* (having an average similarity coefficient of less than 0.15, Figure 3.3) are grouped in one Table.

The format of the Tables follows, essentially, that to be used by the National Vegetation Classification (NVC, Rodwell in preparation) and is designed to make comparison practical. Certain differences will, however, be found.

The constancy classes are equivalent:

V = present in 80% of samples
IV = >60%
III = >40%
II = >20%
I = ≤20%

However, category I (≤20% has not been used at all in the construction of the Tables, because a large number of vascular plants were recorded, many occurring only casually in the more disturbed railway vegetation types. Inclusion of such information would produce extremely long and complicated Tables, or would mask trends defined where the particular species occurs in greater abundancy in a related *nodum*. Use of this category has been made by the NVC, and this may be because of the comparative smallness of the datum sets used to define some *noda*. Within the *Centaurea nigra* sub-community (cf Page 1980) of the *Arrhenatheretum elatioris* for example 10 samples are used by the NVC, whilst the BRS includes 859 stands. Similarly, 735 stands here define the *Urtica dioica* subcommunity, whilst 118 are grouped in that *nodum* by the NVC. Clearly the BRS is more specialised than the NVC, but the greater weight of information in some areas should be taken into account when strict comparisons are made.

A simplified cover/abundance ratio of 5 states was used here. Use of the Domin Scale, preferred by the NVC, would have given a raw data array of >23 x 10^6 components (see above), and the increased problems of data handling were considered to outweigh the finer definition given by the latter scale.

For comparison, the following categories are broadly equivalent:

BRS	NVC (DOMIN)
1	1-2
2	3
3	4-5
4	6-7
5	8-10

TABLE 3.3 The distribution of vegetation *noda* within track classes on BR land. 3497 samples are listed, the remaining 5 supported bryophytes only and were not classified.

TRACK CLASSES

VEGETATION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	Total	No Track Classes
1																					3	9	6				18	3
2				2																	8	22	9				41	4
3															7				1			12	20	4			44	5
4				2				1					1	1	2	1		1	5		7	15	4	3			43	12
5	1			6				2					6		0	1	2		4	2	11	19	1	2	4		66	14
6	2			1				7	1		13	1	1		5	3	3	9	3	1	5	8	1			2	68	17
7	5			4			2	14		1	1	2	16	4	9	3	6	2	16	5	8	10	4		8		129	19
8	1							1							3				1		3	29	13				51	7
9	2	3		2			2	6	1		2	6	2	1	3		2	1	6		6	15	2	2	4		67	19
10		17					2	1						1													21	4
11	3	1						3		22		19	1	1	1			1	2								54	10
12	19	8	7	9	3		54	32	3	4	18	3	11	1	4	6	8	3	10			2			2	8	215	21
13	1			18			2	23			8	13	1	1	27	10	3	32	42	1	17	5	14		15		233	18
14	6	2	2	4	2		4	24	9	3	17	16	2	12	31	21	6	58	64	8	30	14	42		27		411	23
15	19	13	10	15	14	1	49	42	16	11	19	13	19	16	14	12	15	10	34	8	5	7	5		9	24	399	25
16		5		1			8	16	1	3	6	6	1	1	6	1	7	4	13		2		5		1		87	18
17	5	1	1	2			2	9	9	7	12	10	2	2	9	5	11	6	12	1	5	4	1			3	118	22
18	4				1		3	16	1		13	1	2	1	23	3	6	7	11		2	5	2				101	17
19		9	3	1			9	2	10		3	2			5	14		8	4	1	2	6	8		1	1	89	18
20	16	14	8	4	3		29	17	16	24	10	12	2	1	17	9	20	13	17	4	13	12	0		1	3	282	24
21	11	1		6	1	2	6	4	1		8	6	7	4	31	4	15	4	39	5	11	13	4		2	2	186	23
22	13	30	6	9	8	3	21	14	6	2	8	10	23	3	4	12	9	4	14	6	3	9	3		2	12	234	25
23			1								4		2		2		2	3	7	1	3						25	9
24	1	27	3	11	11		22	11			2	2	9	5	7		9	6	10			1			2	16	154	18
25	3	5	4	1	5	8	11	4			8	3	4	1	7	2	6		15			5				2	94	18
26	1	18	1										1	1													22	5
27	35		1	28	25		46	1					5	10	2	2	7	2	1	2	1	5		1		2	170	18
28																					11	11	2				24	3
29																		2	1			3					6	3
30	7	5		2						1	1	2	1	1						5		1					25	10
31						5	3												2								10	3
32											1		1														2	2
Total	155	159	47	128	73	19	274	250	76	78	163	125	119	71	225	109	136	174	334	50	164	251	152	12	78	75	3497	
No vegetation types	20	16	12	20	10	5	18	22	12	10	19	18	23	20	23	17	18	20	25	14	21	25	20	5	13	11		

KEY

Vegetation: 1. *Molinia-Myrica nodum*; 2. *Callunetum vulgaris* 1; 3. *Callunetum vulgaris* 2; 4. *Dryopteris filix-mas nodum*; 5. *Pteridietum*; 6. *Holcus mollis nodum*; 7. *Agrostis-Festuca nodum*; 8. *Potentilla erecta* variant; 9. *Achillea millefolium* variant; 10. Chalk grassland; 11. *Brachypodium pinnatum* grassland; 12. *Poa angustifolia* variant; 13. *Anthoxanthum odoratum* variant; 14. *Vicia cracca* variant; 15. *Alopecurus pratensis* variant; 16. *Equisetum arvense* variant; 17. *Chamerion angustifolium* variant; 18. *Holcus mollis* variant; 19. *Carex riparia nodum*; 20. *Heracleum-Anthriscus nodum*; 21. *Chamerion angustifolium nodum*; 22. *Urtica-Rubus nodum*; 23. *Ulmus glabra nodum*; 24. *Arum maculatum nodum*; 25. *Prunus spinosa nodum*; 26. *Clematis-Viburnum nodum*; 27. *Querceto-Fagetea*; 28. Ombrogenous mire; 29. *Rhododendron ponticum* stands; 30. Reed beds; 31. *Senecio viscosus nodum*; 32. *Matricaria maritima nodum*.

Track classes: 1. South Eastern; 2. Southern Chalk Uplands; 3. Chilterns; 4. South Western; 5. Central Southern; 6. South Coastal; 7. South Midlands; 8. Midlands and East Anglia; 9. Eastern Lowlands; 10. Fens; 11. Pennine Coal Measures; 12. Northern Sandstones; 13. West Coastal; 14. Lancashire Plain; 15. Pennines; 16. Western Coal Measures; 17. Midland Hills; 18. North Coast Carboniferous; 19. Scottish Lowlands; 20. North West Coastal; 21. Highland Coastal; 22. West Highlands; 23. Central Highlands; 24. Welsh Uplands; 25. Igneous Coastal; 26. Weald.

The distribution of BRS vegetation types is given by track class. In Table 3.3, the number of samples of each defined *nodum* in each track class is given. The distribution of track classes is shown on the maps following page 68.

The vegetation types are described below, and habitat information is given about each *nodum*.

3.3.1 Heath and fern associations

Heath and fern associations cover approximately 1870 ha of BR verge, and, with the exception of the *Pteridietum* (*nodum* 5), which is widely distributed, are restricted to base-poor soils along lines in northern and western Britain.

The synoptic Table (3.4) given is based on 212 samples and 226 vascular species; 5 *noda* are distinguished. The first 3 are heath and mire communities restricted to Scottish Region, and broadly comparable to *noda* defined by McVean and Ratcliffe (1962). Constant species for this group are *Calluna vulgaris*, *Erica cinerea*, *Potentilla erecta* and *Deschampsia flexuosa*. *Nodum* 4 is essentially a woodland type. *Dryopteris filix-mas* and *Teucrium scorodonia* are constant, and, together with other forbs, occur with or without a canopy of ash, birch, sallow, larch or sessile oak. This vegetation is found in Scottish and upland areas of London Midland and Eastern Regions. The *Pteridietum* (*nodum* 5) is distributed throughout BR on freely-draining acid soils.

a. 1. *Molinio-Callunetum**, *Molinia-Myrica nodum*

160 ha, West Highlands

This is very close to the *Molinia myrica nodum* defined by McVean and Ratcliffe (1962), although *Erica cinerea* and *Oreopteris limbosperma* are constant members (11) of the railway type and *Deschampsia flexuosa* was found more frequently.

The swards are dominated by *Molinia caerulea* which occurs in the highest constancy and cover/abundance states. *Potentilla erecta* and *Myrica gale* are consistently associated, whilst *Erica tetralix* and/or *Calluna vulgaris* are sometimes co-dominant. *Campylopus pyriformis*, *Hypnum cupressiforme* var. *ericetorum* and *Dicranum scoparium* were recorded frequently within this *nodum*. The number of vascular species in each sample (4 m^2) varies between 4 and 15 ($\bar{x}$7), whilst from between 0 and 9 ($\bar{x}$3) bryophytes were recorded.

This vegetation has a very limited distribution on BR land occurring mainly between Lochs Shiel and Ailort on the West Highland (Inverness to Mallaig) line. It occurs on flat or moderately sloping verges, on peat or peaty soil, with a pH range of 3.8-5.7 ($\bar{x}$4.4). Very little management, tipping or disturbance was recorded.

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* An ombrogenous mire related to this community, but with an average similarity of less than 0.15 (Figure 3.3), is described with the miscellaneous *noda*.

TABLE 3.4 Heath and fern associations

212 samples, 226 species

	1	2	3	4	5
Deschampsia flexuosa	II (1-3)	II (1-5)	IV (1-5)	II (1-5)	
Agrostis canina	II (1-2)	IV (1-5)		II (1-5)	
Blechnum spicant	II (1-2)	II (1-2)		II (1-2)	
Betula pubescens		II (2-5)		III (3-5)	
Betula pendula		III (2-5)	II (1-5)		II (1-5)
Anthoxanthum odoratum		II (1-4)	II (1-5)		II (1-3)
Pteridium aquilinum		III (1-5)		II (1-5)	IV (2-5)
Rubus fruticosus		II (1-3)		II (1-4)	IV (1-5)
Calluna vulgaris	III (1-5)	IV (1-5)	V (1-5)		
Potentilla erecta	V (1-3)	IV (1-3)	III (1-3)		
Erica cinerea	II (1-3)	II (1-5)	II (1-3)		
Myrica gale	V (1-3)				
Erica tetralix	III (1-4)				
Succisa pratensis	III (1-2)				
Oreopteris limbosperma	II (1-3)				
Molinia caerulea	V (5)	V (1-5)			
Salix aurita	III (2-4)	II (1-5)			
Sorbus aucuparia		II (1-5)			
Dryopteris dilatata		II (1-2)			
Galium saxatile		II (1-3)	II (1-3)		
Hypericum pulchrum		II (1-2)	II (1-2)		
Festuca ovina			III (1-5)		
Vaccinium vitis-idaea			II (1-5)		
Agrostis capillaris			II (1-2)		II (1-5)
Viola riviniana			II (1-3)	III (1-2)	II (1-3)
Rubus idaeus			II (1-2)	II (1-2)	II (1-5)
Teucrium scorodonia				II (2-4)	
Solidago virgaurea				II (1-2)	
Fraxinus excelsior				II (1-5)	
Quercus petraea				II (1-5)	
Fragaria vesca				II (1-3)	
Larix decidua				II (2-5)	
Salix caprea				II (1-5)	
S. cinerea ssp. oleifolia				II (1-5)	
Dactylis glomerata				II (1-3)	
Dryopteris filix-mas				IV (1-5)	II (1-5)
Epilobium montana				II (1-2)	II (1-2)
Digitalis purpurea					II (1-2)
Holcus lanatus					II (1-5)
Holcus mollis					II (2-5)
Chamerion angustifolium					II (1-5)
Galium aparine					II (1-4)
No. Samples	18	41	44	42	67

b. 2. *Callunetum vulgaris, nodum* 1

360 ha, Scottish Region

Two *noda* showing affinities with the *Callunetum vulgaris* described by McVean and Ratcliffe (1962) or the dry *Calluna* moor of Birse (1965) are recognised from railway land in Scottish Region.

The first (Table 3.5, *nodum* 2) is characterised by abundant *Molinia caerulea*, possibly reflecting a history of verge burning (Muirburn Research Group 1978), and by birch, sallow and rowan, with bracken and some bramble. These may be more recent colonists of the comparatively ungrazed and now less intensively managed verges. From 5-19 ($\bar{x}$10) vascular species were recorded in each sample, and from 1-12 ($\bar{x}$5) bryophytes. Most frequent amongst these were *H. cupressiforme* var. *ericetorum*, *Dicranella heteromalla* and *Hylocomium splendens*. *Breutelia chrysocoma* occurred occasionally and *Pohlia drumondii* was recorded from one site (R323, Glenfinnan).

The vegetation occurs on flats and cuttings with moderate to steep slopes and more or less podsolised soils. The pH range is 3.8-6.1 ($\bar{x}$4.6), and very little management or tipping was recorded.

c. 3. *Callunetum vulgaris, nodum* 2

390 ha, Scottish Region

The second *nodum* recognised within the *Callunetum* is distinguished by the virtual absence of *M. caerulea*, bracken, bramble and most non-ericaceous woody species. *C. vulgaris* is more consistently dominant, and *D. flexuosa* and *Festuca ovina* are frequent associates. *Vaccinium vitis-idaea* occurs occasionally (II), as do *Anthoxanthum odoratum* and *Agrostis capillaris*. The most common bryophytes are *Hylocomium splendens*, *Pleurozium schreberi*, *Polytrichum commune*, *Pseudoscleropodium purum* and *H. cupressiforme* var. *ericetorum*. *Racomitrium lanuginosum*, *Barbilophozia floerkei* and *Lophozia ventricosa* were recorded from some rather better drained samples, whilst *Sphagnum palustre*, *Riccardia chamedryfolia* and *Odontoschisma sphagni* occurred at the other end of the range. The number of bryophytes recorded from each sample was from 4-7 ($\bar{x}$6), whilst 3-12 ($\bar{x}$7) vascular plants were found.

The samples are mainly from steeply sloping cuttings on base-poor soils (pH 3.7-5.4, $\bar{x}$4.6). No management, tipping or railway disturbance was recorded.

d. 4. *Dryopteris filix-mas nodum*

320 ha, Scottish Region and Pennines

This *nodum* is based on a woodland ground flora dominated by *Dryopteris filix-mas* and restricted to Scottish Region and carboniferous limestone sites in the Pennines. Affinity is with the *Quercetea robori-petraeae* (Braun-Blanquet & Tuxen 1943) or, more closely, with Tansley's (1949) *Quercetum petraeae*, or McVean and Ratcliffe's (1962) "mixed deciduous woodland". Subdivision by canopy species, which include in addition to *Q. petraea*, *Fraxinus excelsior*, *Betula pubescens*, *Larix decidua* and

Salix spp., produces recognisable forms, there being, for example, a strong correlation between birch and raspberry, and between ash and *Dryopteris dilatata*. The latter vegetation is particularly characteristic of the Glasgow-Oban line. The *nodum* also exists without a tree canopy; however, with a datum set of only 42 samples, splitting seemed unwise.

Constant ground flora species include *Blechnum spicant*, *Agrostis canina*, *Deschampsia flexuosa*, *Teucrium scorodonia*, *Solidago virgaurea* and *Pteridium aquilinum*. *Trientalis europaea* and *Goodyera repens* occurred in one or two samples, whilst elsewhere *Mycelis muralis* and *Gymnocarpium dryopteris* were found. An average of 13, and range between 9 and 14, vascular species were recorded at each stand, whilst between 3 and 13 ($\bar{x}$6) bryophytes occurred. Particularly frequent amongst the bryophytes were *Thuidium tamariscinum*, *Dicranum scoparium*, *Dicranella heteromalla*, *Polytrichum formosum*, *Eurynchium praelongum* and *Lophocolea bidentata*. Less common were *Ctenidium molluscum* on carboniferous limestone and *Orthodontium lineare* on peat. Not surprisingly, the pH range recorded, 5.2-7.8 ($\bar{x}$6.4), was wide.

The vegetation occurs on moderately to steeply sloping formations, with cuttings being rather better represented than embankments. Underlying strata include calcareous and siliceous rocks, and some tipping of spent ballast was recorded. In high rainfall areas, *Dryopteris filix-mas* is a very common plant of railway tip, and observations suggest that it also shows resistance to herbicides commonly sprayed along verges by BR (Table 2.1). This may account for its more consistent inclusion in the railway facies described, than in comparable forms elsewhere.

e. 5. *Pteridietum aquilinum*

590 ha, all Regions

Communities dominated by *Pteridium aquilinum* are widespread on BR land. The *nodum* described here is broadly comparable with the association defined by Tansley (1949). *P. aquilinum* and *R. fruticosus* occur consistently, whilst *Digitalis purpurea*, *Holcus mollis*, *H. lanatus*, *A. elatius* and *Chamerion angustifolium* are amongst frequent (11) associates. Commonly occurring bryophytes include *Rhytidiadelphus squarrosus*, *Lophocolea bidentata*, *Brachythecium rutabulum*, *Pseudoscleropodium purum*, *Thuidium tamariscinum* and *Hylocomium splendens*. The number of vascular plants in each sample is between 4 and 20 ($\bar{x}$14) and of bryophytes 0 and 7 ($\bar{x}$3).

The *Pteridietum* occurs mainly on freely-draining embankments with moderate inclines and some ballast tipping. Few samples occurred in the north-facing quadrant of the compass. Although little management was recorded, the widespread distribution of this vegetation type may be due, in part, to earlier verge-burning regimes.

3.3.2 Fine-leaved grasslands

The synoptic phytosociological table (3.5) of fine-leaved grasslands found on BR verges is based on 388 samples and 354 vascular species; 6 *noda* are recognised, varying in species composition between grass heath and chalk and limestone swards. These grasslands cover approximately 3400 ha, and are distributed throughout BR. They occur

TABLE 3.5 Fine-leaved grasslands

388 samples, 354 species

	6	7	8	9	10	11
Festuca rubra	IV (1-5)	IV (1-5)	III (1-5)	V (1-5)	V (1-5)	
Poa pratensis	II (1-5)	III (1-5)	II (1-2)	III (1-5)		II (1-3)
Arrhenatherum elatius	III (1-5)	III (1-5)		II (1-5)	V (1-5)	IV (1-5)
Dactylis glomerata	II (1-5)	III (1-5)		III (1-5)	III (1-4)	III (1-4)
Rubus fruticosus agg.	II (1-5)	II (1-5)				III (1-5)
Rumex acetosa	II (1-2)		III (1-4)	III (1-4)	IV (1-2)	
Chamerion angustifolium	II (1-5)				II (1)	
Plantago lanceolata		III (1-5)	II (1-3)	III (1-5)	V (1-2)	II (1-2)
Rumex acetosella		II (1-5)		II (1-3)		
Holcus mollis	V (1-5)					
Pteridium aquilinum	II (1-5)					
Agrostis capillaris	IV (1-5)	V (1-5)	V (1-5)	IV (1-5)		
Anthoxanthum odoratum		III (1-5)	IV (1-5)	III (1-5)		
Holcus lanatus		III (1-5)	IV (1-5)	III (1-5)		
Hypochoeris radicata		II (1-5)	II (1-2)	II (1-4)		
Calluna vulgaris			III (1-5)			
Festuca vivipara			II (1-5)			
Galium saxatile			III (1-4)			
Hypericum pulchrum			II (1-2)			
Succisa pratensis			II (1-2)			
Potentilla erecta			IV (1-5)			
Festuca ovina			III (1-5)			
Molinia caerulea			III (1-5)			
Juncus effusus			II (1-5)			
Luzula multiflora			II (1-3)			
Ranunculus repens			II (1-4)	II (1-2)		
Viola riviniana			II (1-2)	III (1-3)		
Senecio jacobaea			II (1-2)	II (1-2)		
Trifolium repens				II (1-5)		
Cerastium fontanum				II (1-2)		
Luzula campestre				II (1-2)		
Achillea millefolium				III (1-5)		
Daucus carota				II (1-2)	IV (1-2)	
Hieracium pilosella				II (1-4)	IV (1-3)	
Hieracium spp. vulgata				II (1-5)	II (1)	
Taraxacum officinale				II (1-2)	II (1)	
Fragaria vesca				II (1-4)	V (1-4)	
Centaurea nigra				II (1-5)	II (1-3)	III (1-4)
Leucanthemum vulgare				II (1-2)	V (1-5)	II (1-4)
Lotus corniculatus				II (1-5)	IV (1-3	II (1-3)
Lathyrus pratensis				II (1-2)		II (1-3)
Heracleum sphondylium				II (1-2)		II (1-2)
Bellis perennis					IV (1-2)	
Hypericum perforatum					IV (1)	
Vicia sativa ssp. nigra					II (1-3)	
Vicia hirta					II (1-2)	
Galium mollugo					II (1-2)	
Picris hieracioides					II (1)	
Clinopodium vulgare					V (1-2)	
Leontodon hispidus					II (1-2)	
Senecio erucifolius					III (1-2)	
Pimpinella saxifraga					II (1-2)	
Geranium robertianum					II (1-2)	
Avenula pubescens					III (1-2)	
Poterium sanguisorba					III (1-2)	
Anthyllis vulneraria					II (1-2)	
Brachypodium sylvaticum					II (1-5)	
Clematis vitalba					II (2-3)	
Origanum vulgare					II (1-2)	
Viburnum lantana					III (1-3)	
Polygala vulgare					II (1-3)	
Crataegus monogyna					II (1-3)	
Fraxinus excelsior					II (1-2)	
Brachypodium pinnatum					II (2)	IV (3-5)
Poa angustifolia						II (1-3)
Bromus erectus						II (1-5)
Cirsium arvense						III (1-4)
Convolvulus arvensa						III (1-5)
Festuca arundinacea						II (1-4)
Viola hirta						II (1-3)
No. Samples	66	129	51	67	21	54

at extremes of pH, in upland areas, and on unstable slopes (eg chalk cuttings), where the *Arrhenatheretum elatioris* characteristic of BR verges does not compete successfully. Fine-leaved grasslands are also found where small mammal grazing is sufficient to inhibit coarser grasses, and along browse margins, where livestock from adjacent pasture feed through or over the boundary fence, hedge or wall. This grassland is particularly interesting because, whilst being selectively grazed, it is neither dunged nor trampled. It is not well documented in the literature.

Results described in Section 4 of this report, where changes in railway vegetation are considered, suggest that, in the absence of systematic burning, and under a small mammal grazing regime, *Festuca rubra* may compete successfully with *A. elatius*. The rate of increase in area of BR verge supporting a fine-leaved grassland was found to be more rapid than that where an *Arrhenatheretum* grows (Figure 4.3); whilst a majority of recently (usually accidentally) burnt swards are dominated by *A. elatius* (Table 4.1). Systematic verge burning was discontinued in the early 1960s.

The abundance of *Holcus mollis* in some of the more acid grasslands (Table 3.5) and the comparative scarcity of *Festuca ovina* and absence of *Cynosurus cristatus* may reflect the history of burning (cf Tansley 1949), whilst reduction in this method of management, coupled with increased rabbit grazing in recent (post-myxomatosis epidemic) years, has probably encouraged species diversity along verges.

Fine-leaved grasslands with *Vulpia* and *Aira* spp. are widespread on the cinder cess. They are not discussed in detail here because of the restriction of systematic sampling to rural verges.

Descriptions of the 6 *noda* are given below. They are divided into bent-fescue grasslands, in which a grazed type with 2 variants (7, 8, 9), and a subcommunity with *Holcus mollis* on peaty and humic soils (6) are recognised and distinguished from calcicolous *noda* of herb-rich (10) and *Brachypodium pinnatum* (11) grasslands. The geographic range of each is shown in relation to the track classification (Table 3.3), the more specialised forms on peat and calcareous substrata (6, 10, 11), which are not directly dependent on grazing, having a more restricted distribution.

a. 6. *Holcus mollis* subcommunity

580 ha, Scottish, London Midland and Eastern Regions

Although this community recognisably belongs amongst the *Agrostis-Festuca* grasslands described by Tansley (1949), the common occurrence of *A. elatius* and *C. angustifolium*, together with the abundance of *H. mollis* (possibly in consequence of previous burning), suggests that this is a distinct railway form of vegetation.

It is the least species-rich of the fine-leaved *noda* described, having between 8-13 ($\bar{x}$11) vascular species and 0-4 ($\bar{x}$3) bryophytes in each sample. The most frequently recorded bryophytes were *Campylopus pyriformis*, *Polytrichum juniperinum*, *Rhytidiadelphus squarrosus* and *Brachythecium rutabulum*, the latter usually occurring on spent ballast beneath the grass canopy.

The grassland has a northern and western distribution, and was found most often on flats or south-westerly slopes with a moderate incline. The soil is humic or peaty with a low pH (3.9-6.2, x̄5.2), and very commonly strewn or partially covered with old (not recently tipped) spent ballast. In samples adjacent to the track, some spraying was recorded; elsewhere little recent management was observed.

b. 7. *Agrostis capillaris-Festuca rubra* grassland

1130 ha, all Regions

This community is widely distributed on BR land and includes many of the cattle and sheep browsed margins, and more heavily rabbit grazed swards. In addition to the type, 2 grazed variants are recognised. One is found on more acid soils (8, *Potentilla erecta* variant), whilst the other (9, *Achillea millefolium* variant) occurs on more fertile and less freely draining soils.

The type is comparatively species-rich, with between 9 and 25 (x̄18) vascular species, and 0 to 5 (x̄1) bryophytes in each sample. Amongst the constant vascular plants are *Anthoxanthum odoratum*, *Holcus lanatus*, *Poa pratensis*, *A. elatius* and *Dactylis glomerata*, whilst common bryophytes include *Ceratodon purpureus*, *Bryum capillare* and *Polytrichum juniperinum* acrocarpous species usually found in freely draining areas, with little shade.

Most samples were from flats, or wide freely-draining and moderately sloping cuttings, with a pH range between 5.3 and7.9 (x̄6.4). Vegetation from one siliceous stone wall rising abruptly from the cess is rather anomalously included. A majority of swards had ballast, varying from light to severe, strewn around. Little management was recorded.

c. 8. *Potentilla erecta* variant

450 ha, Scottish and London Midland Regions

This variant is confined to base-poor soils (pH 4.0-6.2) in Scottish and London Midland Regions, with single (possibly anomalous) aliens in Eastern and Southern Regions.

The constant vascular plants of the type (above) are associated with, amongst other heath species, *Calluna vulgaris*, *Galium saxatile*, *Festuca ovina* and *Molinia caerulea*. Common bryophytes include *Rhytidiadelphus squarrosus*, *Hylocomium splendens* and *Plagiomnium undulatum*. Numbers of vascular plants range between 0 and 5 (x̄3) in each sample.

The grassland was found on predominantly flat formations, with some light ballast-tipping and little management.

d. 9. *Achillea millefolium* variant

590 ha, all Regions

This variant occurs on deeper, more fertile soils with a pH between 6.0 and 7.6 (x̄6.7). A majority of samples are grazed by livestock from adjacent pasture, and occur on flats along embankment footings or at the top of cutting slopes. The increased fertility may be associated with spray drift, or drainage into the footings, but not with dunging, as grazing is restricted to, or through, the boundary and livestock seldom escape on to railway land. Constant species which distinguish this variant are *Trifolium repens*, *Cerastium fontanum*, *Luzula campestris* and *Achillea millefolium*. From 5-16 ($\bar{x}$13) vascular plants and from 0-3 ($\bar{x}$1) bryophytes occur, including almost consistently *Rhytidiadelphus squarrosus*.

Little management or tipping was observed.

e. 10. Chalk grassland

180 ha, Southern and Western Region

This grassland clearly falls within the *Festuco-Brometea* of Braun-Blanquet and Tuxen (1943) or thermophilic dry grassland defined by Wolkinger and Plank (1981).

On BR land, it is restricted to steeply sloping, unstable, chalk cuttings in Southern and Western Regions.

The community is extremely species-rich with from between 22 and 28 ($\bar{x}$26) vascular plants in each 4 m^2 sample. *Clinopodium vulgare*, *Bellis perennis* and *Hypericum perforatum* are the most constant distinguishing species. Amongst bryophytes, only *Brachythecium rutabulum* was occasionally recorded.

The samples were on calcareous soil of pH 7.3-7.7 ($\bar{x}$7.5). No tipping or management was recorded, and the instability of the slopes probably discourages colonisation by woody species.

f. 11. *Brachypodium pinnatum* grassland

470 ha, Southern and Eastern Regions

These grasslands also have a limited distribution, occurring on moderately sloping calcareous cuttings in Southern and Eastern Regions. The soil is often clay and the pH varies between 7.2 and 8.2 ($\bar{x}$7.8).

The swards are comparatively coarse and only moderately species-rich, with from 9-15 ($\bar{x}$12) vascular plants and 0-5 ($\bar{x}$2) bryophytes in each stand. Constant species include *Cirsium arvense*, *Convolvulus arvense*, *Poa angustifolia* and *Bromus erectus*, and the community is distinguished from drier members in this group by the virtual absence of *Festuca rubra*. At one site, *Ophrys apifera* occurs abundantly, whilst at others *Cirsium eriophorum* and *Genista tinctoria* are interesting associates. Amongst bryophytes, *Homalothecium lutescens*, *Campylium chrysophyllum* and *Eurynchium striatum* are important.

Although little management and no tipping was recorded, it is likely that burning has, in the past, played some role in the development of the sward.

TABLE 3.6 *Arrhenatheretum elatioris*

1594 samples, 461 species

	12	13	14	15	16	17	18
Arrhenatherum elatius	V (1-5)	V (1-5)	V (1-5)	V (1-5)	V (1-5)	V (1-5)	V (1-5)
Festuca rubra	V (1-5)	V (1-5)	V (1-5)	III (1-5)	III (1-5)	II (1-5)	II (1-5)
Dactylis glomerata	IV (1-5)	V (1-5)	V (1-5)	II (1-2)	II (1-4)	II (1-2)	II (1-5)
Heracleum sphondylium	II (1-4)	III (1-4)	III (1-4)	III (1-4)	II (1-4)	II (1-4)	III (1-3)
Lathyrus pratense	II (1-4)	III (1-4)	III (1-4)	II (1-2)			
Poa pratensis	III (1-5)	III (1-5)	IV (1-5)	II (1-4)			
Equisetum arvense	II (1-4)	II (1-4)	II (1-5)	IV (1-5)	II (1-5)		
Rubus fruticosus agg.	III (1-5)	III (1-5)		II (1-5)	V (1-5)	V (1-5)	IV (1-5)
Chamerion angustifolia		II (1-5)	II (1-5)			V (1-5)	IV (1-5)
Elymus repens			II (1-5)	IV (1-5)		II (1-3)	II (1-[illegible])
Centaurea nigra	III (1-5)	III (1-5)	III (1-5)				
Plantago lanceolata	V (1-3)	IV (1-3)	II (1-3)				
Holcus lanatus	II (1-5)	III (1-5)	III (1-5)				
Rumex acetosa	II (1-2)	III (1-3)	II (1-3)				
Taraxacum officinale	II (1-2)	II (1-2)	II (1-2)				
Poa angustifolia	IV (1-5)						
Potentilla reptans	III (1-5)						
Leucanthemum vulgare	III (1-4)						
Vicia sativa ssp. nigra	II (1-4)						
Cerastium fontanum	II (1-2)						
Achillea millefolium	IV (1-2)	II (1-2)					
Anthoxanthum odoratum		III (1-5)					
Agrostis capillaris		II (1-4)					
Lotus corniculatus		II (1-3)					
Hieracium spp. vulgata		II (1-3)					
Angelica sylvestris		II (1-2)					
Tussilago farfara		II (1-3)					
Viola riviniana		II (1-2)					
Vicia cracca			II (1-2)				
Cirsium arvense				IV (1-5)	II (1-4)	II (1-3)	II (1-3)
Urtica dioica				II (1-5)	II (1-5)	III (1-5)	III (1-4)
Poa trivialis				II (1-5)			
Alopecurus pratense				II (1-5)			
Anthriscus sylvestris				II (1-2)			
Galium aparine					II (1-4)	III (1-4)	
Holcus mollis							IV (1-5)
No. Samples	215	233	411	399	87	118	101

3.3.3 *Arrhenatheretum elatioris*

13 730 ha, throughout BR

The railway *Arrhenatheretum* may be strictly compared with the *Arrhenatheretum elatioris* defined by Rodwell for the NVC. A prepublication copy of the chapter concerning mesotrophic grasslands has been distributed within the NCC and kindly made available.

The *Arrhenatheretum* is almost ubiquitous on railway land, occupying about 13 730 ha, and absent only from track class 24, Welsh Uplands, where the narrowness of randomly chosen verges may have led to under-sampling. In Table 3.6, 7 *noda* are recognised based on a sample of 1594 stands and 461 species.

The first 3 of these are considered variants of the *Centaurea nigra* subcommunity defined by the NVC, but are not directly identifiable with *noda* described. The remaining 4 fall within the *Urtica dioica* sub-community. The *C. nigra* members are here distinguished by that species and by *Holcus lanatus, Rumex acetosa* and *Taraxacum officinale*. Character species for the second subcommunity are *Urtica dioica* and *Cirsium arvense*, which is also distinguished by having rather more bramble (*Rubus fruticosus* agg.) and rather less *Festuca rubra*. The *C. nigra noda* are characteristic of disturbed cuttings, whilst the *U. dioica noda* more frequently occur on the deeper soils of embankments and slopes.

The most consistent floristic differences between the railway *Arrhenatheretum* and that defined by the NVC from data collected from other (non-railway) habitats are the complete absence of *Cynosurus cristatus* (recorded in species lists but not stands, from 3 random sites only), and the general and widespread occurrence of *E. arvense* and *C. angustifolium* (present in all *noda*, at level 1 where not otherwise marked; Table 3.7).

Poa angustifolia is not described in the NVC *Arrhenatheretum* but gives its name here to a variant based on consistent occurrence (215 samples) and association with other species of well drained slopes with sunny aspects. *Poa angustifolia* is present at level I (not tabulated) in all members of the *C. nigra* subcommunity.

The comparative species paucity of the railway *Arrhenatheretum* is more apparent than real. The large number of samples gives constancy values here considerable weight when compared, for example, with the values given in the NVC. An inspection of NVC tables suggests greater diversity, but this is due to the rather smaller datum set (one tenth) used. Mean species/sample are approximately equal, although the maximum number of species/sample recorded tends to be much higher in the railway datum set, where casual and adventive plants occur frequently. *Acanthus mollis*, *Kniphophora* sp. and *Triticum aestivum* are amongst more interesting species found.

The 7 railway *noda* are described below. The *C. nigra* variants are *Poa angustifolia* (12), *Anthoxanthum odoratum* (13) and *Vicia cracca* (14), whilst the *U. dioica* variants are *Alopecurus pratensis* (15), *Equisetum arvense* (16), *Chamerion angustifolium* (17) and *Holcus mollis* (18). The distribution of these *noda* with respect to track classes is shown in Table 3.3.

a. 12. *Poa angustifolia* variant

1890 ha, all Regions

The *Poa angustifolia* variant occurs on disturbed flats and south facing cutting slopes. Moderate to heavy ballast tipping, recent burning and scrub cutting were frequently recorded. The pH range is wide, 5.0-8.2 ($\bar{x}$7.0), and probably not as critical to the *nodum* as the freely draining character of the soil.

Constant associates which distinguish this variant are *Vicia sativa* ssp. *nigra*, *Potentilla reptans* and *Leucanthemum vulgare*. Whilst *Cerastium fontanum* is a constant member of the NVC *Arrhenatheretum*, on railways it is only present with any consistency in this *nodum*. The number of vascular plants in each stand varied between 1 and 42 ($\bar{x}$19), and the species richness and diversity is almost certainly associated with disturbance. Bryophytes are less abundant, and between 0 and 4 ($\bar{x}$1) were recorded, including particularly *Bryum capillare* and *Brachythecium rutabulum*. Amongst the more interesting species recorded were *Leptodictyum riparium* and *Tortula ruraliformis*, more commonly associated with, respectively, pond or river margins and sand dunes.

b. 13. *Anthoxanthum odoratum* variant

2040 ha, all Regions except Southern

This variant occurs on rather more acid soils (pH 5.1-7.3, $\bar{x}$6.3), on moderately sloping north facing formations (usually cuttings). Considerable disturbance by ballast tipping was recorded, although burning and scrub cuttings were less important than in the previous *nodum*. Most samples came from rather nearer the cess, where railway influence is stronger, than the boundary.

Between 9 and 24 ($\bar{x}$16) vascular plants and 0-5 ($\bar{x}$2) bryophytes were recorded from each stand. The constant species which distinguish this variant from other members of the subcommunity include *Agrostis capillaris*, *Lotus corniculatus*, *Hieracium* spp. *vulgata* and *Angelica sylvestris*, which is frequently found where spent ballast provides some light mulching of the underlying soil. Amongst commoner bryophytes were *Lophocolea bidentata*, *Brachythecium rutabulum*, *Rhytidiadelphus squarrosus* and *Eurynchium confertum*.

c. 14. *Vicia cracca* variant

3610 ha, all Regions

This is a coarse variant on rather deeper, circumneutral (pH 6.1-8.3, $\bar{x}$6.7) soils on flats and low cuttings or embankments. The majority of samples fell into east or west facing quadrants. Tipping, varying from light to severe, was fairly consistently recorded, whilst the most frequent form of management noted was selective spraying of scrub and woody species.

The variant is distinguished from other members of the subcommunity by the presence of *Elymus repens* and *V. cracca*. It is considered the railway type. The fewer number of selective species in part reflects its large size. This variant is the most widely distributed vegetation on BR land, occupying approximately 3610 ha.

Individual stands are less species-rich than related *noda*, with from 5-21 ($\bar{x}$13) vascular species and 0-8 ($\bar{x}$1) bryophytes being recorded. *B. rutabulum* and *Bryum capillare* are the most commonly occurring bryophytes in this rather disturbed grassland.

d. 15. *Alopecurus pratensis* variant

3500 ha, all Regions

This is the other large and widespread variant of the *Arrhenatheretum* occurring on BR land. It is characteristic of flats and embankments (and a few cuttings), many of which have gently (<30^{o}) to moderately (<45^{o}) inclined slopes with a south-westerly aspect. Tipping, often severe but always more or less colonised (old), was consistently recorded, and the majority of samples came from closer to the cess than the boundary. Soil pH varied between 4.8 and 8.4 ($\bar{x}$6.9).

The variant shows character species with both the *Centaurea nigra* community (*Lathyrus pratensis* and *Poa pratensis*) and the *nodum* with which it is included (*Cirsium arvense* and *Urtica dioica*). It is essentially intermediate, occurring on warmer (sw) and better drained embankments, as well as on some cuttings. The *Centaurea nigra* sub-community is characteristic of cutting slopes, whilst the *U. dioica nodum* is virtually restricted to the often more disturbed embankment slopes, with comparatively deeper soils.

E. repens and *Equisetum arvense* occur at a high constancy level in this *nodum*, which is distinguished from related variants by *A. pratensis*, *Poa trivialis* and *Anthriscus sylvestris*. The average number of vascular species in each stand is 13 (range 3-42), whilst from 0-8 ($\bar{x}$1) bryophytes were recorded. Frequently occurring species included *B. rutabulum*, *Funaria hygrometrica* and *B. capillare*.

e. 16. *Equisetum arvense* variant

760 ha, all Regions

This is a comparatively species-poor variant ($\bar{x}$11, range 2-21) which includes recently colonised ballast tips. Bramble (*Rubus fruticosus* agg.) is ubiquitous and horsetail (*E. arvense*) a common associate.

The *nodum* occurs on embankment slopes, many of which have a south-easterly aspect, and on most of which spent ballast has been tipped. Little other management was recorded. The pH is circumneutral (4.5-8.0, $\bar{x}$6.9), and the most frequently associated bryophytes are *B. rutabulum* and *Eurynchium praelongum*.

f. 17. *Chamerion angustifolium* variant

1040 ha, all Regions

Closely related to the previous *nodum*, this variant is distinguished by the constant occurrence of *Chamerion angustifolium*. It occurs on embankments (and occasional cutting) slopes with variable, but consistently colonised, tipping. The pH ranges between 5.2 and 7.6 ($\bar{x}$6.5), and no preferred aspect or particular form of management was recorded.

TABLE 3.7 Tall herb and bramble

791 samples, 349 species

	19	20	21	22
Arrhenatherum elatius	V (1-5)	V (1-5)	II (1-5)	IV (1-5)
Urtica dioica	III (1-5)	V (1-5)	III (1-5)	V (1-5)
Galium aparine	III (1-5)	IV (1-5)	II (1-5)	IV (1-5)
Rubus fruticosus	III (1-5)	II (1-5)	IV (1-5)	V (1-5)
Cirsium arvense	III (1-5)	II (1-5		II (1-5)
Filipendula ulmaria	V (1-5)	II (1-5)		
Equisetum arvense	II (1-2)	II (1-2)		
Festuca rubra	II (1-3)	II (1-5)		
Elymus repens	III (1-5)	II (1-5)		
Carex riparia	II (1-5)			
Lathyrus pratensis	II (1-4)			
Dactylis glomerata	II (1-4)			
Angelica sylvestris	II (1-3)			
Vicia cracca	II (1-3)			
Heracleum sphondylium		III (1-5)		
Anthriscus sylvestris		II (1-5)		
Chamerion angustifolium		II (1-5)	III (1-5)	
Dryopteris filix-mas			II (1-5)	
No. Samples	89	282	186	234

There are an average of 12 vascular species (8-16) and fewer than 1 (0-3) bryophytes in each sample, with only *B. rutabulum* occurring commonly.

g. 18. *Holcus mollis* variant

890 ha, all Regions except Southern

The distribution of this *nodum* seems largely determined by soil pH and ballast tipping. The soil was recorded as considerably more acid, $\bar{x}$5.5, with a narrower range, 4.3-6.7, than found in other members of the railway *Arrhenatheretum*. Tipping was consistently recorded, and varied from recent and heavy to old and light.

Although no preferred aspect or formation was noted, the *nodum* was not found on steep inclines, and only occurred close to the cess in cuttings. Management was minimal.

The variant is distinguished by the presence of *Holcus mollis* and is not particularly species-rich ($\bar{x}$13, range 8-21). No bryophytes were recorded.

3.3.4 Tall herb and bramble

6930 ha, all Regions

The phytosociological position of these *noda* is not entirely clear. They are probably intermediate between the *Arrhenatheretum* already defined, and the woodland edge communities (*Rhamno-prunetea*, Westhoff & den Held 1969). They are particularly characteristic of mid and lower embankment slopes, where a thin layer of, or scattered, spent ballast mulches the underlying soil, which is usually damp and organic. Nitrophilous and oily wastes from trains, and runoff from the cess drain into these areas. Where tipping is deeper, or the soil better drained, these communities grade into the *Arrhenathereium*. Where unmanaged, they give way to sallow, and alder scrub, or, in drier areas, ash or blackthorn.

The tall herb and bramble *noda* are characterised by *A. elatius*, *U. dioica*, *Galium aparine* and *Cirsium arvense*. Damper *noda* with *Filipendula ulmaria*, *E. arvense*, *F. rubra* and *E. repens* are distinguished from those in which bramble becomes ubiquitous.

The phytosociological Table (3.7) is based on 791 samples and 349 vascular species. It distinguishes between the 4 communities which are described below (distribution, Table 3.3).

a. 19. *Carex riparia nodum*

780 ha, all Regions

This and the following *nodum* show strong affinities with the *Filipendulion* (Segal 1966) of the *Molinio-Arrhenatheretea* as defined by Westhoff and den Held (1969). They differ in the constant occurrence of *E. repens* and bramble, which appear to be railway attributes. Little similarity to the *Caricetium ripariae* of Soo (1928) is found.

The vegetation occurs in ditches, along embankment footings and on some poorly drained flats. On embankments, tipping was recorded. The pH range is 5.2-7.7 ($\bar{x}$6.7), and cutting and spraying of woody vegetation was frequently noted, in accordance with BR policy of keeping drainage ditches clear.

Constant species, which distinguish this *nodum* are *Carex riparia, Lathyrus pratensis, Dactylis glomerata, Angelica sylvestris* and *Vicia cracca*. The mean number of vascular species in each sample is 11 (6-17) and of bryophytes 1 (0-3), of which only *B. rutabulum* and *Lophocolea bidentata* occurred frequently.

b. 20. *Heracleum-Anthriscus nodum*

2470 ha, all Regions

This is similar to the *Heracleetosum* (Zonneveld 1960, in Westhoff & den Held 1969), but distinguished by coarse railway species, eg *E. arvense, G. aparine* and *E. repens*, as in the previous *nodum*.

The community is found on ballast-mulched embankment slopes, of gentle to moderate incline and no preferred aspect. The pH varies between 5.4 and 7.8 ($\bar{x}$6.8). Little management was recorded.

Constant species which distinguish this *nodum* are *H. sphondylium, A. sylvestris* and *C. angustifolium*, and frequently occurring bryophytes include *B. rutabulum* and *L. bidentata*. The mean number of vascular species is 10 (5-30) and bryophytes 1 (0-3).

c. 21. *Chamerion angustifolium nodum*

1630 ha, all Regions

This *nodum* occurs on rather better drained, although still ballast tipped, slopes. There is some bias towards a southerly aspect. Soil pH varies widely between 4.4 and 9.0 ($\bar{x}$6.3), and it is likely that warmth and drainage are more important to the distribution of this vegetation.

The *C. angustifolium nodum* is species-poor ($\bar{x}$9, 1-18) with much, often dominant, bramble and some *Dryopteris filix-mas*. Between 0 and 7 ($\bar{x}$3) bryophytes were recorded in each stand, with *B. rutabulum, L. bidentata, E. praelongum, Plagiothecium denticulatum, Amblystegium serpens* and *Plagiomnium undulatum* occurring fairly consistently.

This and the following *nodum*, both with much bramble, almost certainly belong close to the *Rhamno-Prunetea* (Westhoff & den Held 1969) in European classification.

d. 22. *Urtica-Rubus nodum*

2050 ha, all Regions

This very coarse, species-poor ($\bar{x}$8, 3-18) vegetation is widespread on BR land on all formations. Some preference is shown for moderately inclined embankments, and tipping was fairly consistently recorded. Soil pH is variable, with a wide range of 4.9-8.6 ($\bar{x}$6.8), and is probably not very influential.

TABLE 3.8 Secondary woodland

474 samples, 277 species

	23	24	25	26	27
Fraxinus excelsior	IV (1-5)	III (1-5)	II (1-5)	II (1-5)	
Crataegus monogyna	III (1-5)	V (1-5)	III (1-5)	III (1-5)	
Rubus fruticosus	II (1-3)	IV (1-5)	V (1-5)	V (1-5)	V (1-5)
Rosa canina		II (1-5)	III (1-5)	IV (1-5)	II (1-4)
Hedera helix		IV (1-5)	II (1-5)	II (1-5)	IV (1-5)
Arrhenatherum elatius		III (1-5)	III (1-5)	II (1-4)	II (1-4)
Ulmus glabra	IV (4-5)				
Viola riviniana	III (1-2)				
Acer pseudoplatanus	IV (1-5)	III (1-5)			
Urtica dioica	III (1-5)	III (1-4)			
Dryopteris filix-mas	III (1-5)	II (1-4)			
Epilobium montana	III (1-2)	II (1-2)			
Mercurialis perennis	II (1-4)	II (1-5)			
Arum maculatum		II (1-4)			
Galium aparine		IV (1-5)	II (1-2)		
Prunus spinosa		II (1-5)	II (1-5)		
Clematis vitalba				IV (3-5)	
Chamerion angustifolium				V (2-5)	
Viburnum lantana				IV (1-5)	
Glechoma hederacea				II (1-2)	
Prunus avium				II (2-5)	
Veronica chamaedrys				II (1-4)	
Quercus robur					IV (1-5)
Corylus avellana					III (1-5)
Betula pendula					III (1-5)
Acer campestre					II (1-5)
Lonicera periclymenum					II (1-5)
Brachypodium sylvaticum					II (1-4)
Primula vulgaris					II (1-4)
No. samples	25	154	94	22	179

There are no constant differentiating vascular species, and, although from between 0-7 ($\bar{x}$2) bryophytes were recorded in each stand, the list of those occurring frequently is identical with the previous *nodum*.

3.3.5 Secondary woodland

The majority of woodland samples are included in this Section, although the *Quercetum sessiliflorae* and some *noda* with *Betula* and *Salix* spp. showed greater similarity (Czekanowski coefficient) with the heaths (Section 1), whilst bramble and *Rhododendron ponticum* thickets are described with Sections 3 (tall herb and bramble) and 5 (miscellaneous) respectively.

Information for the synoptic table (3.8) defining this group, is from analysis of 474 stands and 277 species. Constant members are *Fraxinus excelsior, Crataegus monogyna, Rubus fruticosus* agg., *Rosa canina, Hedera helix* and *Arrhenatherum elatius*.

The placing of secondary woodland in existing classifications is not entirely straightforward. Distinction here has been made between ash/hawthorn, in which 4 *noda* (23-26) are recognised, and oak/hazel woodland (*nodum* 27). In European nomenclature, *noda* 23, 24 and 25 show affinity with the *Dryopterido-Fraxinetum* (Klotzli 1970), whilst *noda* 26 and 27 may be placed with some confidence in the *Querceto-Fagetea* (Braun-Blanquet *et al.* 1937), although identification to a finer level is not possible.

The largely immature soils, disturbance and occurrence of numerous casual species lead to a comparatively heterogeneous secondary woodland, which is particularly rich in ash, bramble, and, more locally, birch and sallow. Hawthorn and blackthorn scrub are widespread. Ash saplings were frequently found on spent ballast tips, whilst birch and sallow colonise cindery areas and flats where drainage becomes impeded. More mature stands and oak or beech woodland tend to occur preferentially on cutting slopes.

A working nomenclature is adopted below, which may later be revised to coincide with, or complement, the NVC. The distribution of the 5 *noda* in relation to track classes is given in Table 3.3

a. 23. *Ulmus glabra nodum*

220 ha, London Midland and Scottish Region

This is a mixed deciduous woodland with a north-westerly distribution. A single outlier occurs in Southern Region. The woodland is found on embankments, and occasionally cutting slopes, with a moderate incline and preferential north aspect. Ballast tipping was frequently recorded over soil with a mean pH of 6.5 (4.7-8.2).

Ash and sycamore occur at their most constant in this *nodum*, which is characterised by wych elm and *Viola riviniana*. The ground flora also includes *Dryopteris filix-mas, Urtica dioica* and *Mercurialis perennis*. Amongst bryophytes, *Eurhynchium praelongum* and *Hypnum cupressiforme* occurred frequently. The mean number of vascular plants in each stand was 9 (2-16) and of bryophytes was 2 (0-3).

TABLE 3.9 Miscellaneous associations

68 samples, 175 species

	28	29	30	31	32
Molinia caerulea	V (2-5)				
Potentilla erecta	IV (1-2)				
Myrica gale	III (2-5)				
Scirpus caespitosus	II (1-3)				
Narthecium ossifragum	II (1-4)				
Eriophorum angustifolium	II (1-5)				
Viola palustris	II (1-2)				
Succisa pratensis	II (1-2				
Erica tetralix	II (1-6)				
Galium saxatile	II (1-4)				
Agrostis canina	II (2-5)				
Juncus effusus	II (1-5)				
Rhododendron ponticum		V (5)			
Rubus fruticosus agg.		II (1-2)	III (1-5)		
Phragmites australis			V (2-5)		
Urtica dioica			III (1-5)		
Equisetum arvense			II (1-5)		
Arrhenatherum elatius			III (1-5)		
Senecio viscosus				V (1-2)	
Teucrium scorodonium				IV (1-4)	
Senecio jacobaea				III (1-3)	
Cerastium fontanum				II (1-2)	
Sagina procumbens				II (1-4)	
Poa annua				II (2-3)	
Matricaria maritima					V (1)
Cochlearia danica					III (3)
Halimione portulacoides					III (1)
Juncus gerardii					III (4)
Spartina x townsendii					III (5)
Puccinellia maritima					III (2)
Triglochin maritima					III (3)
Polygonum aviculare					III (1)
No. Samples	24	4	28	10	2

The *nodum* is probably best considered a variant of ash woodland with wych elm, as defined by Ratcliffe (1977).

b. 24. *Arum maculatum nodum*

1350 ha, all Regions, but local in Eastern and Scottish

This is more strictly ash wood (sensu Ratcliffe 1977), occurring on calcareous (pH 6.3-8.1, $\bar{x}$6.9) slopes with some bias toward a western distribution (Table 3.3). It is not found in the large eastern lowland classes, and has a fairly restricted distribution in Scottish Region. The vegetation grows most frequently on moderately inclined north facing embankments. Tipping was often recorded, although little evidence of recent management was found.

Constant, and particularly abundant, amongst the species recorded were *Crataegus monogyna, Hedera helix* and *Galium aparine*. *Arum maculatum* is a differential species. Of the bryophytes, *B. rutabulum* and *E. praelongum* were prominent, whilst *Fissidens taxifolius* was often found. From between 7 and 13 ($\bar{x}$9) vascular plants and 0-2 ($\bar{x}$1) bryophytes occurred in each sample.

c. 25. *Prunus spinosa nodum*

820 ha, all Regions

Distribution is similar to the *Arum maculatum nodum*. Floristically, this vegetation is distinguished by comparative species paucity (3-13. $\bar{x}$8) and by more consistent bramble. Ash and sycamore were less frequently recorded. The *nodum* occurred on flat, and gently to moderately sloping, formations with no preferred aspect. Scrub cutting, spraying or disturbance was recorded from most stands, and it is likely that this is a deflected (managed or disturbed) facies of the previous *nodum*. pH (6.3-7.5, $\bar{x}$6.9), tipping, and numbers (0-4, $\bar{x}$1) and kinds of bryophytes are comparable.

d. 26. *Clematis-Viburnum nodum*

190 ha, Southern, Western and London Midland Regions

This *nodum* is virtually restricted to chalk flats and cuttings in Southern Region, although one or two outliers in the Chilterns (LMR) and Western Region occur. It grades into the beech woods included in *nodum* 27.

It occurs on calcareous soils of pH 7.2-8.1 ($\bar{x}$7.7), and usually shows some signs of management or disturbance. Recent tipping on flats adjacent to the cess was recorded, although the *nodum* is more characteristic of the flat fenced safety area along the top of steep cuttings.

Of the character species, *Rosa canina* agg. is particularly abundant, whilst *Chamerion angustifolium, Prunus avium, Veronica chamaedrys* and *Glechoma hederacea*, in addition to *Clematis vitalba* and *Viburnum lantana*, are differential. A mean of 10 (1-17) vascular species was recorded. The vegetation was sampled during 1977, before bryophyte recording was introduced to the survey.

e. 27. *Querceto-Fagetea*

1570 ha, all Regions

This large woodland group occurs predominantly on base-poor soils in southern Britain; 75% of stands occur in 4 track classes, South Eastern (1), South Western (4), Central Southern (5) and South Midlands (6). It is virtually absent from Eastern Region, and occurs only locally in Scottish Region.

The woodland is found on all formations, although the sample shows some slight preference for embankments. Recorded slope and aspect were variable, although in the latter a small south-western bias was observed. The stands are comparatively undisturbed, with light tipping and some scrub clearance and felling. The mean soil pH is 5.3 (4.0-7.1).

Constant differential species include *Quercus robus*, *Corylus avellana* and *Betula pendula*, and from between 4-28 ($\bar{x}$10) vascular plants were recorded in each stand. Bryophytes were not adequately sampled, but amongst those found were *Atrichum undulatum*, *Eurynchium praelongum*, *Aulacomnium undulatum*, *Plagionmium hornum*, *Dicranella heteromalla*, and, slightly more interestingly, *Plagiothecium succulentum*.

3.3.6 Miscellaneous associations

550 ha, throughout

A group of miscellaneous associations with a similarity coefficient of less than 0.15 (average linkage, Czekanowski coefficient, Figure 3.3) is described here (Table 3.9; 68 samples, 175 species).

a. 28. Ombrogenous mire

210 ha, Scottish Region

This *nodum* occurs on poorly drained flats along railways in upland and highland areas of Scottish Region. It is related to the *Molinia-Myrica nodum* (3.3.1.a).

Constant species include *Molinia caerulea*, *Potentilla erecta* and *Myrica gale*. It is distinguished from the *Molinia-Myrica nodum* by *Narthecium ossifragum*, *Eriophorum angustifolium*, *Viola palustris* and *Scirpus caespitosus*. Bryophytes included *Sphagnum papillosum*, *S. russowii*, *S. palustre*, *S. subnitens*, *S. rubellum*, *Campylopus pyriformis* and *Calypogeia fissa*. The mean number of vascular species in each sample is 10 (3-20), and of bryophytes is 4 (0-7).

Recorded soil pH varied between 3.8 and 9.1 ($\bar{x}$5.2), and no signs of management or tipping were observed.

b. 29. *Rhododendron ponticum* stands

Southern and Scottish Regions

Four stands supporting a thicket of *Rhododendron ponticum* with bramble were recorded. Mean soil pH was 5.4, and no tipping or management was recorded.

c. 30. Reed beds

250 ha, all Regions

Reed (*Phragmites australis*) beds were found in ditches and along embankment footings in all Regions on BR, although outside Southern and Eastern Regions distribution was very local.

Constant species include *P. australis*, bramble, nettle and false oat grass. A mean number of 6 (2-10) vascular plants was recorded from each stand. Bryophytes were not adequately sampled.

The reed beds occurred in ditches on wet soils of pH 5.3-7.7 ($\bar{x}$6.9). Very little management or disturbance was noted.

d. 31. *Senecio viscosus nodum*

90 ha, Southern, Eastern and London Midland Region

This is an ephemeral association on cinder and recently tipped, spent ballast. It is widespread on the railway cess and is entirely under-sampled because of the BR safety constraint to examine systematically only rural verges.

Constant species are mainly annuals and include *Senecio viscosus, Cerastium fontanum, Sagina procumbens* and *Poa annua*. *Teucrium scorodonia* and *Senecio jacobaea* also differentiate this *nodum*. Bryophytes are almost strictly acrocarpous, and include *Bryum argenteum, B. caespiticium, B. bicolor* agg., *Funaria hygrometrica* and *Ceratodon purpureus*. *Marchantia polymorpha* occurs in damper stands. The average number of vascular and bryophyte species in each stand respectively are 10 (1-17) and 2 (0-4). Recorded mean pH was 6.7 (5.6-7.7).

e. 32. *Matricaria maritima nodum*

London Midland Region

Two stands of littoral vegetation including *Matricaria maritima, Juncus gerardii* and *Puccinella maritima* were recorded. The pH was high at 9.5, and no disturbance or tipping was noted.

4 CONSERVATION OF RAILWAY VEGETATION

4.1 Introduction

The intention of this work has been to provide an inventory of railway species and vegetation on which a general strategy for conservation and management of railway verges could be based. Some preliminary value judgements were made by us, and, in addition to the documentation of species and vegetation, 185 sites of particular biological interest (BI) have been identified.

There are 5 appendices to this report, listing the BI sites by BR Region, and describing briefly the importance and interest of railway vegetation. Suggestions for general and local management are made. The appendices, which supplement the detailed site listings prepared for the NCC (Sargent and Mountford 1979; 1980; 1981), are for distribution within BR, and are intended to provide a basis for discussion between BR and NCC.

In this Section, the implications for conservation of the relationship between sites of interest and the railway network as a whole, are considered. Information collected in Southern and Western Regions during 1977 and 1981 is then described, and a Markov model, predicting vegetation population changes, is given. The Section concludes with a discussion about changing vegetation structure in relation to conservation and management.

4.2 Biological Interest sites

In order to increase the chance of visiting as many 'better' sites as possible, the random survey was supplemented with visits to areas of known or likely interest. Sites of particular biological interest (BI) were selected from within random and subjective surveys in the following proportions:

	SUBJECTIVE	RANDOM	TOTAL
Eastern Region	31	35	66
Southern Region	1	10	11
Western Region	15	12	27
London Midland	32	12	44
Scottish Region	19	18	37
Total BI sites	98	87	185
Total sites visited	241	480	721
% sites designated	41	18	26

Although the numbers of BI sites from within the parallel surveys are comparable, a considerably greater proportion of sites occurred in the subjective than the random survey. Identification of BI sites followed discussion and agreement between all members of the team, and depended on the following criteria:

Inclusion of rare or local species, or associations.

Inclusion of species, associations, or habitat types not locally common.

Inclusion of many *taxa* - diversity.

Area - constrained by ± parallel boundaries and a restricted length of track in randomly visited sites; this criterion was not used except in so far as a minimum verge width, allowing for edge effects, is found in all BI sites.

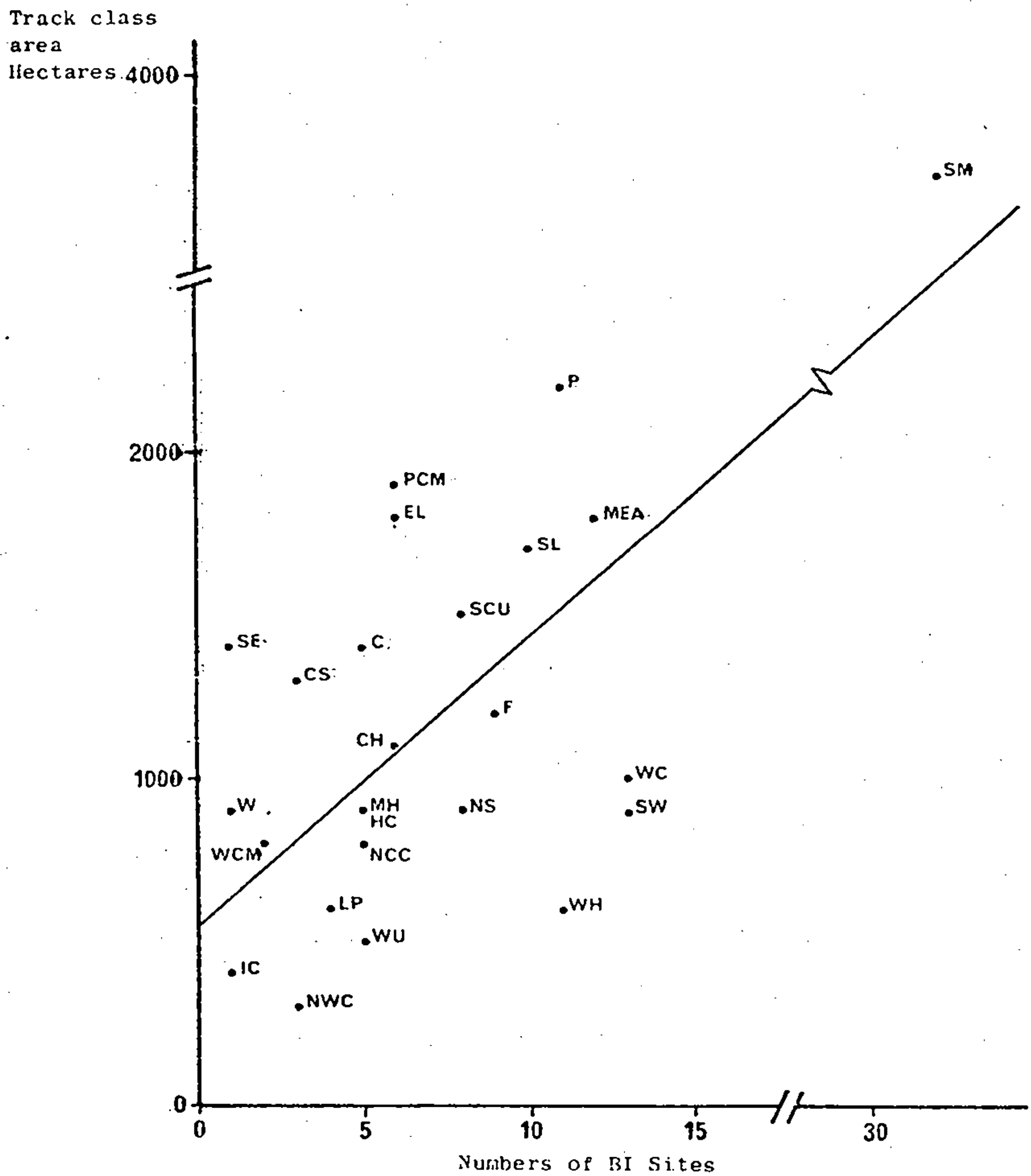
Detailed files for all these sites are lodged with the NCC, and distribution maps are given in the appendices. Most of the BI sites are also shown in red on the maps in Section 3, although a group have been erroneously omitted from the southern part of London Midland Region, and one or two sites not included elsewhere.

The distribution of BI sites within track classes (Section 3) was examined. A direct comparison between numbers of BI sites and track classes is artificial, as all track classes are of different sizes. Correlation was therefore sought between numbers of BI sites and track class length (r=0.667), or verge area (r=0.752). The stronger correlation with area indicates that verge width is of some importance, although the contribution (mean verge width : numbers BI sites : r=0.351) is small. Although numbers of vegetation types (preliminary classification) are correlated with track class area (r=0.524; Sargent 1983), there is little correlation between numbers of vegetation types and BI sites (r=0.171), and a diversity index, obtained by dividing area by vegetation types, gives a weaker correlation (r=0.665) than area alone. When the largest track class, SM, is omitted from the calculation, the correlation between area and BI sites diminishes (r=0.541).

The regression of BI sites against track class area is shown in Figure 4.1. The classes which include proportionally more BI sites have a predominantly western distribution and are upland or coastal. The lowland southern and eastern classes support rather fewer BI sites, despite the introduction of some bias, during the subjective survey, toward sites close to Monks Wood (Cambridgeshire) where the team is based. The inclusion of Fens (F) amongst the 'better' classes probably reflects this bias, but may also be due to the comparatively rich diversity of the railway in relation to surrounding arable land.

Pennines (P) and Pennine Coal Measures (PCM) are amongst the 'least interesting' classes, although some outstanding lines, including the Blackburn-Hellifield, and part of the Skipton-Carlisle, and some excellent sites, eg R203 Wye Dale, occur in the 'Pennines'. Pennines is the second largest track class. Its position in the regression may be due in part to undersampling during the subjective survey. Nevertheless, in common with 'Pennine Coal Measures', much of the track in 'Pennines' crosses industrialised and, sometimes, derelict land, where the verges are disturbed and support tall herb, bramble and scrub (associations which are not deemed to be of particular biological interest).

FIGURE 4.1 BI Sites within track classes



The numbers of designated BI sites plotted against the area of the track classes in which they occur. r=0.752. If the large track class, SM, is omitted from the calculation, the correlation diminishes and r=0.541. Track class 6, South Coastal, has no BI sites and is omitted from the diagram.

KEY SE = SOUTH EASTERN; W = WEALD; SCU = SOUTHERN CHALK UPLANDS; C = CHILTERNS; SW = SOUTH WESTERN; CS = CENTRAL SOUTHERN; SM = SOUTH MIDLANDS; MEA = MIDLANDS AND EAST ANGLIA; EL = EASTERN LOWLANDS; F = FENS; PCM = PENNINE COAL MEASURES; NS = NORTHERN SANDSTONES; WC = WEST COASTAL; LP = LANCASHIRE PLAIN; P = PENNINES; WCM = WESTERN COAL MEASURES; MH = MIDLAND HILLS; NCC = NORTH COAST CARBONIFEROUS; SL = SCOTTISH LOWLANDS; NWC = NORTH WEST COASTAL; HC = HIGHLAND COASTAL; WH = WEST HIGHLANDS; CH = CENTRAL HIGHLANDS; WU = WELSH UPLANDS; IC = IGNEOUS COASTAL.

When the distribution of BI sites against railway formations is examined, 43% of sites are found to occur on cuttings, whilst a further 31% are on mixed formations dominated by cuttings. The distribution is as follows:

	Formation	BI sites	% total
	Cuttings	79	42·7
	Embankments	10	5·4
	Flats and ditches	11	5·9
Mixed	Mainly cuttings	58	31 4
	Mainly embankments	11	5·9
	Mainly flats	16	8·7
	TOTALS	185	100.0

Mineral soil and less ballast and waste tipping (Section 2.2.2), together with greater verge width (sloping formations are usually wider than flats) contribute to the strong bias towards cuttings as sites of interest.

The preponderance of upland and hilly track classes, having proportionately more BI sites (Figure 4.1), is associated with the comparatively larger numbers of cuttings these classes support.

It is apparent that considerably more of BR land is of interest than was within the resource of the survey to record. This fact is shown both by the correlation between numbers of BI sites and track class area, the implication being that, when more area is examined, further BI sites are found, and, also by the BI designation given to 18% of randomly visited sites, implying that almost one fifth of BR land is of local or, occasionally, national interest.

Any conservation strategy should not, therefore, rely solely on the individual site listings prepared by us, but should include a generalised management policy in which particular attention is paid to cuttings. A possible approach is outlined in each of the appendices.

4.3 Changes in railway vegetation

Underlying this work has been the concern "that much conservation interest in terms of herb rich grassland may be affected by the development of coarser vegetation and scrub in the absence of regular management" (Way & Sheail 1977). The idea of the loss of fine-leaved grassland was echoed by Gulliver (1980), who suggested that "without mowing the short, railside grasses quickly changed to tall grassland. Very soon, one or two aggressive grasses, such as false oat grass and cocksfoot came to dominate these swards".

To examine changes occurring under the present *ad hoc* management regime, 30 randomly distributed sites in Southern and Western Regions, first recorded during 1977, were visited again in 1981; 283 quadrats were relocated by careful measurement and scored as previously.

FIGURE 4.2 Population changes

	2A	2B	3	4	
2A	24	4	2	1	31
2B	9	52	11	4	76
3	1	20	36	5	62
4	5	7	7	77	96
	39	83	56	87	265

Transition matrix showing the movement of quadrats between the 4 major vegetation groups in Southern and Western Regions during 1977-1981. In row 2B, for example, 52 quadrats remained constant, 9 were lost to 2A, and 11 and 4 lost to 3 and 4 respectively. Increments to the population are given in column 2B. Row totals, therefore, give the population size in 1977, whilst column totals show the population in 1981.

All data (2 x 283 quadrats) were ascribed to the preliminary TWINSPAN classification using the Czekanowski similarity coefficient (Section 3), and the fate of each quadrat between 1977 and 1981 recorded. Data falling in each TWINSPAN class were then referred to the appropriate larger classification unit or group. Change between such larger groups is less likely to reflect classification error, and implies real changes in vegetation structure. 265 quadrats occurred and remained amongst groups 2A, fine-leaved grassland; 2B, false oat grassland; 3, tall herb; and 4, scrub and secondary woodland. The remaining 18 quadrats were classified elsewhere, or moved in to, or out of, these groups, and were not included in the analysis. The relationship between groups is shown in Figure 3.3. The virtual absence of group 1 is due to geographic distribution.

In Figure 4.2, a matrix showing quadrat movement from 1977-1981 between the 4 groups is given. In row 1, for example, 24 quadrats remained as fine-leaved grassland, whilst 4 became false oat, 2 went to tall herb, and one is now classified as scrub or secondary woodland. Recruitment to fine-leaved grassland is given in column 1. The row totals, therefore, give the population in 1977, whilst the column totals describe the situation in 1981. Thus, it may be seen that there was a net recruitment of 8 quadrats into the fine-leaved grassland population during the time in question.

The information in the matrix was used to build a Markov model (Horn 1975; Usher 1979), which assumes that at some future time the populations will stabilise, and predicts the distribution of quadrats (ie the size) within those populations when they do so. The results are shown graphically in Figure 4.3, and it may be seen that between the years 2009 and 2013 no further change occurs.

The results are contrary to the expectations of Way and Sheail (1977) and of Gulliver (1980).

Various criticisms of the model and preliminary collection of information can be made, although use of a coarse level of classification (groups 1-5 Figure 3.3) eliminates error in allocating quadrats.

The criticisms include:

(1) There were only 2 data collections and the time span between the 2 dates was short. A temporary reversal in long term trends may have been picked up.

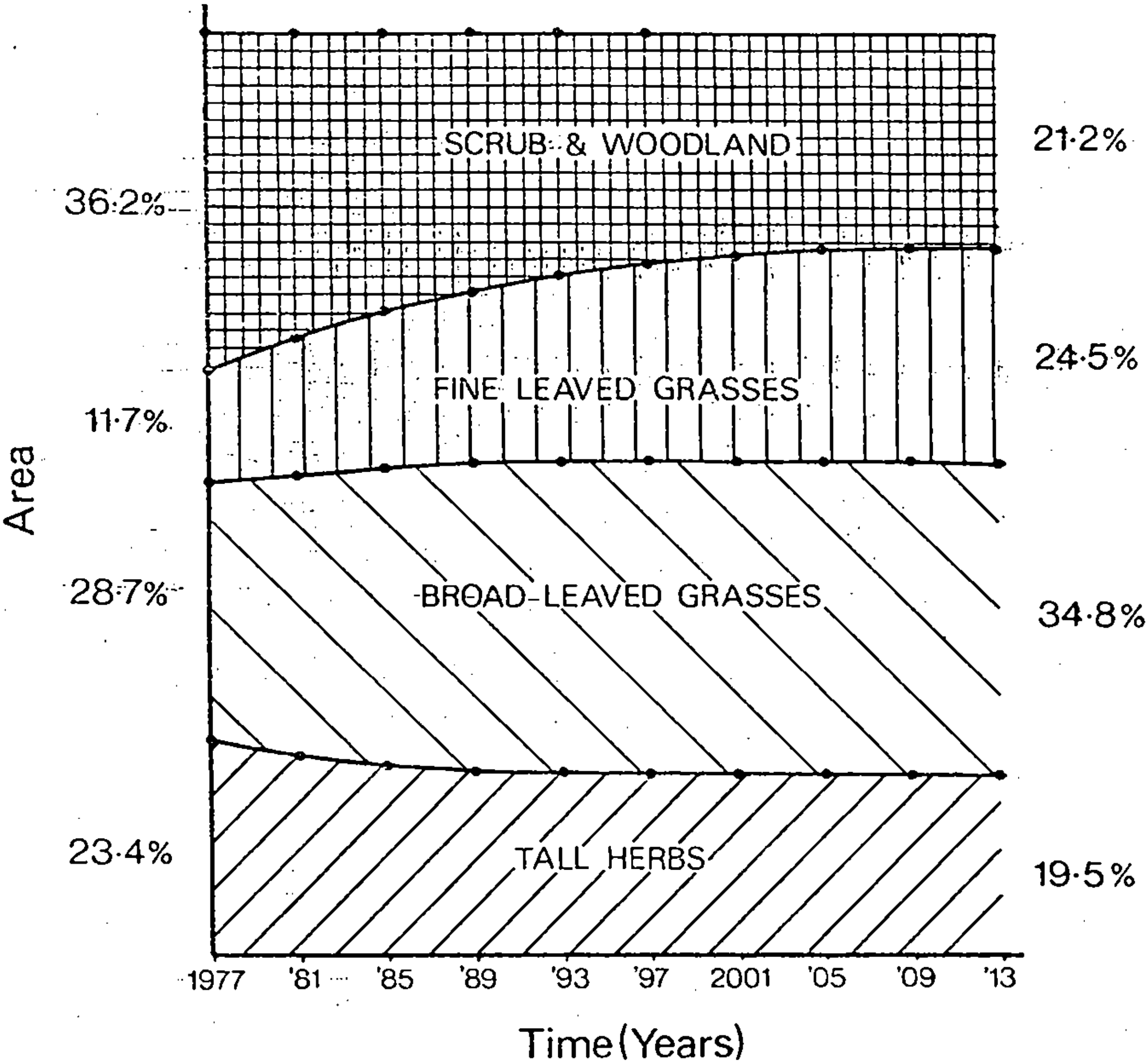
(2) The Markov model tends, inherently, to emphasise short-term trends during projection. A minor fluctuation may become exaggerated.

(3) The information is from Southern and Western Regions only, and so almost certainly shows a geographic bias.

(4) Although careful measurements were made (the position of all quadrats is recorded in relation to, and lies within, 100 m of a BR mile post), some small error will have occurred during relocation.

(5) The model assumes that the transition probabilities are stationary in both space and time.

FIGURE 4.3 Vegetation dynamics



Predicted population changes between the 4 major vegetation groups occurring in Southern and Western Regions. The Markov model (see text) is based on information collected in 1977 and 1981 from 265 quadrats, and projects trends occurring between these 2 dates. The model stabilises between the years 2009 and 2013, at which time the net loss or increment has been calculated.

However, the model depends on what actually took place at the randomly selected sites, and, if the argument is restricted to Southern and Western Regions, and allowance made for perturbation and exaggeration during projection, the results lead to some interesting, if controversial, hypotheses.

Prior to 1960, verge management took the form of annual burning, grass cutting and scrub clearance. Cutting was done during early summer to prevent spread and germination of seeds on the cess. Cutting is no longer carried out, scrub and woodland clearance is on an *ad hoc* basis, and burning is only occasional or accidental (Section 2). BR staff have become concerned about the spread of woody species and have lately introduced more scrub clearance (C Beagley, personal communication).

It is probable that the model has picked up this increased activity; 19 quadrats were lost from group 4 (scrub and secondary woodland) between 1977 and 1981, whilst only 9 were recruited to the population. The loss is towards all other vegetation groups, and the direction is almost certainly dependent on the original character of the scrub or woodland, together with grazing pressures and other disturbances in the intervening period. Some cleared woodland, retaining a characteristic ground flora, and woody seedlings will have continued to be classified within group 4.

In group 3 (tall herbs) 32% (20 quadrats) have moved to 2B (false oat grassland), whilst 14% (11 quadrats) of the initial population of 2B have moved in the reciprocal direction. Tall herbs and false oat grass include primary colonisers of recently burnt and ballasted areas. At the top of slopes, where tipped ballast is usually deepest, false oat, and sometimes bramble, colonise. Lower down, where ballast forms a thinner layer and serves to mulch the underlying soil, nettle, meadowsweet and cleevers compete (Section 2). Rosebay willow herb establishes successfully on spent material with a high proportion of cinder and small-particled material. It is less frequently associated with burnt sites (see below).

Although some *noda* within the tall herb and false oat groups will be comparatively stable (Section 3), those developing in response to the outlined disturbances and giving rise to the observed fluctuations between groups are clearly less so. In a recovering, or less disturbed, environment, the natural succession seems to be towards coarse (false oat) grassland, although scrub may also develop. Ash seedlings and saplings were frequently noted on spent ballast tips, whilst bramble may encroach and provide a nurse crop for some woody species.

The net movement from coarse to fine-leaved grassland is, perhaps, the least expected result from this study. Whilst 4 fine-leaved grassland quadrats went to false oat, 9 moved in the opposite direction. False oat grass withstands annual scything (Pfitzenmeyer 1962) and cessation of this activity is unlikely to have led directly to an increase in this category (although it will clearly facilitate the development of woody plants). More frequent mowing (Gulliver 1980) was an unusual management strategy, but the concomitant removal of litter may have been more important. On some railway verges, false oat has formed a tussock grassland, with very few other plants surviving in the intervening, litter-thatched troughs. This phenomenon may be more closely associated with inhibition of microbial activity by SO_2 as it was more often observed in industrialised areas (eg Derbyshire coalfields).

The recovery of rabbit populations from myxomatosis began in the early 1960s, at about the same time that verge cutting stopped. More recently, BR has begun to erect rabbit-proof fencing, in response to complaints from neighbouring farmers and land owners. Although false oat appears to survive vole (*Microtus agrestis*) grazing (there is abundant evidence of voles in most false oat railway swards), increased rabbit pressure is probably favouring the spread of red fescue. Ferns (1976) on the other hand has shown that red fescue may be an important component of vole diet. Land snails (*Cepaea nemoralis*) have a more catholic diet and enjoy both grasses (Williamson & Cameron 1976).

Rabbit scrapes and the numerous ant hills (usually *Lasius flavus*) lend diversity and provide alternative habitats for some fine-leaved ephemerals (eg *Aira caryophyllea, Vulpia bromoides*) and cess annuals under pressure from heavy chemical spraying (Section 2).

However, a more important factor in the increase of fine-leaved grasslands may be the reduction of burning. Of 157 quadrats recorded during the random survey as 'recently burnt' (ie within the past 18 months), 111 occurred in false oat grasslands (2B), 30 in group 3 (tall herb), 9 in group 1 (heath and base poor), and 7 in group 2A (fine-leaved grasslands) (Table 4.1). These figures depart significantly from the null hypothesis that the distribution of recently burnt quadrats between groups would be proportional to their distribution in the entire data set ($p<0.1$). The number of false oat quadrats is considerably more than expected, whilst the number of fine-leaved quadrats is fewer. Tall herb (group 3), is somewhat less than expected, whilst group 1 is strictly proportional. Groups 5 and 6 have no representatives amongst the recently burnt quadrats.

TABLE 4.1 The distribution of vegetation types in recently (within 18 months) burnt quadrats

Group	No. Quadrats observed	No. Quadrats expected
1	9	9
2A	7	17
2B	111	71
3	30	35
4	0	14
5	0	2
	157	157

The distribution of vegetation types in recently burnt quadrats is not comparable with the overall distribution ($x^2 = 54.2$, $p<0.1$).

The foregoing suggests that burning favours the spread of false oat grassland. It is well established that *Brachypodium pinnatum* grasslands are encouraged by burning, but no reference could be found in the literature to the development of *Arrhenatheretum* under such conditions. However, the bulbous form of false oat or 'onion couch' (*Arrhenatherum elatius* var. *bulbosum* (Willd.) Spenn) is widespread on railway verges, and it is likely that this is a response to the frequent burnings of the past, the bulb lending some resistance to burning.

Whether the lack of burning is advantageous to red fescue requires experimental testing. However, fescues do compete successfully with false oat in some localities. Peterkin and Rorison (1982), working with sheeps fescue (*Festuca ovina*), have suggested recently that one explanation could be the ability of *F. ovina* to continue some metabolic processes at lower temperatures than *A. elatius*.

The mechanisms underlying vegetation change on railway land are not fully understood. The vegetation is extremely diverse and the number of variables involved is very large. However, assuming some scrub control is practised, there seems, under present conditions of grazing by small mammals, and comparatively little burning, to be a gradual succession towards fine-leaved grassland. There is also some increase in coarse grasslands, but this is largely at the expense of scrub and tall herbs.

The implications of this work for the conservation of railway verges is large, and ITE (funded by Science vote) have therefore set up a number of monitoring sites distributed throughout BR land, which will enable detailed long term studies to be made. A programme of experimental work designed to examine interactions between key railway species under disturbance (ballasting, burning, grazing) and recovery is also being started.

ACKNOWLEDGEMENTS

This project was begun in 1976 by Dr Michael Way (now at MAFF), and has been very much a question of team work on which it is my privilege to report.

Without the close co-operation of BR and especially of Mr Christopher Beagley (BRB HQ), who gave freely of his time and attention, this work would almost certainly have foundered.

Particular appreciation is felt for the enthusiasm and competence shown by Mr Owen Mountford during data collection and the documentation of sites of Biological Interest. Dr Dorian Moss, Dr Robert Bunce, Mr Ken Lakhani, Mr Jeff Moller (all ITE) and Dr Brian Huntley (Durham University) gave invaluable analytical and statistical advice and assistance with computing. Dr Steve Chapman (ITE) kindly oversaw the project during 1977, and Mr John Killick (NERC) has given consistent encouragement and help.

During each field season a student was attached to the project and I would like to thank the following for their useful and enthusiastic contributions: Mr Ian Bolt, Bath; Mr Alan Lawes, UWIST; Mr Alan Marsden, Brunel; Mr Brendan Carleton, Bath; Mr Jonathan Harris, UWIST; Mr Jonathan Turner, Plymouth.

I am also most grateful to Mr John Jeffers and Dr Jack Dempster for critically reading the manuscript. The graphs and the drawings were prepared by Miss Susan Nicholson and Mr Andrew Foy, both of Luton College and the digitised maps by Mr David Catlow at the Experimental Cartography Unit (NERC). The manuscript was kindly typed by Mrs Valerie Burton, Mrs Gaynor Pywell and Mrs Helen Wood, to all of whom my especial thanks are due.

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