# *Ecology of Vegetation Change in Upland Landscapes*

## *Part II : Study Areas*

PREFACE

As acknowledged in the Preface to Part I of this Report, the work described was carried out by the Institute of Terrestrial Ecology (ITE), Natural Environment Research Council (NERC), under contract to the Department of the Environment (DOE) as DOE/NERC contract DGR/483/23. ITE is grateful to DOE and their Review Committee for support throughout, and to DOE for permission to publish the contract report in this form.

Errata

p9 line 11 from end, delete 'centuries', insert 'century'.
p35 line 3 from end, spelling - 'pastures'.
p54 line 16, should read '... cold and moderately wet ...'.
p58 line 11 from end, delete 'and', insert 'but'.
p75 line 22, delete 'were'. insert 'was'.
p85 line 17 from end, should read '... as moderately cold and ...'.
p130 line 7, delete 'occupies', insert 'occupy'.
136 line 16, delete 'intensive', insert xtensive'.
1 line 3, delete 'or', insert 'of'.

C O N T E N T S

PART II: STUDY AREAS

# INTRODUCTION

The results of this study of Ecology of Vegetation Change in Upland Landscapes are being published in two parts. Part I: General Synthesis (Ball et al 1981) identifies, from a classification of data collected in 12 study areas, 16 pasture and heath vegetation classes important in the farmland/moorland mosaic that characterises the uplands of England and Wales. It considers the environmental, historical and current management factors that control the occurrence of these classes and interprets, using standard assumptions, the possible directions and rates of potential gradual change between them.

This second part of the report on the contract study carried out for DOE by ITE consists of accounts of the individual study areas: Alwinton, Northumberland; Lunedale, Durham; Shap Rural and Shap, Cumbria (Shap); Bransdale, North Yorkshire; Heptonstall, West Yorkshire; Monyash and Hartington Middle Quarter, Derbyshire (Monyash); Llanfachreth, Gwynedd; Ysbyty Ystwyth, Dyfed; Glascwm, Powys; Ystradgynlais Higher and Glyntawe, Powys (Ystradgynlais); Lynton, Devon; Widecombe in the Moor and Buckland in the Moor, Devon (Widecombe).

The area accounts each contain sections on Physical Environment; Land-use History; Vegetation; Potential Vegetation Change; and a summary Conclusion.

The physical environment sections include the representation in each area of land types in the land classification discussed in Part I. Summary descriptions of these types are repeated here (from Part I, Table 4-1).

| Land Group | Land Type | General Description[2] |
|---|---|---|
| Hill | Steep Hill[1] (1) | High altitude, strong relief, steep slopes; very low density of habitation, low frequency of road access and intensity of agricultural use. |
| | Hill (3) | High altitude, moderate relief and slopes; low density of habitation, frequency of road access and intensity of agricultural use. |
| | High Plateau (4) | High altitude, low relief and gentle slopes; low density of habitation, frequency of road access and intensity of agricultural use. |
| Upland | Steep Upland (5) | Moderate altitude, strong relief and steep slopes; low density of habitation, moderate frequency of road access and intensity of agricultural use. |

| Land Group | Land Type | General Description[2] |
|---|---|---|
| | Upland (7) | Moderate altitude, relief and slopes; high density of habitation, frequency of road access and intensity of agricultural use. |
| | Upland Plateau (8) | Moderate altitude, low relief and gentle slopes; moderate density of habitation and frequency of road access; high intensity of agricultural use. |
| Upland Margin | Upland Margin (6) | Low altitude, moderate relief and rather steep slopes; high density of habitation, frequency of road access and intensity of agricultural use. |

1 Numbers in brackets are those used on computer maps of land type distribution in each area

2 Descriptive terms are relative to the range of character included in the study areas

Computer maps are used in the sections on physical environment to display the distribution of some land characteristics and of land types. Sources of the environmental data are: for physiographic and topographic data, 1:25 000 Ordnance Survey maps; for rainfall, the Meteorological Office national map; for geology, published national and unpublished district maps of the Institute of Geological Sciences; for soils, the England and Wales map of the Soil Survey of England and Wales; for Agricultural Land Classification, the 1:250 000 maps of the Ministry of Agriculture, Fisheries and Food. Full references to these are given in Part I of this report. Other climatic data for the study areas are drawn from their approximate location on small-scale national maps in Meteorological Office Climatic Memoranda 73 (1975) for monthly temperatures; 72 (1974) for sunshine hours; and 74 (1975) for length of snow lie. Temperatures have been adjusted to the mean altitude for each area (Part I. 2.31). No detailed local climatic data were sought for individual areas or for locations within areas, nor are they available in most cases.

In the sections on land-use history, main aspects relevant to the vegetation of each area are outlined. Particular attention has been paid to changes between moorland and farmland over about the past 150 years, as identified from analysis of maps and air photographs. Reference is also made to parish agricultural statistics collated for the post-1900 period. Current farming and other land-use practices are not discussed in detail as they have been comprehensively investigated in a parallel study of the same areas by a group of consultants on behalf of the Countryside Commission. This Upland Landscapes Study (ULS) provided reports (as listed in references to each area account here) that discuss the aims and plans of the farming communities and, from consideration of the present landscapes of each area, predict the likely impact of intended or probable farming and other land-use changes on these landscapes.

The vegetation sections in each area account concentrate on the pasture and heath vegetation classes present on the 70 or more 'main sites' recorded in each area in 1977 or 1978. Maps and text use the vegetation class names and/or reference numbers that have been employed in Part I. Again for ease of reference a summary of these classes, drawn from their description in Chapter 3 of Part I, is included here.

| Vegetation Group | Vegetation Class | General Description |
|---|---|---|
| Improved pastures | 1. Lolium/ Holcus/ Pteridium grassland | Lolium perenne and Holcus lanatus are the co-dominant species with Pteridium aquilinum present as an invading species. This class is usually associated with shallow soils. Surface rocks and boulders are typically present. |
| | 2. Lolium grassland | Lolium perenne is again a dominant species but with Agrostis tenuis and Holcus lanatus as co-dominants. Land used for hay meadows is included in this class. |
| | 3. Lolium/ Trifolium grassland | Characteristic co-dominant species are Lolium perenne and Trifolium repens. A tendency towards drainage impedence is shown by the presence of thistles and rushes. |
| | 4. Herb-rich Lolium grassland | Dominated by Lolium perenne with a range of agricultural weeds present. Trifolium repens and Dactylis glomerata are prominent. This class includes recently resown swards. |
| Rough pastures | 5. Agrostis/ Juncus grassland | Agrostis tenuis and Juncus spp. are characteristic. Herb-rich flushes are a feature, and bracken and brambles are frequent. |
| | 6. Festuca/ Juncus grassland | A main distinction from class 5 is the more prominent presence in class 6 of coarser grass species such as Deschampsia flexuosa, Agrostis canina/ stolonifera and Nardus stricta. Slopes tend to be slightly steeper and soil pH rather lower than for class 5 sites. |

| Vegetation Group | Vegetation Class | General Description |
|---|---|---|
| | 7. Agrostis/ Holcus grassland | Agrostis spp. and Holcus lanatus are co-dominant. This class includes a variety of herb species. It occurs on well drained soils on moderate slopes (6° - 11°) with some surface rocks and boulders present. Scattered trees are also frequent. |
| | 8. Festuca/ Agrostis grassland | Co-dominant species are Festuca ovina and Agrostis tenuis. This class mainly occurs on moderate slopes with shallow soils. Some drainage impedence can be reflected in the presence of species such as Juncus effusus. |
| Grassy heaths | 14. Festuca/ Vaccinium heath | Dry grassy heath on gentle or moderate slopes, shallow soils and free drainage. Characteristic species include: Galium saxatile, Festuca ovina, Deschampsia flexuosa, Juncus squarrosus and Potentilla erecta. |
| | 15. Festuca/ Nardus/ Vaccinium heath | Characteristic species are Festuca ovina, Nardus stricta and Vaccinium myrtillus. It occurs particularly on moderate to steep slopes in the northern study areas e.g. Bransdale. |
| | 16. Festuca/ Nardus/ Molinia heath | Wet upland grassy heath with many species typical of wet situations present, e.g. Carex nigra, Eriophorum vaginatum, Juncus bulbosus, Trichophorum cespitosum and Narthecium ossifragum. Streams and pools are frequent. |
| Shrubby heaths | 9. Calluna/ Molinia/ Vaccinium heath | Relatively species-poor heath located mainly in the south west on shallow soils. Calluna vulgaris is dominant, but other common ericoids are also present. |
| | 10. Vaccinium/ Calluna heath | Also a species-poor class, which differs from class 9 in its stronger shrubby heath element. In class 9, 5 grass species occur at more than 60% of sites, compared with one only in class 10. Surface characteristics include evidence of burning and of eroding peat. |

| Vegetation Group | Vegetation Class | | General Description |
|---|---|---|---|
| | 11. | Nardus/ Sphagnum/ Calluna heath | Mixed heath occurring on boggy moorland with coarse grasses abundant. Characteristic subordinate species include Trichophorum cespitosum, Empetrum nigrum, Carex echinata, Narthecium ossifragum and Vaccinium oxycoccus. |
| | 12. | Eriophorum/ Calluna heath | Blanket bog on deep peaty soils, mainly present in Lunedale. Calluna vulgaris is dominant with Eriophorum vaginatum co-dominant. Eriophorum angustifolium and Sphagnum spp. are also abundant. |
| | 13. | Calluna heath | Dry Calluna heath with bracken sometimes present, occurring mainly in the south western study areas e.g. Widecombe and Lynton. Ulex spp. is a frequent associate. Mainly situated on rocky sites with pockets of well drained soils. |

The frequency of vegetation class occurrence at the time the site recording was carried out is discussed for 'main sites' in each area as a whole, and for sites in land types within each area. The limited number of woodland sites examined in each area are also considered. It must be emphasised that, in the ITE study, field work was necessarily limited to recording vegetation at a series of preselected sites. It is not possible therefore to provide a comprehensive picture of the total vegetation of each area, nor to relate each recorded site to quantitatively identified local management methods, past and present, or, for example, to a detailed assessment of soil conditions. The main objectives were to cover adequately the range of grassland-moorland vegetation in the 12 areas, and to consider the general relationships of this vegetation to its controlling factors. To enable main sites and the smaller number of woodland sites to be located more precisely than can be shown on maps included in the accounts, their grid references are listed in Appendix 1.

The sections on potential vegetation change include predictions of the possible situation that could result from agricultural intensification or decline: at individual sites; for each area as a whole; for land types within each area; and for ULS vegetation mapping units in each area (see below). The changes predicted result from standard trends drawn from the principles set out in Part I, Chapter 5, rather than from consideration of the specific land and management situation at each individual site. Appendix 2 (derived from Figure 5-4 in Part I) lists the standard trends that are used in these predictions of change. Vegetation maps for all study areas except Monyash have been produced by G. Sinclair of Environmental Information Services as part of the Upland Landscapes

Study. Simplified ULS versions of these maps are reproduced in the area accounts here by permission of Mr Sinclair. Associations between ITE vegetation classes at 'main sites' and the ULS mapping units are considered for each area individually. Correlations between the two vegetation groupings for the 11 areas combined are discussed in Appendix 3.

The conclusion section in each area account briefly sums up the main factors locally constraining or encouraging the predicted ecologically potential vegetation changes.

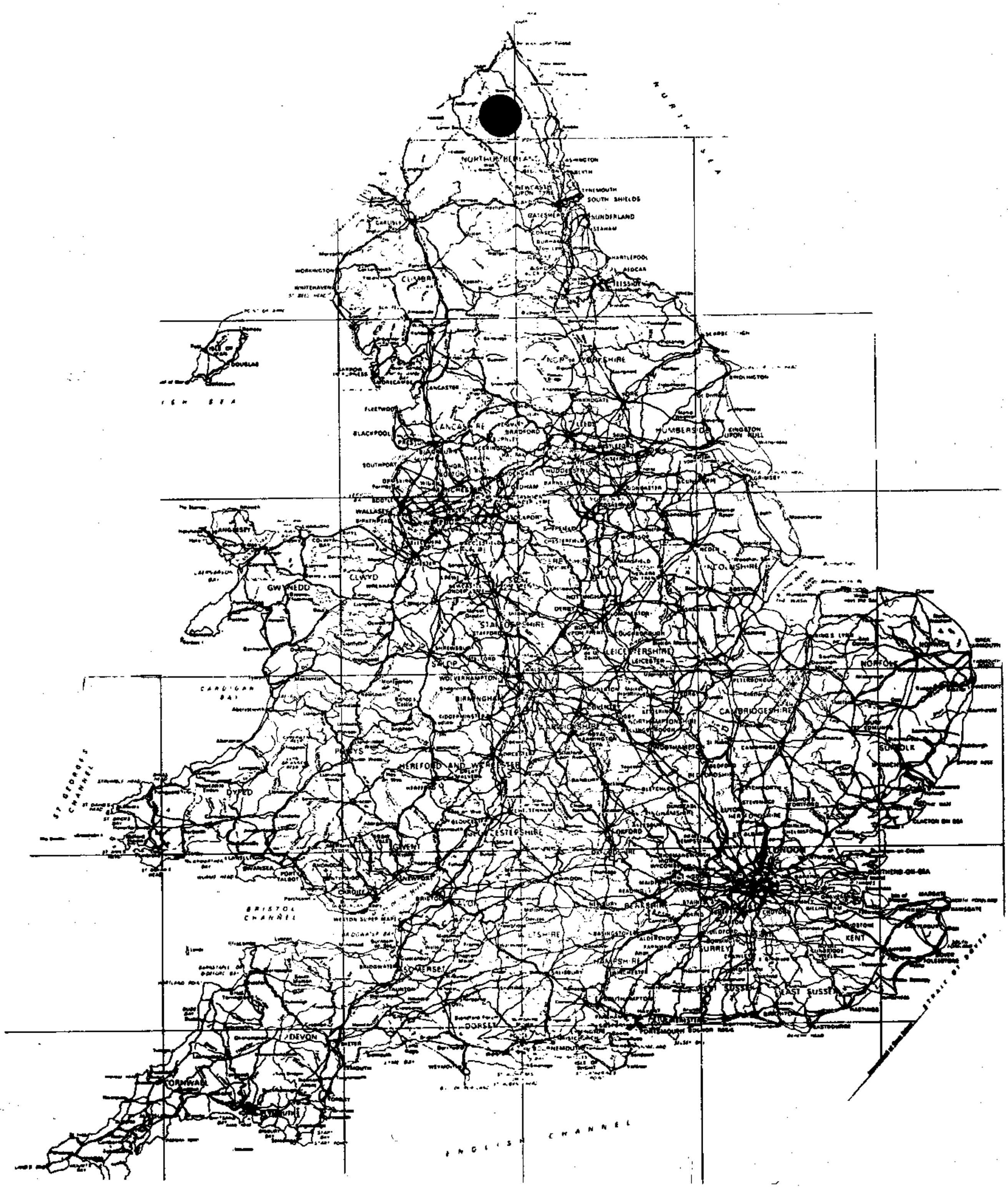
Maps showing the study area locations, and base maps of each study area reproduced from 1:50 000 Ordnance Survey maps, are included with the permission of the Controller of Her Majesty's Stationery Office, Crown copyright reserved. The air photograph of Glascwm on the cover is one of those by Professor J K St Joseph, University of Cambridge, that are included in Part I of this Report.

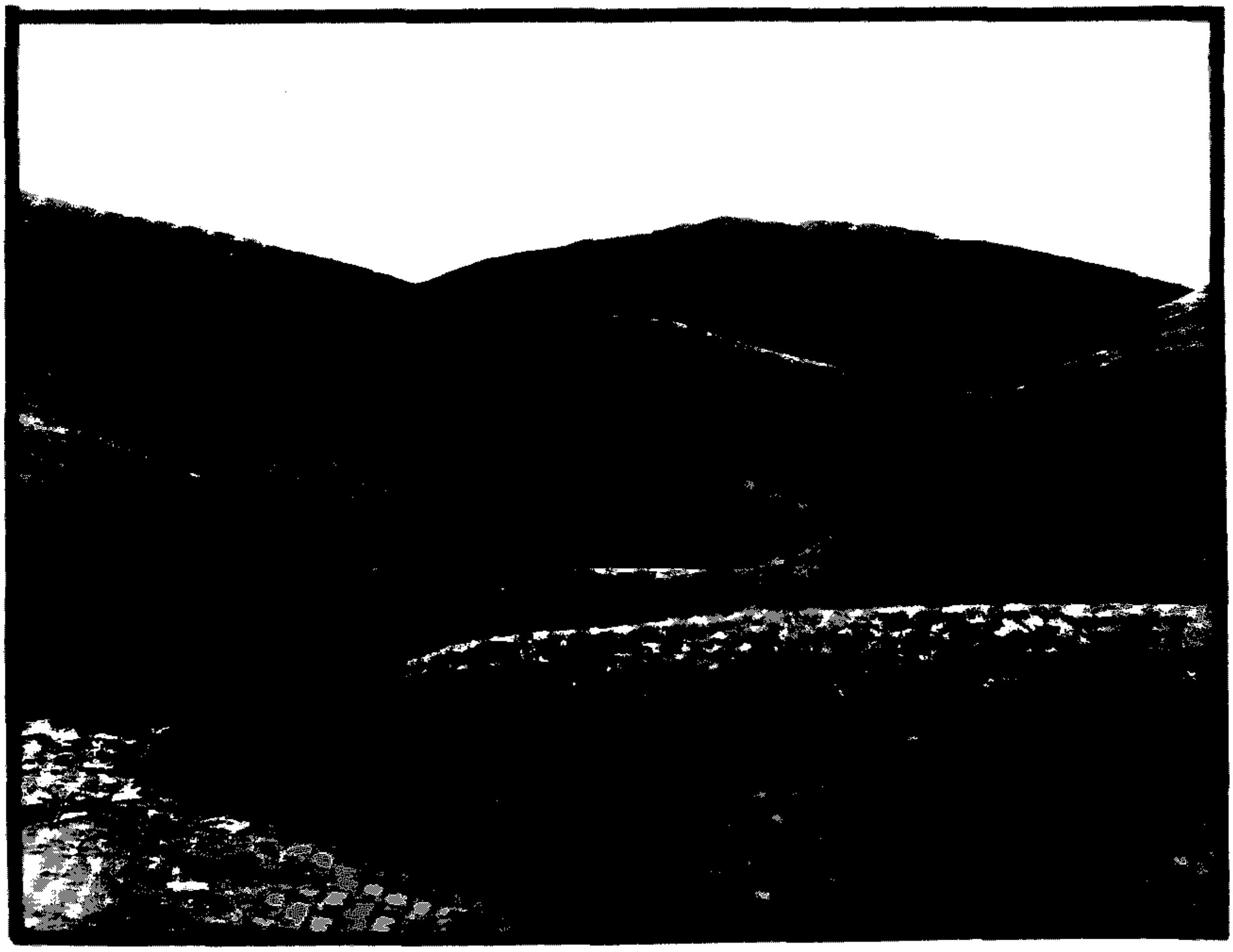
The essential contributions of many colleagues and others are recognised in the Preface and Acknowledgement sections of Part I. The study would not have been possible without the freely given permission of landowners and tenants to carry out vegetation recording on their land.

REFERENCE

Ball, D. F., Dale, J., Sheail, J., Dickson, K. & Williams, W. M. (1981). Ecology of Vegetation Change in Upland Landscapes - Part I: General Synthesis. Bangor Research Station Occasional Paper No. 2, ITE.

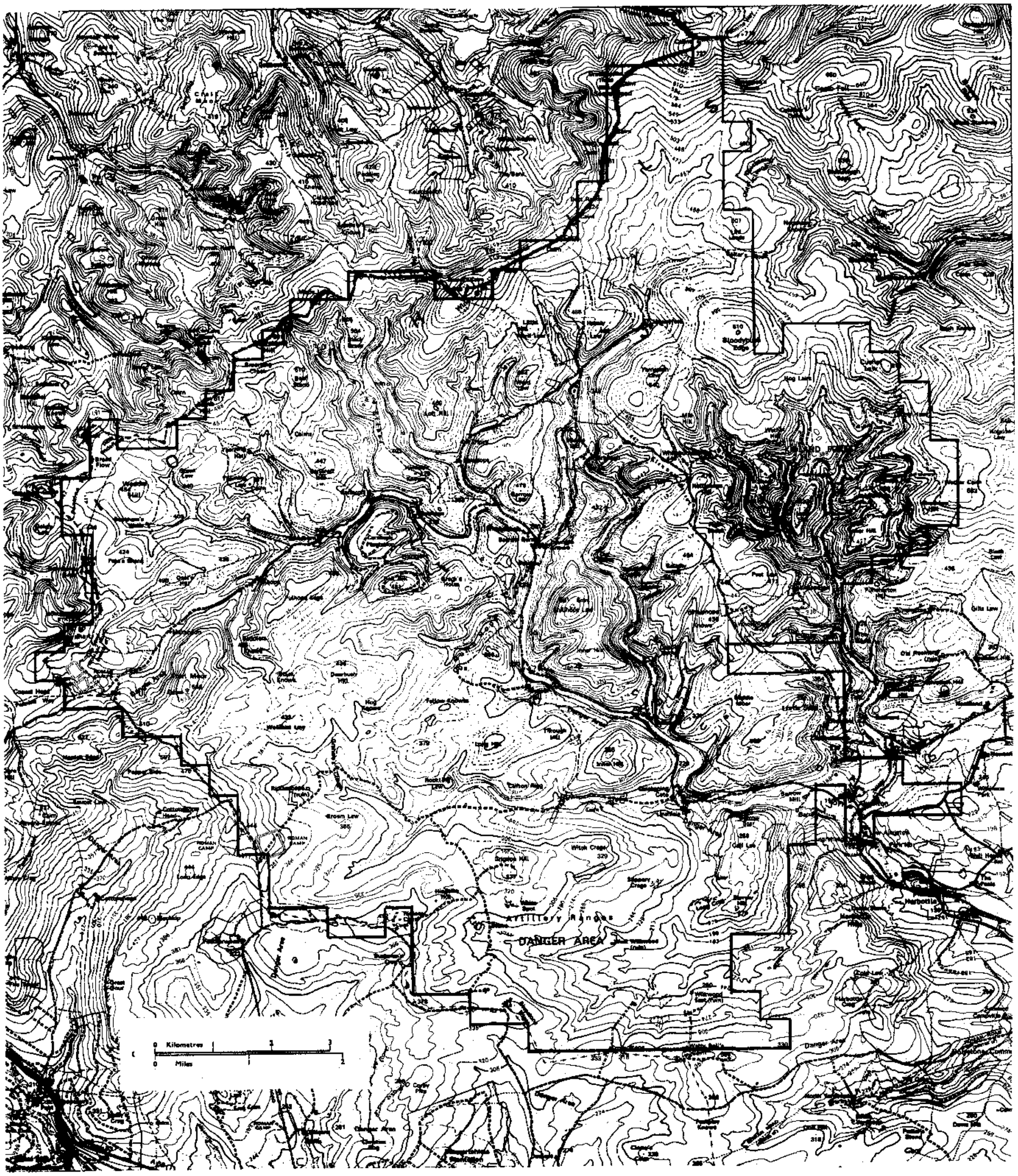
# ALWINTON


NORTHUMBERLAND
NEWCASTLE UPON TYNE
SOUTH SHIELDS
SUNDERLAND
HARTLEPOOL
CARLISLE
WORKINGTON
WHITEHAVEN
CUMBRIA
NORTH YORKSHIRE
LANCASTER
FLEETWOOD
BLACKPOOL
LANCASHIRE
BRADFORD
LEEDS
HUMBERSIDE
KINGSTON UPON HULL
SOUTHPORT
WALLASEY
GWYNEDD
CLWYD
STAFFORDSHIRE
LEICESTERSHIRE
SALOP
WOLVERHAMPTON
BIRMINGHAM
NORFOLK
CAMBRIDGESHIRE
SUFFOLK
CLACTON ON SEA
POWYS
DYFED
HEREFORD AND WORCESTER
CARDIFF
BRISTOL CHANNEL
WESTON SUPER MARE
LONDON
KENT
SURREY
EAST SUSSEX
SOMERSET
DORSET
BOURNEMOUTH
DEVON
CORNWALL
ENGLISH CHANNEL



Valley of the River Coquet. In the right foreground is rough grassland with Nardus stricta prominent. Pastoral rough grazing remains the dominant feature of much of this study area.
(Photo by P.Ainsworth)

FIGURE 1.1 THE STUDY AREA OF ALWINTON



STUDY AREA 1: ALWINTON, NORTHUMBERLAND

PHYSICAL ENVIRONMENT

The study area of Alwinton in the Cheviot region of northern Northumberland (Figure 1-1) is a large parish covering 155 $km^2$, the northern boundary of which follows the border between England and Scotland. It includes the headwaters of the River Coquet (Plate 1). Rothbury and Alnwick are the nearest towns. Land between 244 and 427 m (800-1 400 ft) dominates most of the area, but there is a small sector of lower ground around Alwinton village, and a band of higher land along the western and northern margins (Figure 1-2). Steep and very steep slopes ($>11^o$) are frequent north of the Coquet (Part I, Plate 1), and moderate slopes dominate most of the remainder of Alwinton (Figure 1-3), with gentle slopes ($<5^o$) only prominent in a small part of the area in the south.

Climatically, compared to the other study areas, Alwinton is classifiable as cold and dry (Part I, 2.32 and Figure 2-2). The annual average of daily sunshine hours is 3.5 and there is an average of 30 days a year with snow lying. January and October mean temperatures are estimated as 0.5 and 7.8$^o$C. These climatic values will clearly vary substantially between the village and the hill summits and can only be used to give a general impression for the area (see Part I, 2.31). Because Alwinton is situated east of the high spine of the Pennines that runs through northern England, it lies in the rainshadow of these hills in relation to the main rain-bearing winds coming from the west. Low rainfall (801-1 000 mm, c. 32-40 in pa) occurs over about one quarter of the area in the eastern central sector from Alwinton village to around Windyhaugh. The remainder is in a moderate rainfall zone (1 001-1 200 mm, c. 40-48 in pa). In Smith (1976) the length of the growing season for grass in the upland area of Northumberland which includes Alwinton is given as 200 days (21 April-7 November) at 214 m.

Geologically the most widespread rocks of Alwinton are those of the Cheviot igneous complex, although the Cheviot granite itself has only a very small outcrop in the northeast corner. The study area is mainly composed of andesite lavas, with subordinate volcanic ashes in the west, which occupy much of the moderate altitude ground. The high land in the north is of less weatherable rhyolite rocks. The southern quarter of the area, south approximately of a line from Alwinton village west to Brown Law and the ruin of Ridleeshope, consists of Carboniferous sedimentary rocks, mainly hard nutrient-poor sandstones, but with an area of shales and minor impure limestones around Alwinton village, and a more complex association of sandstones with shales, occasional limestone, and poor coal seams in the south. A small extent of Silurian shale and sandstone is mapped in the extreme west, west of Makendon. Drift deposits of boulder clay are mapped along the lower Coquet and especially along the Ridlees Burn and its tributaries in the southern central sector west of Alwinton village, and also over the eastern half of the area of Carboniferous rocks in the south. Deep peat is mapped on the northeastern hills and near the western boundary of the study area in the south.

From the national soil map, except for a small sector dominated by Brown Earths immediately around Alwinton Village, the greater part of the study area is mapped as dominated by Peaty Podzols (Stagnopodzols), which are peaty-surfaced, strongly leached and acid, but moderately well drained soils. These are associated with very poorly drained Peaty Gleys (Stagnogleys) and poorly drained Gleys, some better drained non-peaty Brown Podzolic Soils, Rankers (shallow immature soils over rock) and Peats. East of the Coquet a large area including the western part of Kidland Forest is mapped as dominated by Deep Peaty Soils.

The agricultural land classification map of the area shows a very limited extent of grade 4 land around Alwinton village, maps 'other uses' for the forestry sectors of Carshope Plantation and part of Kidland Forest, and includes the bulk of the area in the category of lowest agricultural quality, grade 5.

Figure 1-4 illustrates the topographic character of Alwinton. The limited spreads of settlement and of intensive agriculture as assessed by frequent field boundaries are almost confined to around Alwinton village and along the Coquet as far as Windyhaugh. The road and track pattern mainly follows the valleys, many roads being entirely or partially confined to military or forestry use (there are additional tracks for these uses that are not shown on the 1:25 000 OS maps). As a whole the area is now one with a small population and little public use, due particularly to its remote location and to its importance as a military training area. The Upland Landscapes Study (ULS 1979) records a considerable recent forestry expansion, with 1 415 ha planted with conifers between 1967 and 1978 (Part I, Plate 1).

The distribution of land types (Part I, 4.11-4.17) given in Figure 1-5 shows there to be a small extent of upland margin land around the village and running up the main valleys. The hill land group dominates the area, with steep hill prominent in the north, and hill and high plateau in the south. The valley slopes in the central and northern sectors are in the steep upland land type, while upland plateau, in association with high plateau and hill, is prominent in the south-central sector.

LAND-USE HISTORY

Far from being an empty area in prehistoric times, Alwinton was apparently more widely populated then than at the present day (Charlton & Day 1977; Anon. 1978). There is evidence of a comparatively dense scatter of stone houses and field systems dating from about 650 BC on the long ridges of the low-lying Cheviot foothills, protected from the prevailing winds and situated well above the wet and wooded valley bottoms. Romano-British field systems survive near Alwinton (Part I, 4.23). Over the centuries, grazing by sheep and goats led to the destruction of originally extensive areas of woodland and to the area becoming more settled. In grants of grazing rights to the monks of Newminster in the 13th century, for example, it is implied that the wolf was then nearly extinct even in the remoter parts of Upper Coquetdale which, from its character in recent times, might be expected to have been then unoccupied and wild. The sheep flocks of the monasteries, and the seasonal movement of large herds of cattle, may have accelerated the clearance of any remaining woodland from the fells and screes of Kidland.

The hamlet of Alwinton stands at an important junction of drove roads and border tracks, the most famous of which was Clennell Street which ran from the Scottish Border down the ridge between the Alwin tributary of White Burn, and the Usway Burn (Newton 1972). In the 13th and 14th centuries there are the earliest references to such places as Batailshiel on the Usway Burn, Carlcroft and Shillmoor on the Coquet, and Wilkwood on the southern fell land, with evidence also of extensive areas of present day moorland being under some form of cultivation.

This prosperous phase came to an abrupt end in the 15th and 16th centuries, as a result of warfare across the Border (Part I, 4.35). When the grange of Stokershaugh, with its 1 000 acres of pasture, was valued in 1536, it was said to be useless and lying waste 'bycause of the great thefte of the Skottes and outlaws' (Dodds 1940). This site was never re-occupied, but many other farmsteads were repopulated from the late 17th centuries onwards. The fine Georgian farm at Shillmoor has been described as a memorial to the final establishment of peaceful conditions.

From the Napoleonic wars onwards, many of the medieval ploughlands on the higher ground were reclaimed, and some further moorland included in the then arable area. Hardy (1887) for example described how land on Hosedon Burn, to the north of Alwinton, was held by 2 brothers, with spits of land "laid out on a plan, James and Thomas alternatively". Tracts of common land were at this time subdivided into holdings owned by individuals, although later disputes over trespass make it clear that physical boundaries were seldom erected. Most of the area however fell within large estates, from which the individual stock-farms were leased. When the Lordship of Kidland was offered for sale in 1830, it was advertised as "almost a ring-fence estate", with 7 farms 'let to most respectable and substantial tenants', covering an aggregate 22 000 acres (c.8 900 ha). Each farm was characteristically made up of "20 to 30 acres of Old Sward Meadow", and "over 2 000 acres of rough grazing land". The sale catalogue claimed that the estate abounded in grouse and black game, and included streams famous for their trout.

During the 18-19th centuries coal was worked in small pits around Wilkwood (Part I, 4.37) giving a minor industrial supplement to the main stock-farming activity of the area.

The Ordnance Survey carried out its first large scale survey of Alwinton in the 1860s, with revisions in the 1890s and subsequently. Figure 1-6 based on these maps supported by air photographs shows the distribution of moorland core, fringe and farmland (see Part I, 4.47-4.55). The extent of unmodified moorland (the moorland core) has been determined as 12 365 ha (80% of the area), and the moorland fringe (land which at different periods has been recorded as both farmland and moor) as 2 279 ha (15%), out of the total area of 15 525 ha (Figure 1-6). Of the fringe, 1 750 ha have been afforested since 1953, and a further 100 ha have been improved agriculturally. 43% of the fringe falls in the steep upland land type with about 20% each in steep hill and upland margin, giving a relatively high representation in the steep upland and upland margin in relation to the extent of the 3 types in Alwinton (22, 43 and 5% respectively (Part I, Table 4-3b)).

About 100 ha of improved land have reverted to moorland since the 1850s. Air photography provides evidence that a further 350 ha of present day moorland were once cultivated, of which 290 ha were ploughed at some period after 1800. These areas may represent the extension of ploughland in response to high agricultural prices during the Napoleonic wars and their aftermath in the early 19th century, referred to earlier in this section. Data in ULS (1979) show an increase in crops and grass between 1863 and 1978 from 1.4% of the area to just under 5% and an increase in wood and forest from 0.5 to 17.5%. No parish statistics for the period 1900-1965 were available to include in Figures 4-4 to 4-7 of Part I.

VEGETATION

The frequencies of vegetation classes at the 80 main sites recorded in the Alwinton study area during 1978 are given in Figure 1-7. Figure 1-8 shows the locations of these sites (their grid references are listed in Appendix 1) and their vegetation class at that time. The very low proportion of improved pastures (6% of recorded sites) is a marked characteristic of the sampled vegetation, these sites occurring only in the immediate vicinity of Alwinton village and along the Coquet. Rough pastures are more widespread (28% of recorded sites) and these also mainly occur along the valleys where the farmsteads are found. One rough pasture class, Festuca/Agrostis grassland, class 8 (Part I, 3.14), at 23% of the sites, is the most frequently recorded vegetation class at the main sites. Grassy heaths (35% of recorded sites) occur widely, whilst shrubby heath sites (31% of sites) are more concentrated, occurring mainly in 2 bands along the northern and southern borders of the area. The most frequent heath classes are, among grassy heaths, Festuca/Vaccinium heath, class 14 (Part I, 3.16) and Festuca/Nardus/Vaccinium heath, class 15, with among the shrubby heaths, Eriophorum/Calluna heath, class 11.

Semi-natural woodland is limited to small scattered woods. The extent of woodland is lower in Alwinton than in all other study areas (ULS 1979 and see Part I, Table 3-4). The 10 woodlands in which vegetation was recorded by ITE are all classifiable as upland acid woodlands. Most occur on rather wet flushed sites. Although all appear damaged by neglect or their military use, regeneration was recorded in 6 of them. The extensive coniferous plantation of Kidland Forest dominates the northeastern sector of Alwinton, and accounts, with part of Usway Forest in the north and the central Carshope Plantation, for apparent gaps in the distribution of vegetation main sites on Figure 1-8.

Table 1-1 shows the association between vegetation classes at main sites in Alwinton and the land types in which these sites are situated. Figure 1-9 gives a sketch (with a map based on Figure 1-5) of the relationship between vegetation groups and land groups. Three of the 5 improved pasture sites occur in the upland margin land type. Rough pasture and grassy heath sites are concentrated in the steep hill and steep upland land types while the shrubby heaths are mainly divided between the steep hill and hill land types.

## POTENTIAL VEGETATION CHANGE

Alwinton can be considered as an island of open moorland largely surrounded by extensive afforestation. The military ranges dictate present land-use policies over most of Alwinton so that the traditional management of the Border country for livestock has been maintained (Plate 1). From a conservation viewpoint this has resulted in sustaining ecosystems which might otherwise have been lost to afforestation. While military use remains, the potential for major change must be limited. The extensive open moorland will persist as open country, and pressure for further afforestation, other than for local shelter belts, is likely to be resisted. Although the area is within the Northumberland National Park, their policies for Alwinton, allied to the presence of the ranges and forestry, aim to limit public recreational pressure in this sector of the Park.

ULS analysis (1979) based on ADAS hill land classification criteria indicates that almost two-thirds of the rough grazing area is "generally not improvable" though mostly this is "of some existing grazing value". Of the remainder, 10% is considered "improvable" and the rest suitable for limited improvement. As the area has large farms with generally low stocking densities the structural basis for some improvement is there. One farm now tenanted by the Northumberland College of Agriculture may become a focus for demonstrating the potential for change in farming methods.

Looking beyond the restrictions due to military needs, and ignoring the opportunity that any relocation of these needs would give for forestry expansion, the kinds of gradual vegetation change that could occur can be predicted by applying the general principles discussed in Part I, 5.74-5.78 and Figure 5-4 (summarised here in <u>Appendix 2</u>) to vegetation recorded at the main sites in 1978. Improved pasture sites are few but <u>Lolium</u> grassland, class 2, is the most frequent. In considering possible change, it is assumed that these improved pastures would be maintained, whether agriculture expanded or declined. The most prominent rough pasture class is class 8, <u>Festuca</u>/<u>Agrostis</u> grassland. Intensified use would direct change in this class towards the improved pastures while under declining agriculture it could move towards a grassy heath composition. The prominent grassy heaths, <u>Festuca</u>/<u>Vaccinium</u> heath, class 14, and <u>Festuca</u>/<u>Nardus</u>/<u>Vaccinium</u> heath, class 15, would, if agriculture intensified, respectively move towards drier and wetter rough pasture classes (<u>Festuca</u>/<u>Agrostis</u> and <u>Agrostis</u>/<u>Juncus</u> grasslands, classes 8 and 5), while if agriculture declined they would show a trend towards a shrubby heath vegetation of a rather drier class than those now most frequent (<u>Vaccinium</u>/<u>Calluna</u> heath, class 10). The principal shrubby heaths (<u>Eriophorum</u>/<u>Calluna</u> heath, class 12, and <u>Nardus</u>/<u>Sphagnum</u>/<u>Calluna</u> heath, class 11) are likely to persist in most conditions leading to gradual change, although class 11 could move towards grassy heath class 16 (<u>Festuca</u>/<u>Nardus</u>/<u>Molinia</u> heath) if grazing management were intensified on it.

Figure 1-7 includes the altered balance of vegetation classes which would result from the predicted changes at recorded sites under generalised assumptions of a moderate level of intensification or decline in agriculture land-use. Figure 1-8 includes the potential alterations in vegetation classes at individual main sites. With the caution amplified in discussion in Part I (5.78-5.81) that these predictions follow a standard application of trends of change and are not able to take account of physical or management conditions at particular locations, it is estimated that an intensification of agriculture to a moderate degree could lead to increases in both improved pastures and rough pastures, the former from 6 to 34% and the latter from 28 to 35% of the sites recorded. These increases would be counter balanced by losses in both grassy heaths and shrubby heaths, the numbers of recorded sites with these vegetation groups falling from 35 to 14% and from 31 to 17% respectively. The predicted outcome of a moderate decline in agricultural use would be for the proportion of improved pastures to remain at its present 6% of the recorded sites and for the disappearance of rough pasture vegetation. Grassy heaths would fall slightly (from 35 to 28% of sites) while shrubby heaths would increase to occupy 66% rather than the present 31% of recorded sites. In considering the overall impact of these predicted changes on the landscape, agricultural intensification would involve a change in vegetation group at 76% of the recorded main sites, whilst agricultural decline would involve a change of vegetation group at 63% of the sites.

Figure 1-9 includes predictions of change in the frequency of vegetation groups at sites in each land group. The sites in the small extent of upland margin would not change. Sites in the upland could swing from their present 50:50 pasture:heath balance to being almost entirely pastures or entirely heaths. The hill land would be less affected but pastures could go from their present frequency of about 20% up to around 50% or alternatively could disappear.

Figure 1-10 reproduces the Upland Landscapes Study vegetation map of Alwinton (ULS 1979). To allow comparison of the ULS mapping units (based on visual cover of species) with the ITE vegetation classes at sites (based on species presence), Table 1-2 correlates the ITE class for the main sites recorded in 1978 and the additional sites recorded in 1979 (Part I, 5.66-5.67) with the ULS unit in which each site is located. Appendix 3 gives the overall correlation between ULS vegetation map units and ITE vegetation class for 11 study areas (no vegetation map was appropriate for Monyash). It also considers in outline some limitations to the correlations, and their interpretation. Rough pastures occur mainly in the 'smooth grassland' and 'coarse grassland/Nardus' mapping units; shrubby heaths in the 'coarse grassland/Molinia', 'sedge and rush moorland' and especially the 'sub-shrubs/heathers' units.

Grassy heaths occur more widely in a range of ULS mapping units. Table 1-3 shows the changing balance of vegetation groups at sites in each ULS unit that result from the standard predictions of vegetation change outlined above. For example the 'smooth grassland' unit that now seems dominated by rough pastures with grassy heaths could on agricultural intensification become dominated by improved and rough pastures or, following agricultural decline, change almost entirely to being a heath unit.

## CONCLUSION

Alwinton is an area where the requirements of the Ministry of Defence have created a situation in which change may be limited over the next 10-20 years. However, the Upland Landscapes Study indicates that there is increasing co-operation between different land users. This could assist intensification of agricultural use on the large holdings where pressures for changes are limited at present. If the maximum opportunity for change was taken but forestry did not expand, almost half the present heath sites could become pastures on intensification of agriculture. Forestry expansion is clearly a strong option, but would be influenced by National Park policies. Calculations based on simple considerations (Part I, Table 5-19) suggest that forestry could occupy 58% of Alwinton against its present 18%. If agricultural land-use was allowed or required to decline in response to external economic pressures or competing uses then shrubby heaths could expand and rough pastures retreat, in the absence of a forestry takeover. General stability or substantial change in this area largely hinges on whether the military ranges are maintained under a regime similar to their present management, and would also be strongly affected by considerations of whether forestry should expand in this part of the National Park.

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UPLAND LANDSCAPES STUDY. (1979). <u>Alwinton Parish Report</u>. Unpublished report to the Countryside Commission, April 1979.

TABLE 1-1 CORRELATION OF VEGETATION CLASSES AND LAND TYPES - ALWINTON

| Vegetation Group and Class | | Land Group and Type: Hill — Steep Hill (1)* | Hill (3) | High Plateau (4) | Upland — Steep Upland (5) | Upland (7) | Upland Plateau (8) | Upland Margin (6) |
|---|---|---|---|---|---|---|---|---|
| Improved Pastures | 1 | | | | | | | |
| | 2 | | | | | 1 | 1 | 2 |
| | 3 | | | | | | | |
| | 4 | | | | | | | 1 |
| Rough Pastures | 5 | | | | | | | |
| | 6 | 1 | | 1 | 2 | | | |
| | 7 | | | | | | | |
| | 8 | 8 | 1 | | 9 | | | |
| Grassy Heaths | 14 | 5 | 1 | | 7 | | | |
| | 15 | 5 | 2 | 1 | 3 | | | |
| | 16 | 1 | 2 | | | 1 | | |
| Shrubby Heaths | 9 | | | | | | | |
| | 10 | | | | | | | |
| | 11 | 4 | 5 | 1 | | | 1 | |
| | 12 | 3 | 7 | 2 | 1 | | | 1 |
| | 13 | | | | | | | |

As number of sites of each vegetation class located in each land type.
* Land type numbers as used on computer maps, Figure 1-5.

TABLE 1-2 CORRELATION OF ULS VEGETATION MAPPING UNITS AND ITE VEGETATION CLASSES - ALWINTON

| ULS Mapping Unit | Number of ITE Sites in Area of ULS Unit | ITE Vegetation Class | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Improved Pastures | | | | Rough Pastures | | | | Grassy Heaths | | | Shrubby Heaths | | | | |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 14 | 15 | 16 | 9 | 10 | 11 | 12 | 13 |
| Smooth Grassland | 39 | | | | 1 | | 3 | | 19 | 8 | 7 | 1 | | | | | |
| Coarse Grassland/*Nardus* | 18 | | | | | | 5 | | 5 | 3 | 3 | | | | 2 | | |
| Coarse Grassland/*Molinia* | 10 | | | | | | 1 | | 1 | 2 | 1 | | | | 2 | 3 | |
| Bracken | 7 | | | | | | | | 2 | 3 | 1 | 1 | | | | | |
| Sub-shrubs/Heathers | 18 | | | | | | | | | 1 | 2 | 1 | | | 5 | 9 | |
| Sub-shrubs/Bilberry | | | | | | | | | | | | | | | | | |
| Sub-shrubs/Gorse | | | | | | | | | | | | | | | | | |
| Sedge & Rush Moorland | 7 | | | | | | | | 1 | 1 | | 1 | | | 2 | 2 | |
| Farmland | 4 | | 4 | | | | | | | | | | | | | | |

As number of recorded sites in each ITE vegetation class that are located in each ULS unit

TABLE 1-3 PREDICTIONS OF CHANGE IN THE BALANCE OF VEGETATION GROUPS AT SITES LOCATED IN ULS MAPPING UNITS - ALWINTON

| ULS Mapping Unit | ITE Vegetation Groups | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Improved Pastures | | | Rough Pastures | | | Grassy Heaths | | | Shrubby Heaths | | |
| | A | B | C | A | B | C | A | B | C | A | B | C |
| Smooth Grassland | 1 | 23 | 1 | 22 | 16 | | 16 | | 22 | | | 16 |
| Coarse Grassland/*Nardus* | | 10 | | 10 | 6 | | 6 | 2 | 10 | 2 | | 8 |
| Coarse Grassland/*Molinia* | | 2 | | 2 | 3 | | 3 | 2 | 2 | 5 | 3 | 8 |
| Bracken | | 2 | | 2 | 5 | | 5 | | 2 | | | 5 |
| Sub-shrubs/Heathers | | | | | 4 | | 4 | 5 | | 14 | 9 | 18 |
| Sub-shrubs/Bilberry | | | | | | | | | | | | |
| Sub-shrubs/Gorse | | | | | | | | | | | | |
| Sedge & Rush Moorland | | 1 | | 1 | 2 | | 2 | 2 | 1 | 4 | 2 | 6 |
| Farmland | 4 | 4 | 4 | | | | | | | | | |

As number of recorded sites falling in each ITE vegetation group that are located in each ULS unit

A - situation as recorded

B - predicted balance of vegetation if agricultural use increased, 10+ yrs

C - predicted balance of vegetation if agricultural use decreased, 10+ yrs

FIGURE 1.2 ALTITUDE SECTORS - ALWINTON

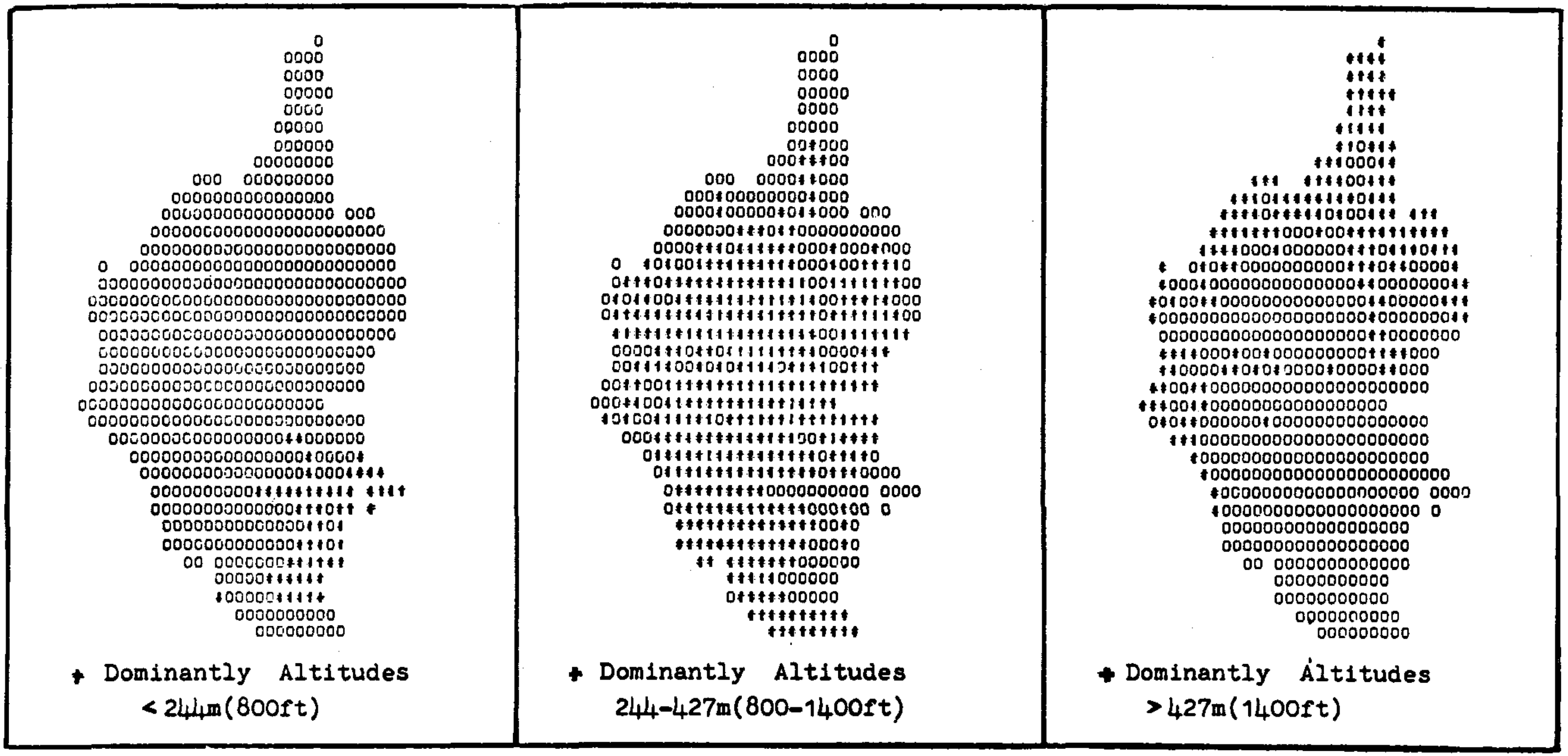
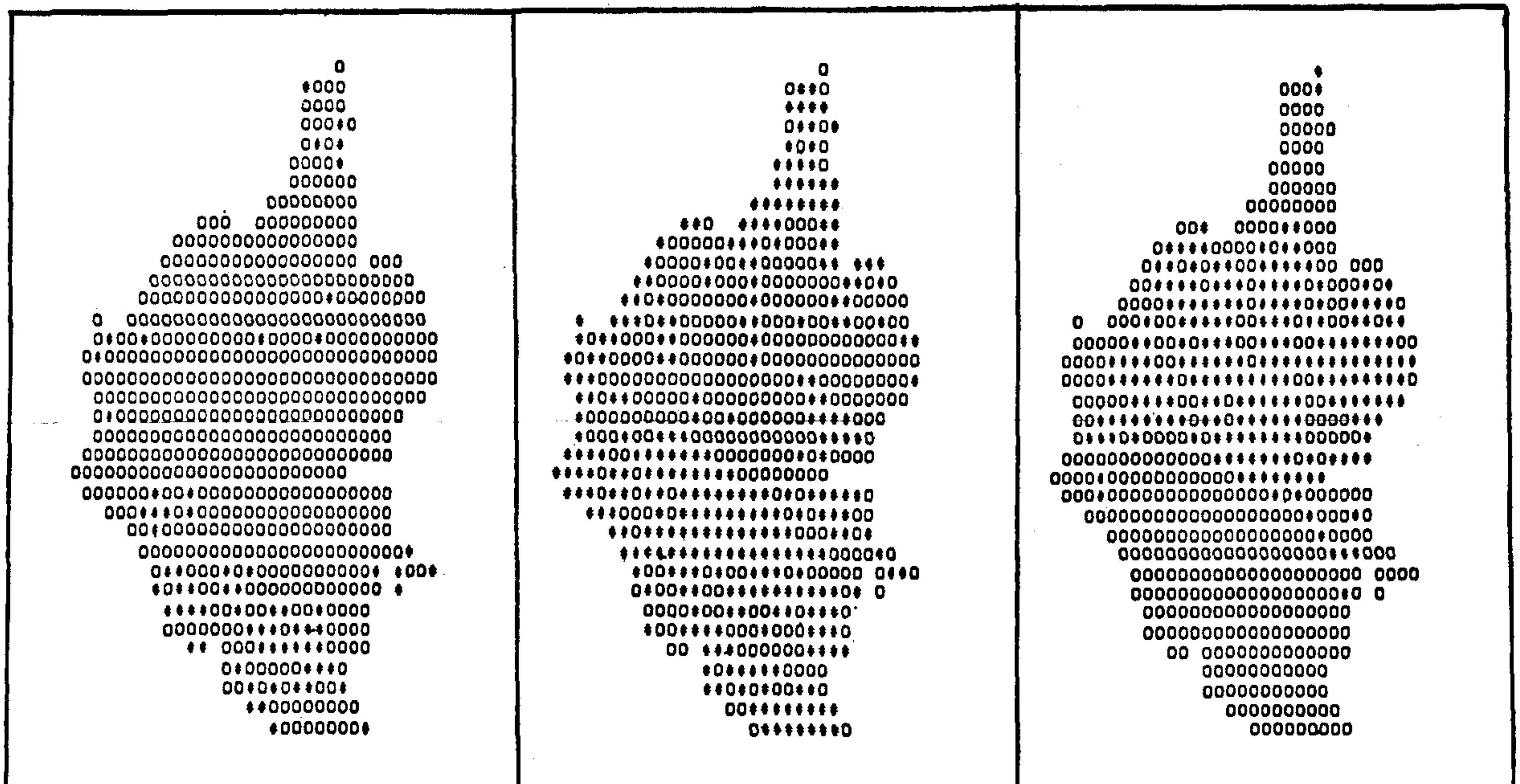


FIGURE 1.3 SLOPE SECTORS – ALWINTON



Dominantly Gentle Slopes ($< 5^{\circ}$)

Dominantly Moderate Slopes ($5\text{–}11^{\circ}$)

Dominantly Steep and Very Steep Slopes ($> 11^{\circ}$)

FIGURE 1.4 TOPOGRAPHIC CHARACTERISTICS - ALWINTON

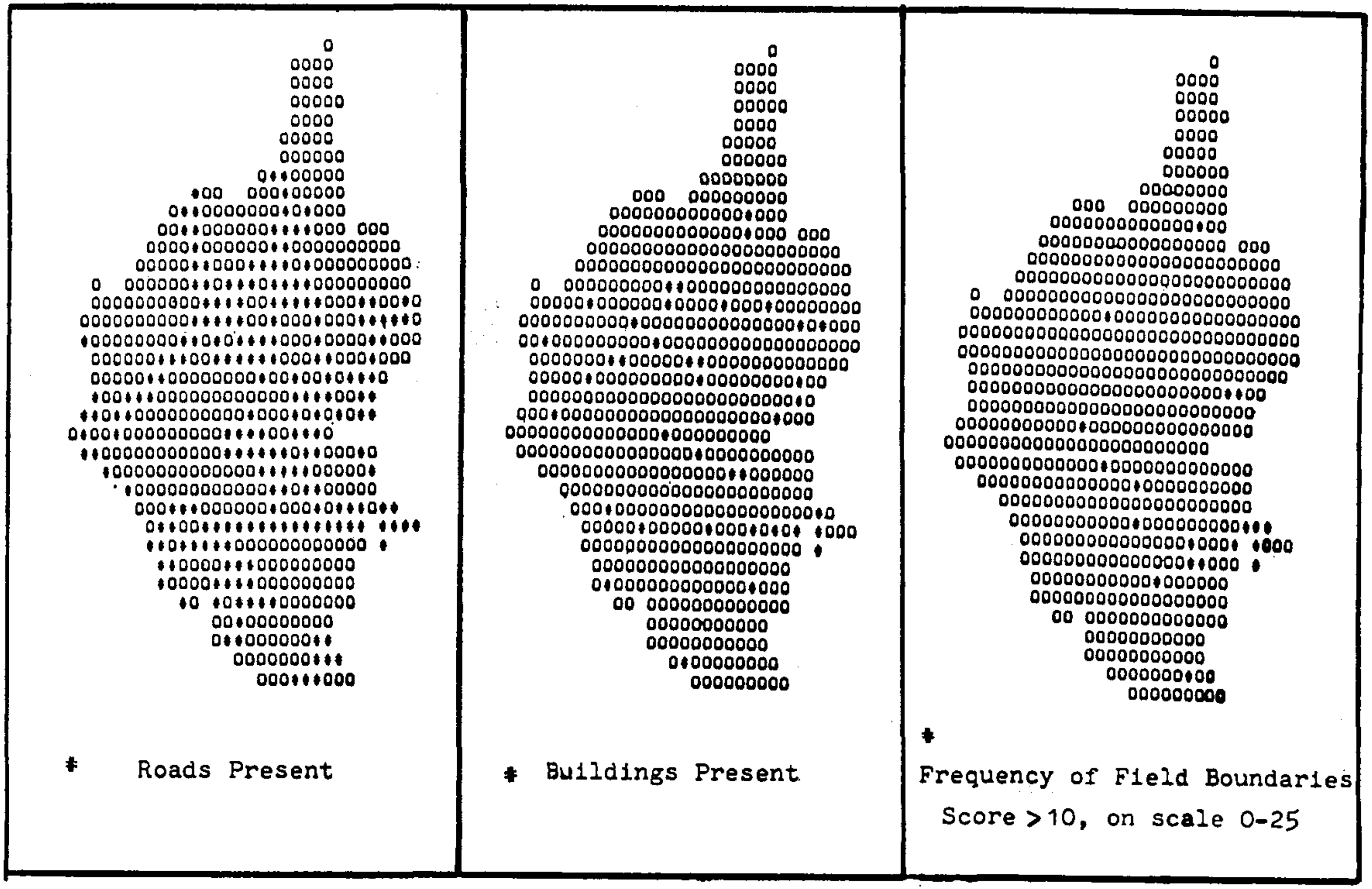
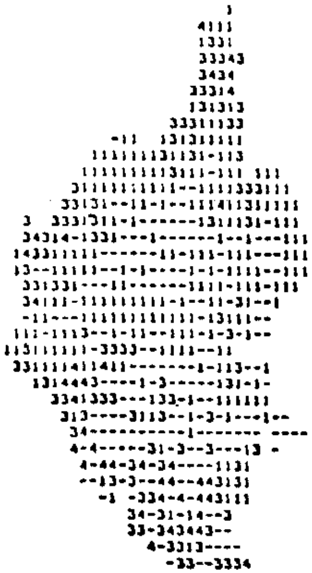


FIGURE 1.5 LAND TYPES - ALWINTON

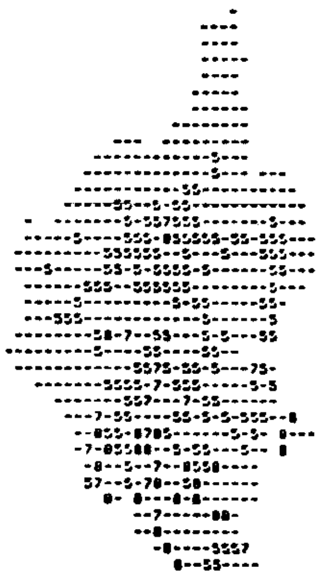


HILL LAND GROUP

1 = Steep Hill

3 = Hill

4 = High Plateau

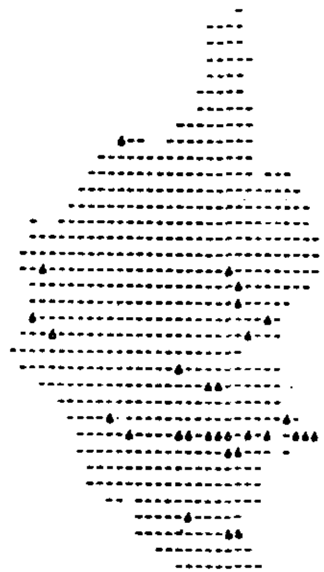


UPLAND LAND GROUP

5 = Steep Upland

7 = Upland

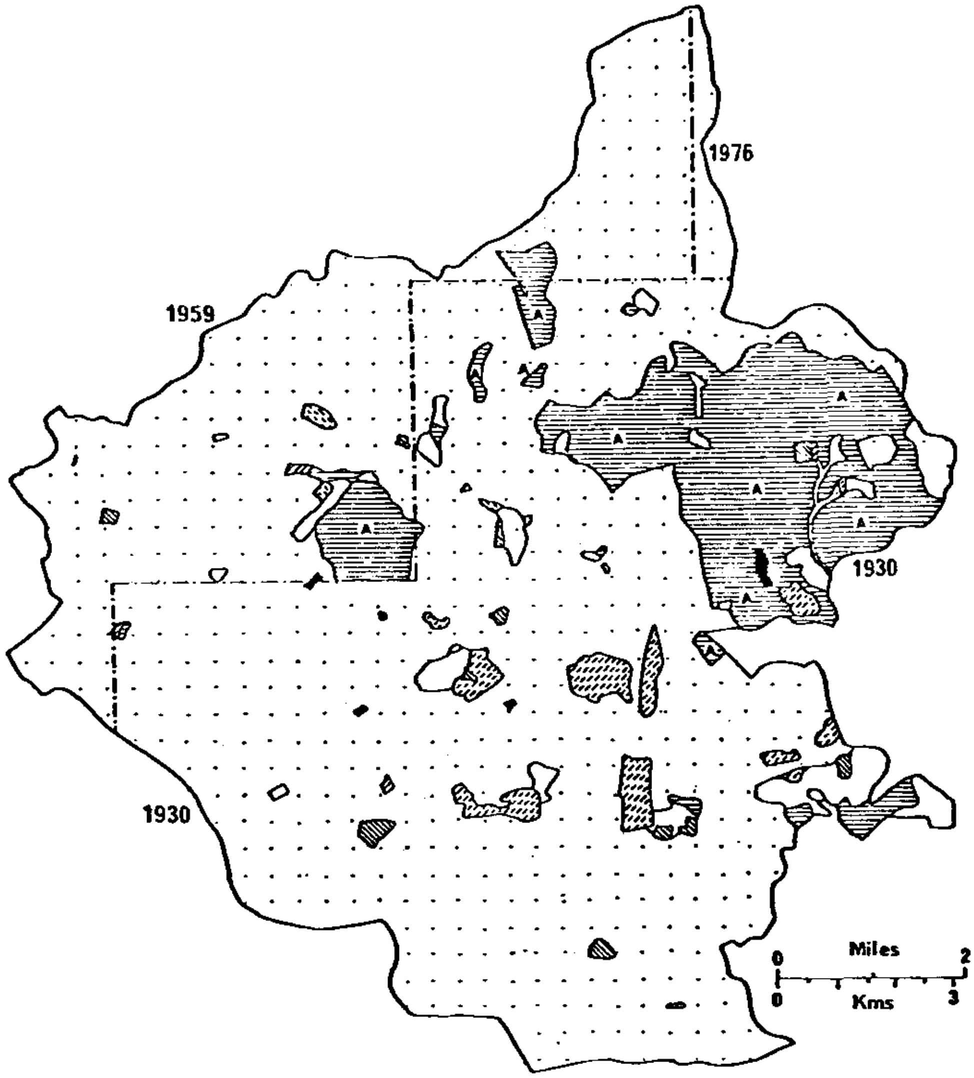
8 = Upland Plateau



UPLAND MARGIN LAND GROUP

6 = Upland Margin

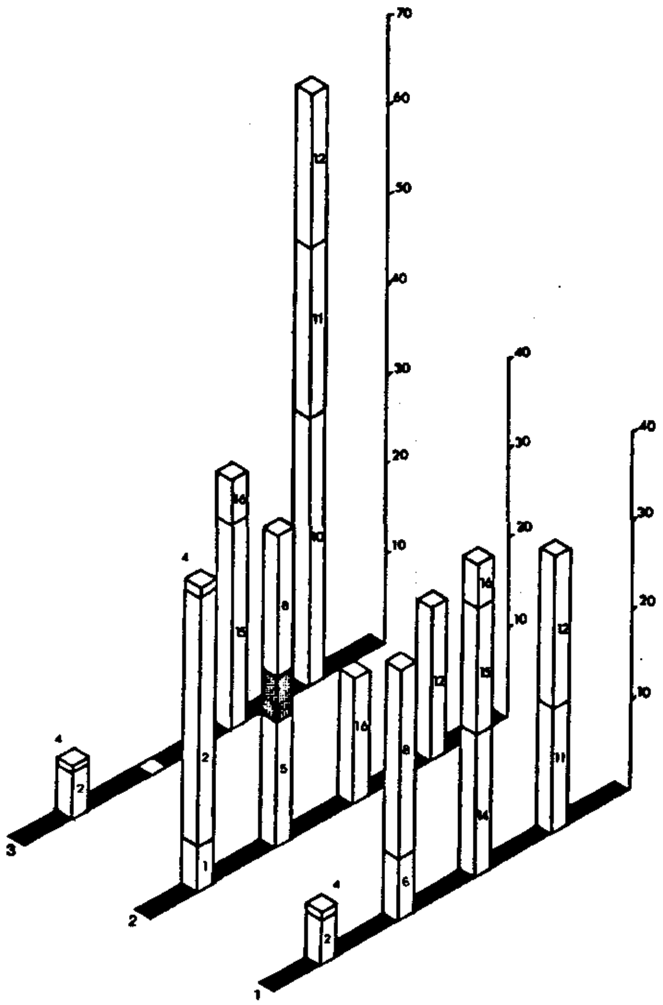
FIGURE 1.6 MOORLAND CORE, FRINGE AND FARMLAND - ALWINTON




CORE
FRINGE RECLAIMED
AFFORESTED MOORLAND
FARMLAND
1976 Date Of Last Revision

FRINGE REVERTED
1940-1959/76
1896-1940
1863-1896
Map Data
Post 1800
Pre 1800
Air Photo Data

# FIGURE 1.7 VEGETATION CLASS FREQUENCY AT MAIN SITES - ALWINTON



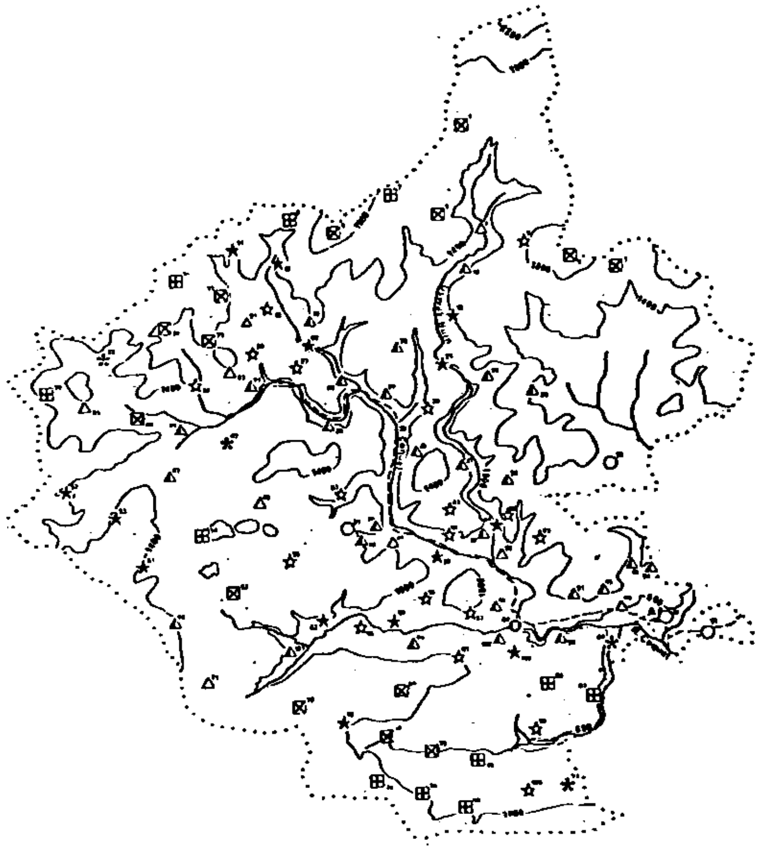

| Vegetation Group | Class | | % Main Sites in Vegetation Class 1 | 2 | 3 |
|---|---|---|---|---|---|
| Improved Pastures | 1 | Lolium/Holcus/Pteridium | - | 5 | - |
| | 2 | Lolium Grassland | 5 | 28 | 5 |
| | 4 | Herb rich Lolium Grassland | 1 | 1 | 1 |
| Rough Pastures | 5 | Agrostis/Juncus | - | 14 | - |
| | 6 | Festuca/Juncus | 5 | - | - |
| | 8 | Festuca/Agrostis | 23 | 16 | - |
| | 5/6 | Agrostis/Juncus or Festuca/Juncus | - | 5* | - |
| Grassy Heaths | 14 | Festuca/Vaccinium | 16 | - | - |
| | 15 | Festuca/Nardus/Vaccinium | 14 | - | 23 |
| | 16 | Festuca/Nardus/Molinia | 5 | 14 | 5 |
| Shrubby Heaths | 10 | Vaccinium/Calluna | - | - | 30 |
| | 11 | Nardus/Sphagnum/Calluna | 14 | - | 19 |
| | 12 | Eriophorum/Calluna | 17 | 17 | 17 |

1. Recorded Main Sites, 1978
2. Predicted Changes at Main Sites if Agriculture Increased, 10 + years.
3. Predicted Changes at Main Sites if Agriculture Decreased, 10 + years.

* Under a regime involving intensification of agriculture Class 16, Festuca/Nardus/Molinia, could move towards either Class 5, Agrostis/Juncus , or the closely related Class 6, Festuca/Juncus. This change is shown on the relevant column of the histogram by the shaded area.

FIGURE 1 .8a LOCATION AND CLASSIFICATION OF VEGETATION MAIN SITES

ALWINTON




Overall Frequencies of Vegetation Groups

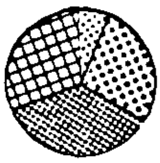
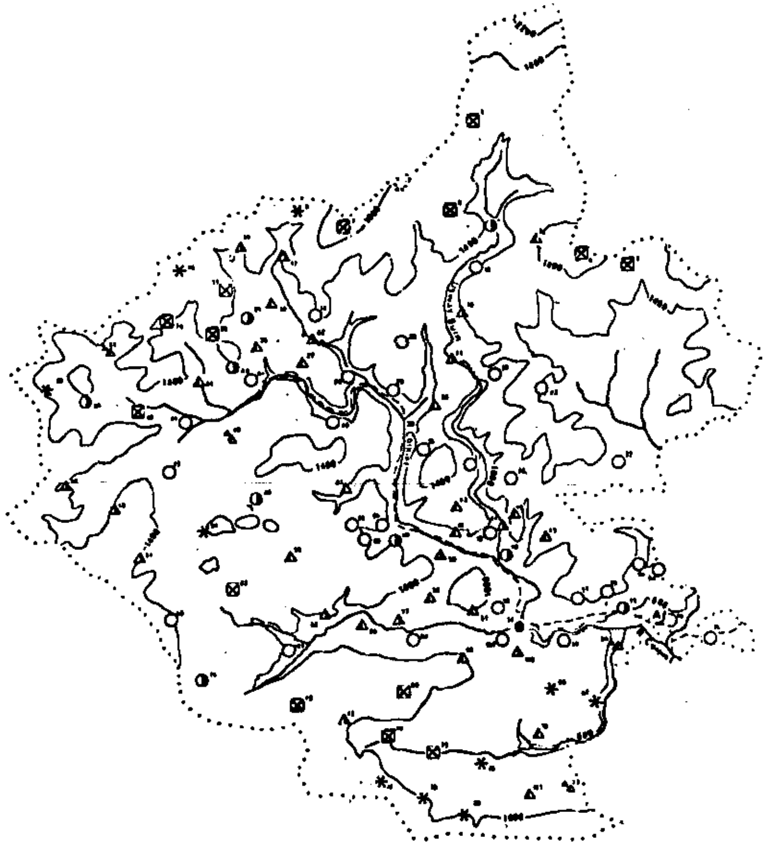
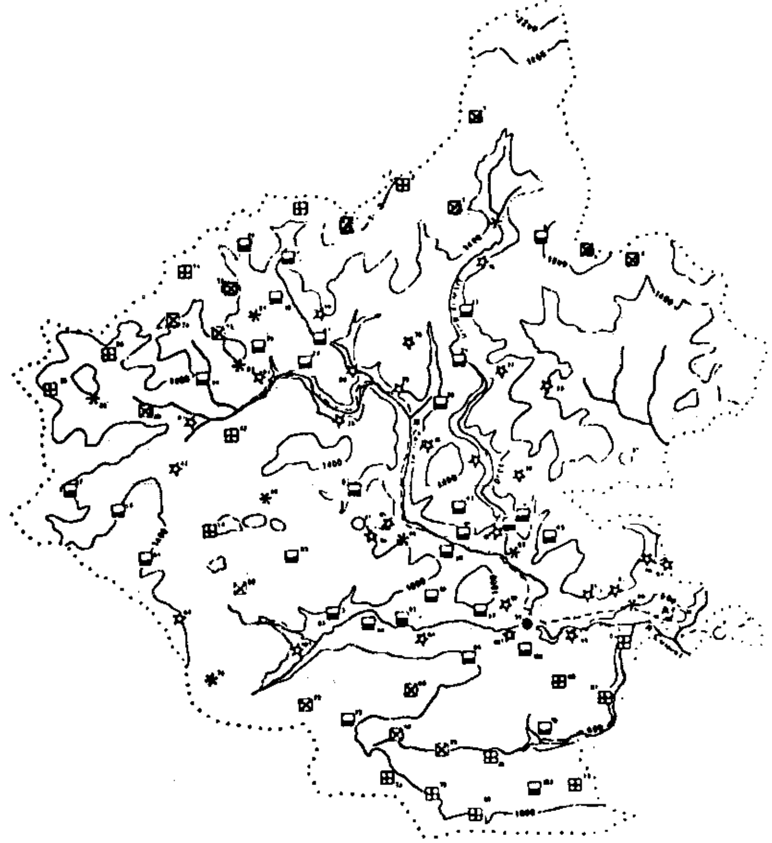


FIGURE 1.8b LOCATION AND CLASSIFICATION OF VEGETATION MAIN SITES - ALWINTON

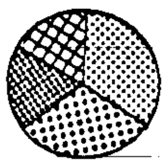


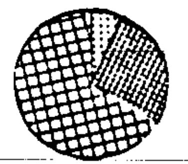
Predicted if Agriculture Increased



Predicted if Agriculture Decreased

Overall Frequencies of Vegetation Groups





## KEY TO FIGURE 1.8

| | | |
|---|---|---|
| Group 1. Improved Pastures | Class 1 : | Lolium/Holcus/Pteridium |
| | Class 2 : | Lolium |
| | Class 3 : | Lolium/Trifolium |
| | Class 4 : | Herb — rich Lolium |
| Group 2. Rough Pastures | Class 5 : | Agrostis/Juncus |
| | Class 6 : | Festuca/Juncus |
| | Class 7 : | Agrostis/Holcus |
| | Class 8 : | Festuca/Agrostis |
| Group 3. Grassy Heaths | Class 14: | Festuca/Vaccinium |
| | Class 15: | Festuca/Nardus/Vaccinium |
| | Class 16: | Festuca/Nardus/Molinia |
| Group 4. Shrubby Heaths | Class 9 : | Calluna/Molinia/Vaccinium |
| | Class 10: | Vaccinium/Calluna |
| | Class 11: | Nardus/Sphagnum/Calluna |
| | Class 12: | Eriophorum/Calluna |
| | Class 13: | Calluna |

## KEY TO FIGURES 1.8 AND 1.9

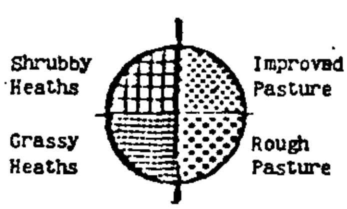
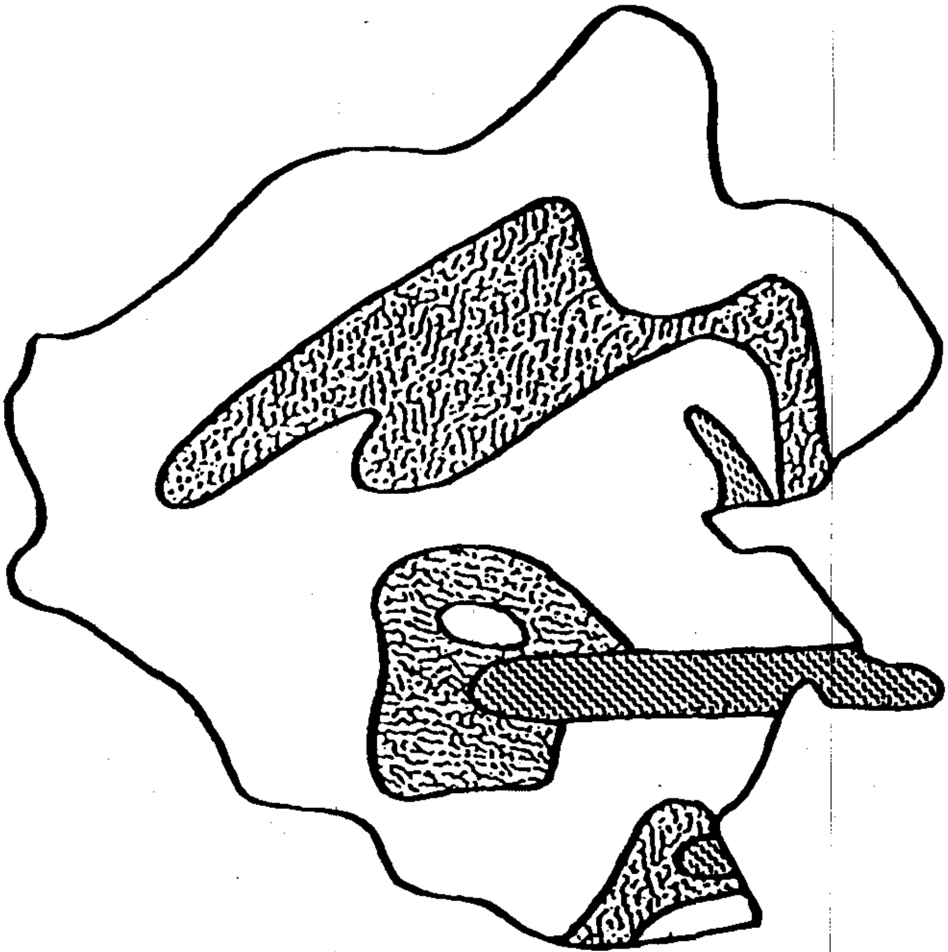


FIGURE 1.9 LAND GROUP-VEGETATION GROUP ASSOCIATIONS - ALWINTON



VEGETATION GROUP FREQUENCIES AT SITES IN LAND GROUPS

PREDICTED CHANGES AT MAIN SITES

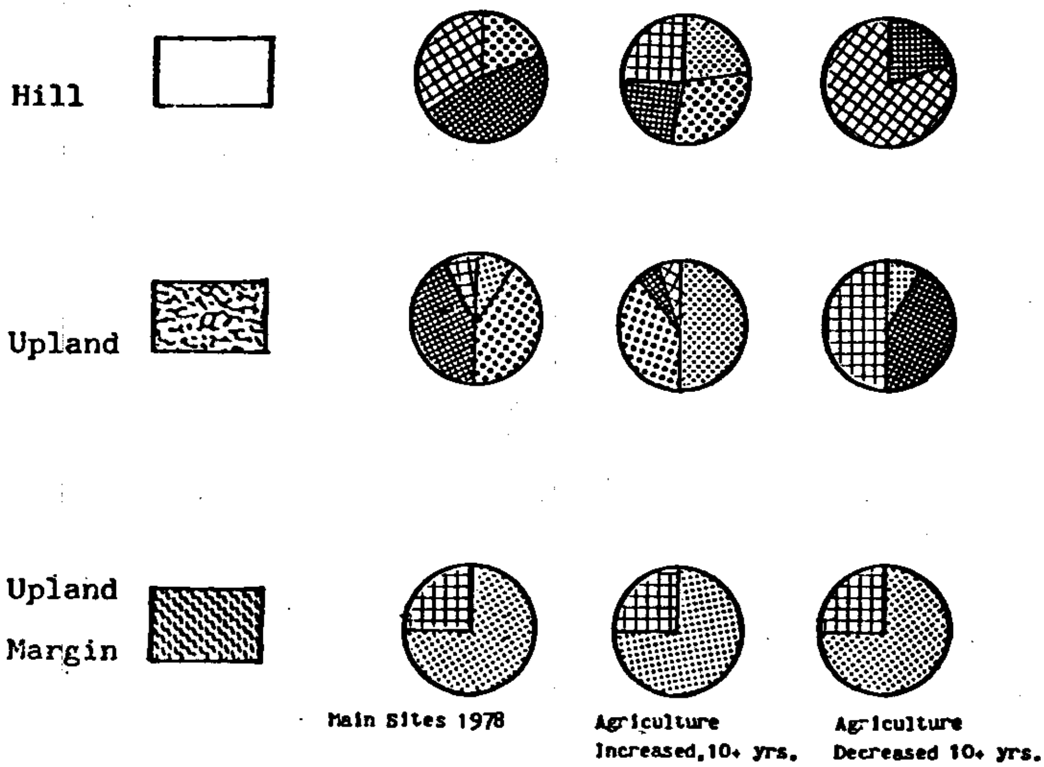
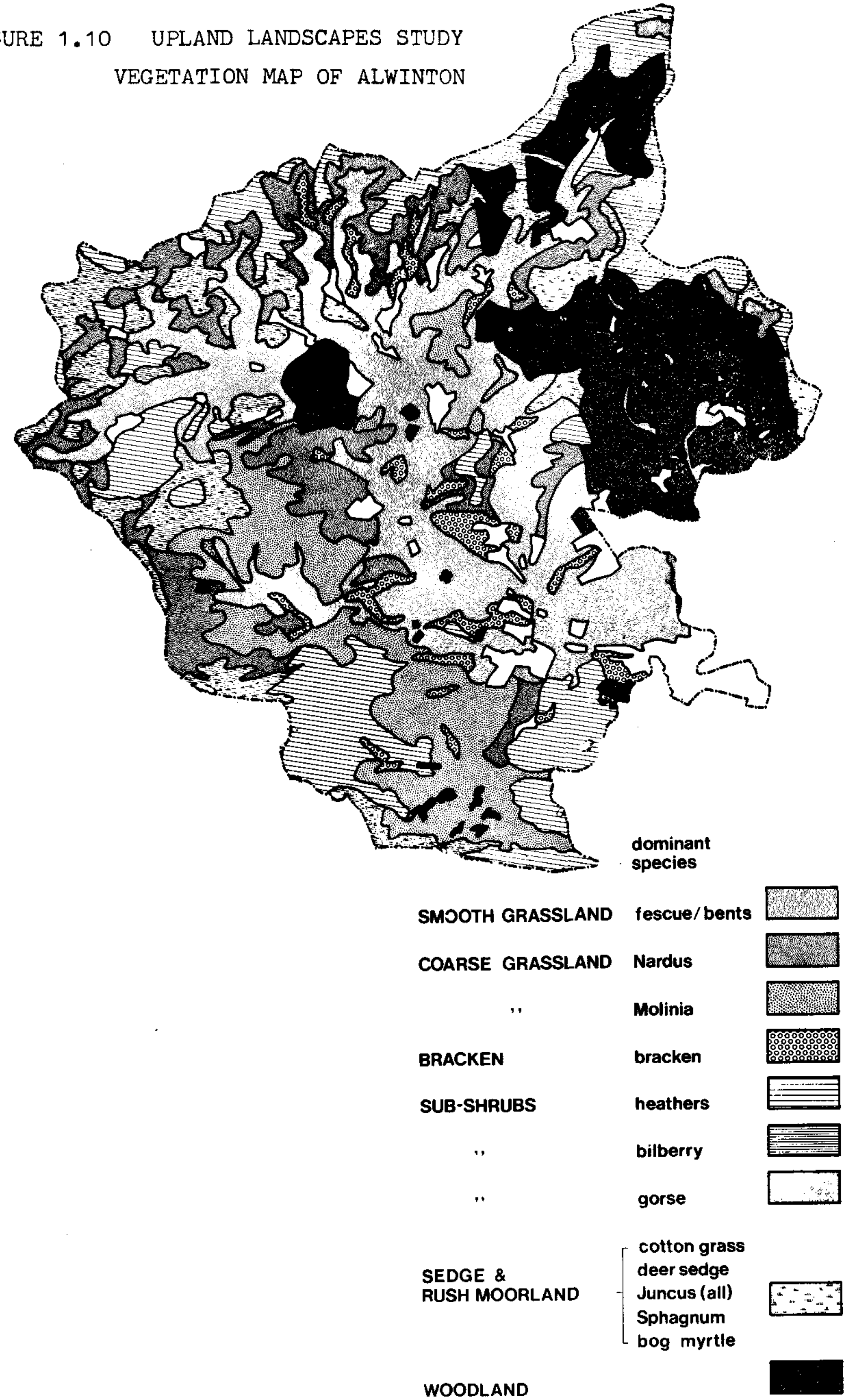


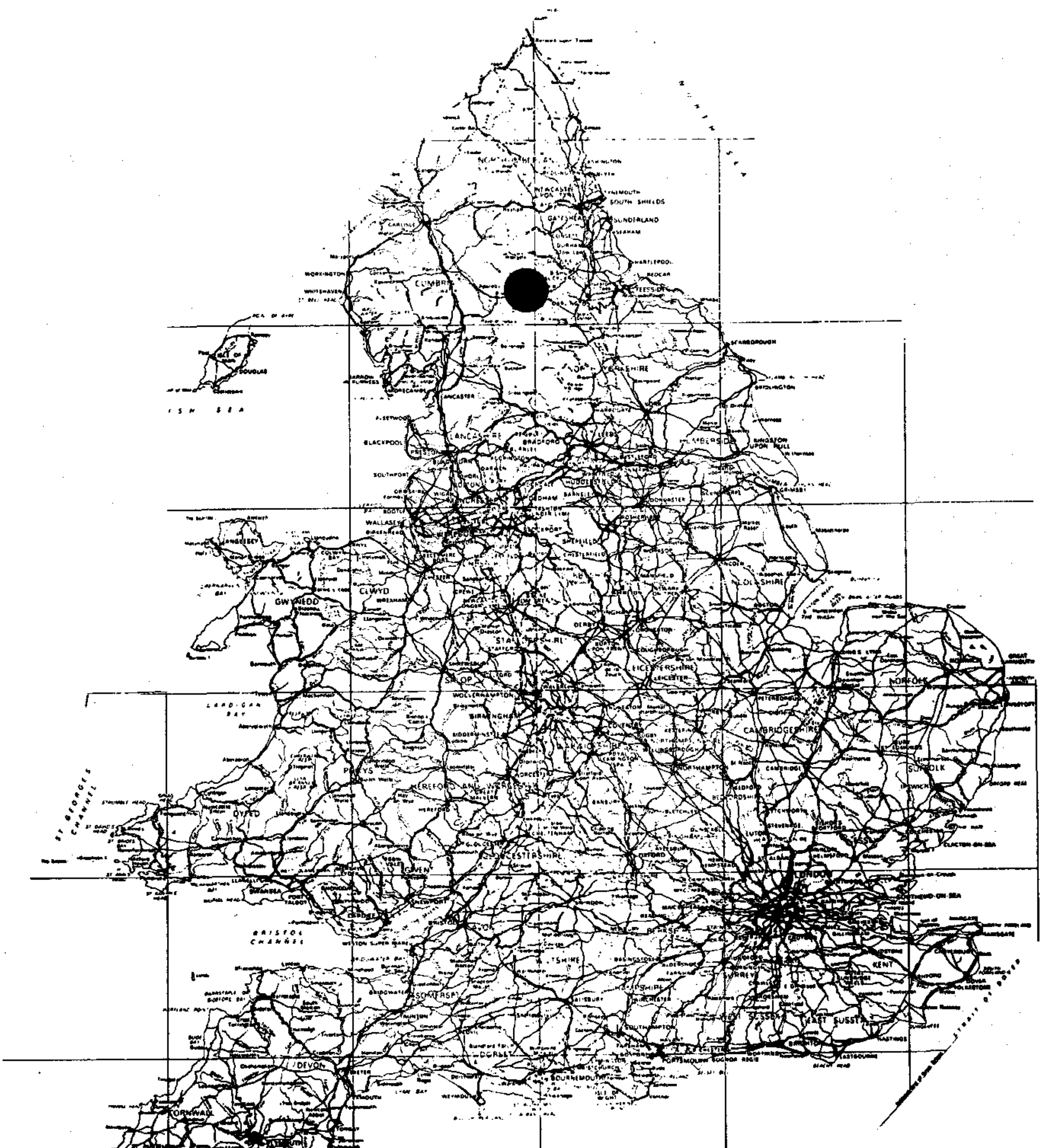
FIGURE 1.10 UPLAND LANDSCAPES STUDY

VEGETATION MAP OF ALWINTON



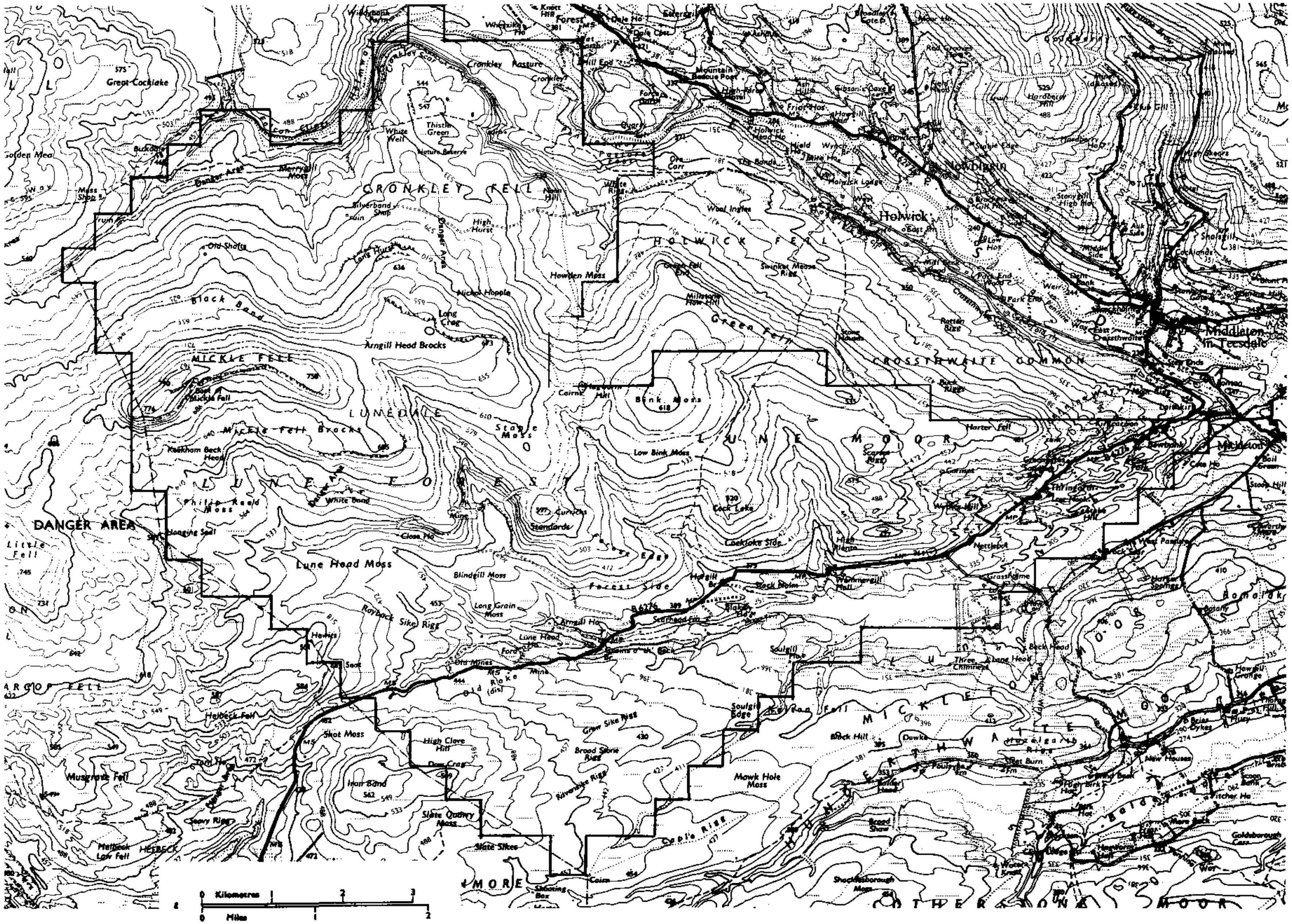

(Map by Geoffrey Sinclair, Environmental Information Services)

# LUNEDALE



View from the B6276 road towards Selset Reservoir. A roadside verge in the foreground is a contrast in its ungrazed condition with grazed rushy rough pasture (Festuca/Juncus grassland class 5), seen beyond the boundary wall. This landscape is affected by the combined influences of the water catchment, low-intensity agriculture, amenity tree planting and grouse production.
(Photo by J. Dale)

FIGURE 2.1 THE STUDY AREA OF LUNEDALE



# STUDY AREA 2: LUNEDALE, DURHAM

## PHYSICAL ENVIRONMENT

The study area of Lunedale covers 93 $km^2$ of the Northern Pennines region in County Durham (Figure 2-1). It lies west of Middleton-in-Teesdale between the headwaters of the Rivers Lune and Tees. Crossed by the B6276 road between Middleton and Brough, Barnard Castle to the southeast is the nearest centre of any size. Lunedale is a relatively high altitude area, with no ground below 244 m (800 ft) and 75% above 427 m (1 400 ft), its highest point reaching 790 m (2 600 ft) on Mickle Fell. Virtually the whole area is dominated by moderate or gentle slopes ($<11^{o}$) (Plate 1).

Climatically, in relation to the other study areas, Lunedale is cold and wet (Part I, 2.32). It is the only study area which falls entirely in the climatically sub-marginal category of Parry (1978). January and October mean temperatures are estimated as 0.2 and 7.1$^{o}$C respectively. The annual average of daily sunshine hours is 3.0, and the average number of days a year for which snow lies is high, at 60 days. A steep east-west rainfall gradient gives a wide rainfall range within the study area (Figure 2-2), though most has fairly high or high rainfall (1 201-1 600 mm, c. 48-64 in, and 1 601-2 200 mm, c. 64-88 in pa). In Smith (1976) the length of the growing season for grass in the region that includes Lunedale has been estimated at 189 days (25 April-31 October) at an average altitude of 315 m. Some short-term local temperature and humidity data are available in a study of the possible influence of the water surface presented by the Selset Reservoir on these climatic factors in an upland situation (Gregory & Smith 1967).

Geologically, almost the whole area is formed of rocks of Carboniferous age. North of the Lune a sequence of limestone, shales and sandstones occurs, including many thick sandstones and one prominent limestone that runs approximately east-west across the area just north of the Lune Valley. To the south of the river are hard sandstones with shales, in the Millstone Grit series. The other important rock type is the dolerite (an intrusive basic igneous rock) of the Whin Sill, in the northeastern part of the area around Cronkley Fell. Locally the relatively nutrient-rich dolerite and outcrops of limestone or metamorphosed limestone adjacent to the dolerite support a diversity of plant species of ecological importance. This is recognised by the Upper Teesdale National Nature Reserve which extends into the area in the northwest, but in general throughout the area there is a cover of peat over the solid rocks. The formation of this peat has been encouraged by high rainfall and low temperatures, moderate to gentle slopes, and the preponderance of nutrient-poor and slow-weathering sandstone and shale soil parent material. Boulder-clay, mainly derived from these sandstones and shales, occurs along the valleys of the Lune and its tributaries. At the scale of the national soil map, a mapping unit dominated by poorly-drained mineral and peaty-topped Gley Soils occurs in these drift areas, and also in the north between Cronkley Fell and the Tees, but the greater part of the area is mapped as dominated by Deep Peaty Soils with associated Peaty Podzols.

Agricultural land classification maps reflect the climatic and soil character of the area. Only a small area of grade 4 land is mapped in the southeast between Laithkirk and Wemmergill, while the majority of the area is classified in the lowest grade, 5.

Topography is illustrated in Figure 2-3, which shows the limited road and settlement pattern and the small extent of land in intensive agricultural use, as assessed by field boundary frequency. Roads, buildings and sectors with frequent field boundaries are all concentrated along the line of the Brough to Middleton road, north of the Selset Reservoir in the east of the area. Mapped roads (though the 1:25 000 Ordnance Survey map does not include the significant recent extension of estate access tracks to the grouse moors) occur in only 20% of the grid squares which comprise the area, buildings are limited mainly to a sector closely comparable to that with frequent field boundaries though some mine buildings occur more remotely, and the sector with frequent field boundaries is only 13% of the area.

The distribution of land types is given in Figure 2-4. Eighty per cent of the area falls in the hill land group, mainly the hill and high plateau land types. The remainder is divided almost equally between upland and upland margin land, the latter occurring principally along the Lune Valley.

## LAND-USE HISTORY

Low temperature, high rainfall, high altitude and peaty soils all interact to make the upper parts of Teesdale, with which Lunedale may be included, marginal for farming. Intensive agriculture has only been possible locally as a result of especially favourable, and often temporary, combinations of economic, social and environment factors. The western dales of the Northern Pennines seem to have had little occupation until the Norse invasions of the 10th century, Lunedale having been one of their areas of settlement, giving rise to its names of Norse origin. Subsequently the Normans and their successors used the area as a royal deer 'forest', with 'above 400 red deer' recprded in Teesdale Forest in 1673 (Raistrick, 1968; Ramsden 1961). Woodland and scrub on lower ground probably survived until the beginning of the 18th century.

Farming and settlement followed the presence of minerals, lead mining possibly first having been carried out in Roman times, and iron having been recorded as smelted in the Forest of Lune in the 13th century. The peak of lead mining activity occurred in the mid-19th century when 'nine-tenths of the population of Teesdale were connected with the mines' (Hunt 1970). Because mining provided a market for produce, as well as part time employment, there was an associated increase in the number of farm holdings between 1803 and 1851, but the population in Lunedale never became concentrated in a hamlet or village.

Farming concentrated on livestock breeding, mainly of sheep (Swaledales) with some cattle to sell to lowland farmers for fattening. Each holding had winter land in the valley meadows and upland grazing on the commons, but, by the 19th century, stocking rates on these common grazings had become so high that animal numbers had for the first time to be limited. In 1823 however, 1 215 ha (3 000 acres) of Lunedale Fell were converted from common to single ownership rights.

By the time the Ordnance Survey (OS) prepared its first large scale maps of the area in the 1850s, mining prosperity was falling. Animal products also declined in value from the 1880s as a result of competition from imported meat and wool. Although ULS (1979) shows that the land under crops and managed grass fell from 11% of the area in 1854 to 6% in 1968, largely due to reservoir construction, the agricultural intensity of use as measured by stock numbers has been relatively unchanged in the area during this century. Cattle and sheep numbers (Figures 4-5 and 4-6 in Part I) show little change between 1910 and 1965.

Figure 2-5 shows the extent of moorland core, fringe, and farmland identified from successive editions of OS maps, recent air photographs, and the 1st Land Utilization Survey of County Durham (Temple 1941). Moorland core covers most of the area (86%) with farmland occupying only 9% and moorland fringe 5%. The fringe areas are highly concentrated in the small extent of the more favourable land types, 50% of the fringe area being in the 11% of Lunedale classified in the upland land group and 40% in the 9% classified as upland margin.

Other than the relatively limited area of farmland and the continuance of mining at Closehouse Mine, now for barytes rather than lead (Part I, Plate 2), the principal land-uses in Lunedale are water supply (reservoirs occupy 1.6% of the area), management of the moorland as a sporting estate for grouse shooting, and the conservation interests on Cronkley and Mickle Fells. The Grassholme Reservoir was built in 1915 and the Selset Reservoir (Plate 1 and Part I, Plate 3) was constructed during the late 1950s and completed in 1960, both of these water bodies causing a loss of farms, farmland and population. Subsequent creation of replacement pastures by improving agriculturally poorer vegetation has been concentrated in the vicinity of the reservoirs and the lost land. The particular impact of grouse moor management on vegetation is through a regular burning regime on the heather moors in an approximately 10-12 year cycle, in order to favour young heather growth, since this is the necessary food for grouse (see Part I, 4.29 and Plate 2). Conservation management aims particularly at protecting the rare limestone flora and regenerating juniper on the dolerite-influenced areas of the moor by control of grazing and burning management and of public pressure. Gilbert (1980) gives a recent account of the Teesdale juniper.

## VEGETATION

Figure 2-6 includes the frequencies with which vegetation classes occurred at the 79 main sites recorded in Lunedale in 1978. Figure 2-7 plots their locations and shows the vegetation class then of each of these sites.

Shrubby heath is the most widespread vegetation group, accounting for 67% of the sites recorded. The remainder are grassy heaths (20%), rough pastures (12%) and a single site with improved pasture. This improved pasture site lies near the reservoirs, and the rough pastures also mainly follow the valley of the Lune. Management of these as hay meadows by traditional methods adds considerably to the interest and character of this part of the Lunedale landscape. The grassy heaths are particularly found in the northwest. How far their location there near the valley of the Tees results from environmental influences such as a soil contrast perhaps related to the presence of Whin Sill dolerite rocks, and how far from management contrasts between this area and the greater part of Lunedale, has not been considered.

In the dominant shrubby heath group, the principal class is Eriophorum/Calluna heath, class 12 (Part I, 3.18), a blanket bog community on wet deep peaty soils. This class has its most prominent occurrence in Lunedale of all the study areas. The most frequent grassy heath class, Festuca/Nardus/Vaccinium heath, class 15 (Part I, 3.16 and Plate 32) is also apparently a characteristically northern class in relation to the range of study areas. Most rough pastures are of Festuca/Agrostis grassland, class 8 (Part I, 3.1).

The limited semi-natural woodland along the Lune Valley is concentrated mainly in the neighbourhood of Wemmergill Hall. Here the woodlands seem to be between 25 and 80 years old, and regeneration is only moderate, being observed in half the 10 woodland sites. Eight woodlands are classified as upland acid woodlands (Part I, 3.24-3.31), the other 2 as lowland basic woodlands (Part I, Table 3.4), these perhaps being influenced by local limestone outcrops.

Table 2-1 relates vegetation class at the recorded main sites in Lunedale to the land type of the grid squares in which each site is situated, while Figure 2-8 shows the relationship of vegetation groups identified at main sites to the land groups of grid squares in which these sites fall, illustrating land group distribution by a sketch map based on Figure 2-4. Sites in the hill land group are mainly heath vegetation, with a few rough pastures. The upland group sites are equally divided between pasture and heath classes, while the small extent of upland margin in this area has more heath than pasture sites.

## POTENTIAL VEGETATION CHANGE

ULS (1979) concludes from an analysis of the potential of rough grazings in Lunedale for improvement, using the ADAS hill land classification criteria, that 90% is agriculturally 'generally unimprovable' though mostly of 'some grazing value' and that 'the agricultural keynote of Lunedale is stability'. It considers that, while grouse moor management is maintained (by the Strathmore Estate which owns about 90% of the parish) with the present heather-burning cycle and level of grazing, the vegetation of the moorland core is unlikely to be substantially modified over the remainder of this century. Only a small amount of reclamation, concentrated on very local areas of bracken, was planned by individual farmers. There could however be a slight increase in the extent of improved grass in the small sector of farmed land in the east and around the reservoirs. More important from an ecological viewpoint would be if the style of management of the rough pasture areas was to change to include the application of herbicides and other measures that would alter their old meadow and hayfield grassland character and composition.

As noted above, the most frequent vegetation classes at the recorded main sites in this parish are Festuca/Agrostis grassland, class 8, in the rough pastures; Festuca/Nardus/Vaccinium heath, class 15, in the grassy heaths; and Eriophorum/Calluna heath, class 12, in the shrubby heaths. The general trends of change of Figure 5-4 of Part I (summarised in Appendix 2) suggest that Festuca/Agrostis grassland could, in a declining use situation in this northern environment, move to Festuca/Vaccinium heath, class 14. The trend with intensifying management of grassy heath of class 15 could be towards Agrostis/Juncus grassland, class 5. Considering change of the grassy heaths in a declining use situation, Festuca/Nardus/Vaccinium grassy heath would change first to Vaccinium/Calluna heath, class 10, and, because surface wetness increases as peat accumulates, this could slowly move through to the Eriophorum/Calluna heath, class 12, which now typifies the moorland of Lunedale. In general this shrubby heath class is unlikely to change in any direction while some degree of natural or imposed burning and the present level of grazing sustains heather regrowth.

Although economic and social considerations suggest that substantial change in this area may not happen, it is possible to assess what proportions of vegetation could occur at the recorded sites if these constraints did not apply. Figure 2-7 includes predictions of the vegetation classes that might, on ecological grounds, develop through gradual change at the recorded main sites, under assumptions of agricultural intensification or decline discussed in Part I, 5.74-5.78 and Figure 5-4. The consequent changes in the proportions of vegetation classes that would result from these predictions are included in Figure 2-6. The hypothetical vegetation class changes which might occur at individual sites and in total for the study area follow the general principles of change discussed in Part I, and not any consideration of local land and land management characteristics.

With this reservation, the prediction is that increased intensity of agricultural use in this area could lead to estimated overall increases of sites which have improved pasture vegetation (from 1 to 12%) and of sites with rough pasture vegetation (from 12 to 20%) with falls in grassy heath sites from 20 to 9% and in shrubby heath sites from 67 to 58%. The predictions for a declining agriculture situation eliminate rough pastures at the recorded sites and decrease the proportion of grassy heaths from 20 to 12% of the recorded main sites, with a consequent increase in shrubby heaths from 67 to 87% of sites.

Under these hypotheses of moderate expansion or contraction in agricultural land-use, in the increased agricultural use situation 41% of sites are estimated as changing their vegetation group, while 32% would change in the declining agriculture situation. Though differently located and of different character, these overall changes would be of a similar scale in their effect on the present landscape. However Lunedale would under either hypothesis retain a substantial area that would be largely unchanged in vegetation character, this area being that dominated now by Eriophorum/Calluna shrubby heath.

The sketch of Figure 2-8 shows the predicted changes in the balance of vegetation groups in each land group. The hill land group would be least affected, shrubby heaths dominating throughout. The upland sector has the greatest potential for change, with alternative end results of 75% pastures at sites in this land group, or about 90% heaths.

The ULS vegetation map of Lunedale is reproduced here as Figure 2-9. Their mapping units based on field assessments of plant cover differ from the vegetation classes based on analysis of lists of species present that are discussed in this Report (see Appendix 3). However it is possible to consider the main sites recorded by ITE (including the additional sites sampled in 1979 (Part I, 5.66-5.67)) as sampling points within the mapping units used by ULS. The classification in 1978 of these ITE 'points' falling within each ULS unit is given in Table 2-2. 'Farmland' is dominated in Lunedale by rough pastures rather than improved pasture classes. Shrubby heath classes occur mainly in the 'sub-shrubs/heathers' mapping unit though about 25% of the main sites in this unit are grassy heaths. 'Sedge and rush moorland' is dominated by Eriophorum/Calluna shrubby heath. Table 2-3 shows the changes in the balance of ITE vegetation groups at sites in ULS mapping units that could result from the predictions of the outcome of agricultural intensification or decline discussed above. Little impact would be caused to the 'sedge and rush moorland'. The other prominent mapping unit, 'sub-shrubs/heathers', could become about 25% rough pastures on agricultural intensification.

## CONCLUSION

The natural environment of Lunedale is such that, among the studied areas, it is one of those in which potential vegetation changes are least likely to be extensive. This situation is reinforced by land management policies. Over most of the area these concentrate on the sporting resource and have as a main purpose the maintenance of shrubby heaths, since heather is essential food for the survival of grouse. Conservation objectives locally favour the particular vegetation of the moorland around the dolerite outcrops and the old meadow character of vegetation in some of the valley fields. These policies are unlikely to encourage any major expansion of agricultural effort or extensive forestry planting, the natural potential for which is in any case limited through most of the area. Only 12% of the area has been assessed as having forestry potential in a simple analysis in Part I (see Table 5-19). Thus it is probably that dominance of shrubby heaths will persist in Lunedale over the rest of this century with only small changes at most from the present frequencies of vegetation groups at the recorded sites.

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TABLE 2-1 CORRELATION OF VEGETATION CLASSES AND LAND TYPES - LUNEDALE

| Vegetation Group and Class | | Land Group and Type: Hill — Steep Hill (1)* | Hill — Hill (3) | Hill — High Plateau (4) | Upland — Steep Upland (5) | Upland — Upland (7) | Upland — Upland Plateau (8) | Upland Margin (6) |
|---|---|---|---|---|---|---|---|---|
| Improved Pastures | 1 | | | | | | | |
| | 2 | | | | | | | |
| | 3 | | | | | | | |
| | 4 | | | | | 1 | | |
| Rough Pastures | 5 | | | | | | | |
| | 6 | | | | | 1 | | 1 |
| | 7 | | | | | | | |
| | 8 | | 3 | 1 | | 2 | | 1 |
| Grassy Heaths | 14 | | 1 | 1 | | | | |
| | 15 | 2 | 6 | 3 | 1 | | | 1 |
| | 16 | | 1 | | | 1 | | |
| Shrubby Heaths | 9 | | | | | | | |
| | 10 | 1 | | | | | | |
| | 11 | 1 | 1 | 3 | | | 1 | |
| | 12 | 1 | 19 | 21 | | 1 | | 3 |
| | 13 | | | | | | | |

As number of sites of each vegetation class located in each land type.
* Land type numbers as used on computer maps, Figure 2-4.

TABLE 2-2 CORRELATION OF ULS VEGETATION MAPPING UNITS AND ITE VEGETATION CLASSES - LUNEDALE

| ULS Mapping Unit | Number of ITE Sites in Area of ULS Unit | ITE Vegetation Class: Improved Pastures | | | | Rough Pastures | | | | Grassy Heaths | | | Shrubby Heaths | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 14 | 15 | 16 | 9 | 10 | 11 | 12 | 13 |
| Smooth Grassland | 6 | | | | | | 1 | | 1 | | 3 | | | | 1 | | |
| Coarse Grassland/*Nardus* | 4 | | | | | | | | 1 | 1 | 1 | | | | 1 | | |
| Coarse Grassland/*Molinia* | | | | | | | | | | | | | | | | | |
| Bracken | | | | | | | | | | | | | | | | | |
| Sub-shrubs/Heathers | 56 | | | | | | | | 2 | 1 | 10 | 2 | | 1 | 4 | 36 | |
| Sub-shrubs/Bilberry | | | | | | | | | | | | | | | | | |
| Sub-shrubs/Gorse | | | | | | | | | | | | | | | | | |
| Sedge & Rush Moorland | 12 | | | | | | 1 | | | | | 1 | | | 1 | 9 | |
| Farmland | 13 | | | | 1 | | 5 | | 6 | | | | | | 1 | | |

As number of recorded sites in each ITE vegetation class that are located in each ULS unit

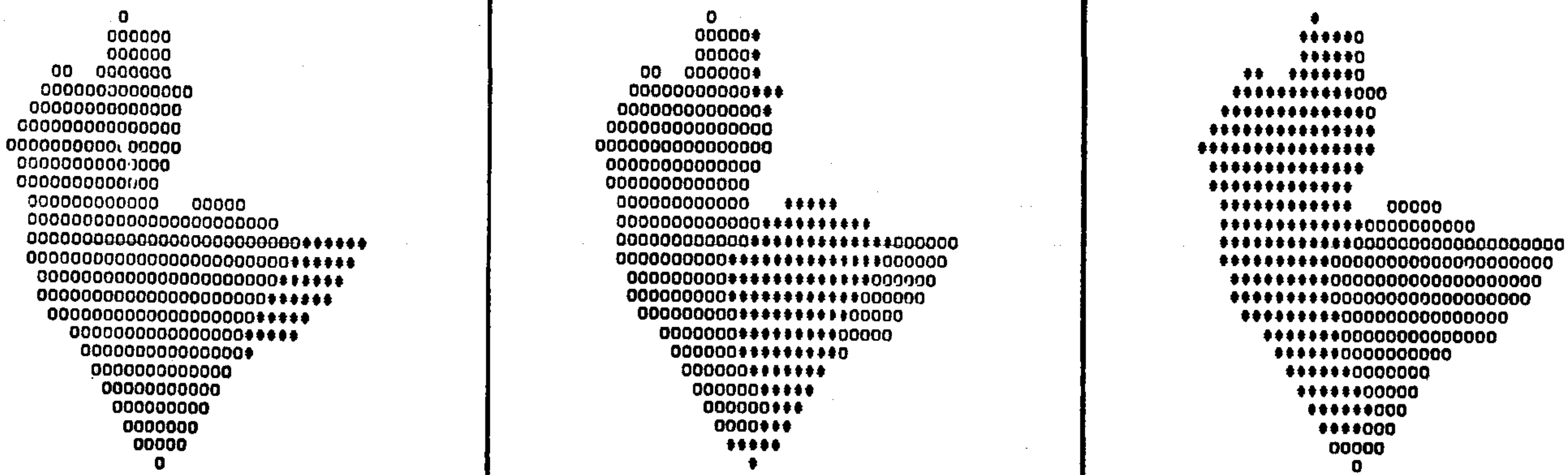
TABLE 2-3 PREDICTIONS OF CHANGE IN THE BALANCE OF VEGETATION GROUPS AT SITES LOCATED IN ULS MAPPING UNITS - LUNEDALE

| ULS Mapping Unit | ITE Vegetation Groups | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Improved Pastures | | | Rough Pastures | | | Grassy Heaths | | | Shrubby Heaths | | |
| | A | B | C | A | B | C | A | B | C | A | B | C |
| Smooth Grassland | | 2 | | 2 | 3 | | 3 | 1 | 2 | 1 | | 4 |
| Coarse Grassland/*Nardus* | | 1 | | 1 | 2 | | 2 | 1 | 1 | 1 | | 3 |
| Coarse Grassland/*Molinia* | | | | | | | | | | | | |
| Bracken | | | | | | | | | | | | |
| Sub-shrubs/Heathers | | 2 | | 2 | 13 | | 13 | 5 | 2 | 41 | 36 | 54 |
| Sub-shrubs/Bilberry | | | | | | | | | | | | |
| Sub-shrubs/Gorse | | | | | | | | | | | | |
| Sedge & Rush Moorland | | 1 | | 1 | 1 | | 1 | 1 | 1 | 10 | 9 | 11 |
| Farmland | 1 | 12 | 1 | 11 | | | | 1 | 11 | 1 | | 1 |

As number of recorded sites falling in each ITE vegetation group that are located in each ULS unit

A - situation as recorded
B - predicted balance of vegetation if agricultural use increased, 10+ yrs
C - predicted balance of vegetation if agricultural use decreased, 10+ yrs

FIGURE 2.2 RAINFALL SECTORS - LUNEDALE



* Moderate Rainfall (1001-1200mm, 40-48in pa)

* Fairly High Rainfall (1201-1600mm 48-64in pa)

* High Rainfall (1601-2200mm 64-88in pa)

FIGURE 2.3 TOPOGRAPHIC CHARACTERISTICS - LUNEDALE

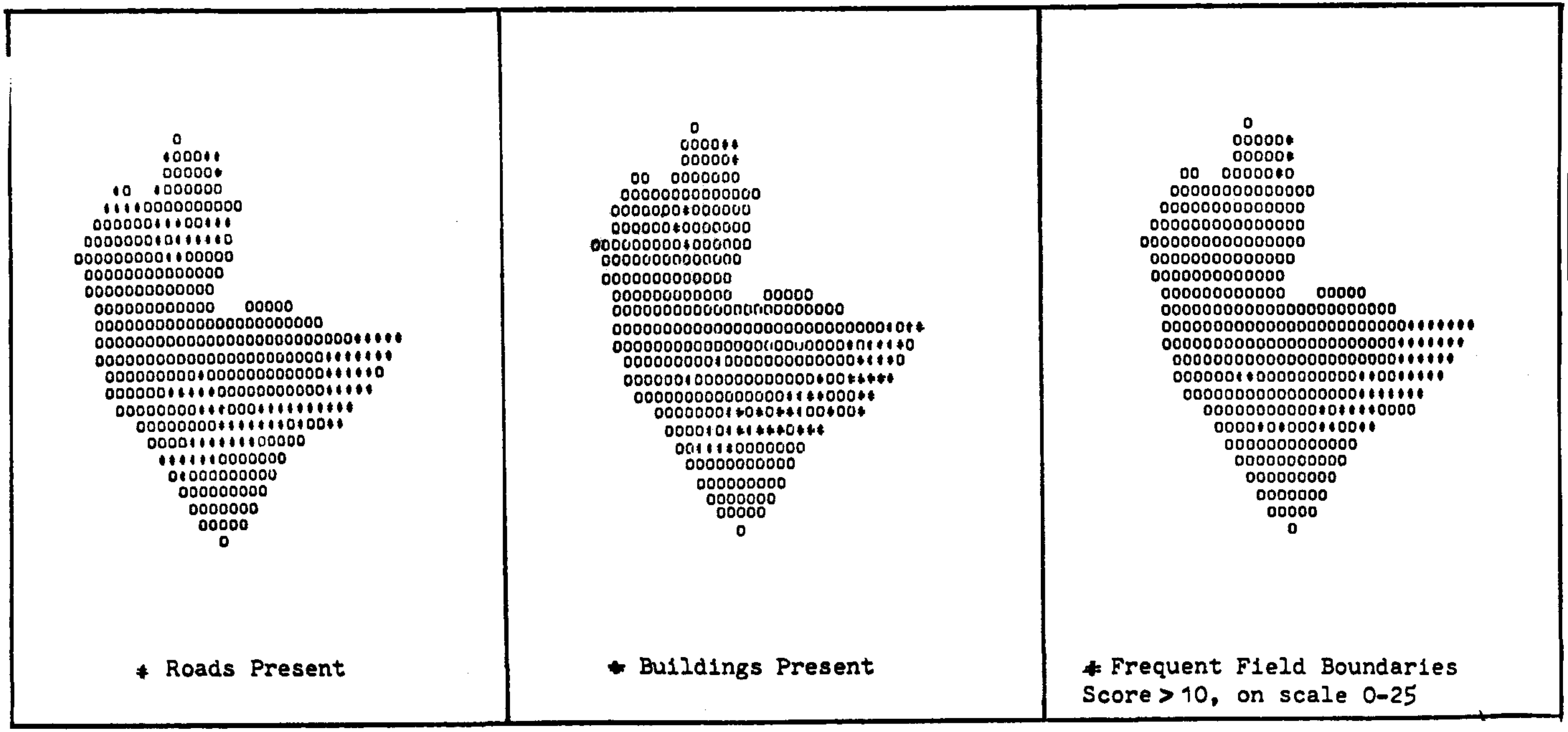


FIGURE 2.4 LAND TYPES - LUNEDALE

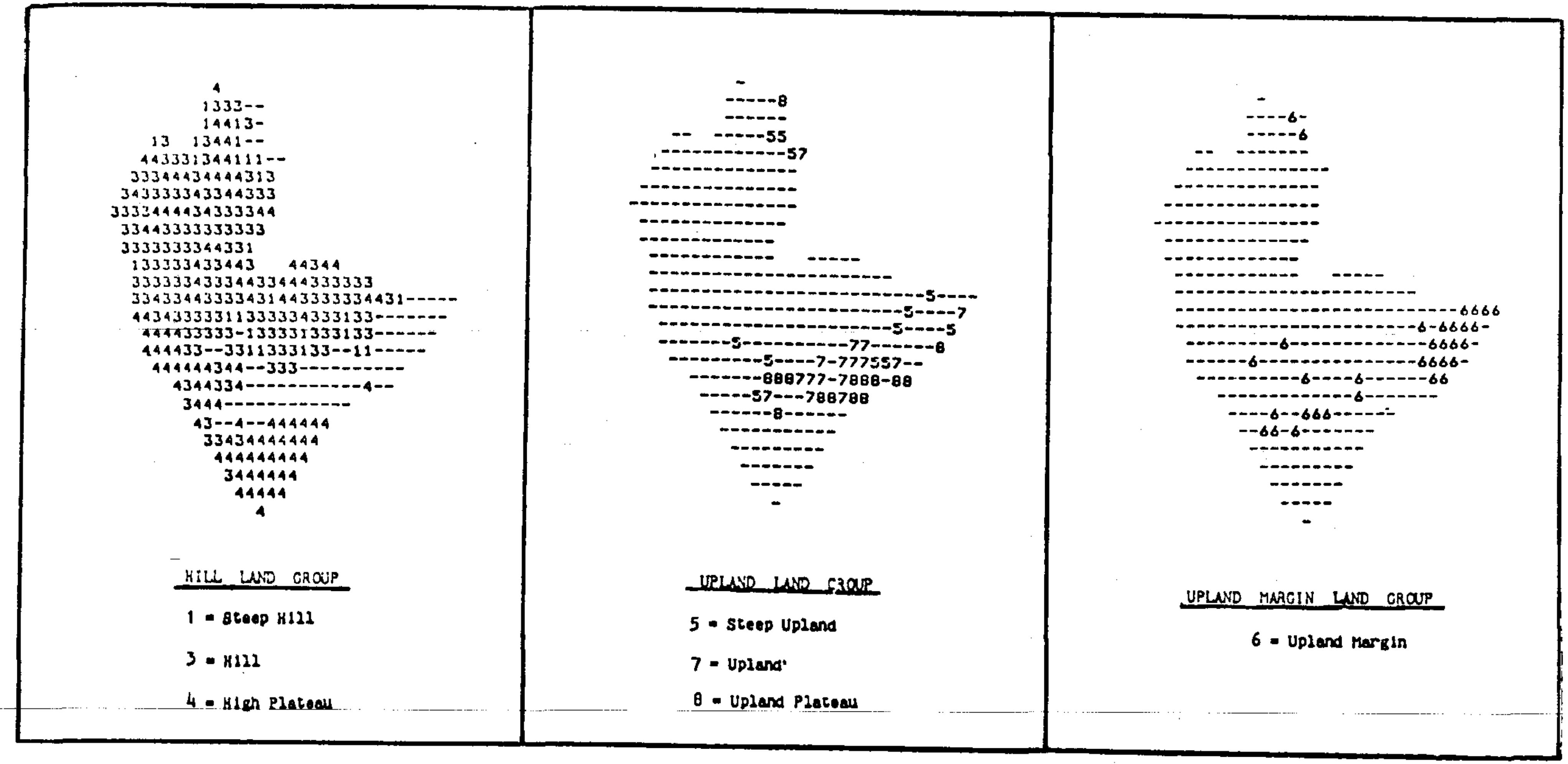
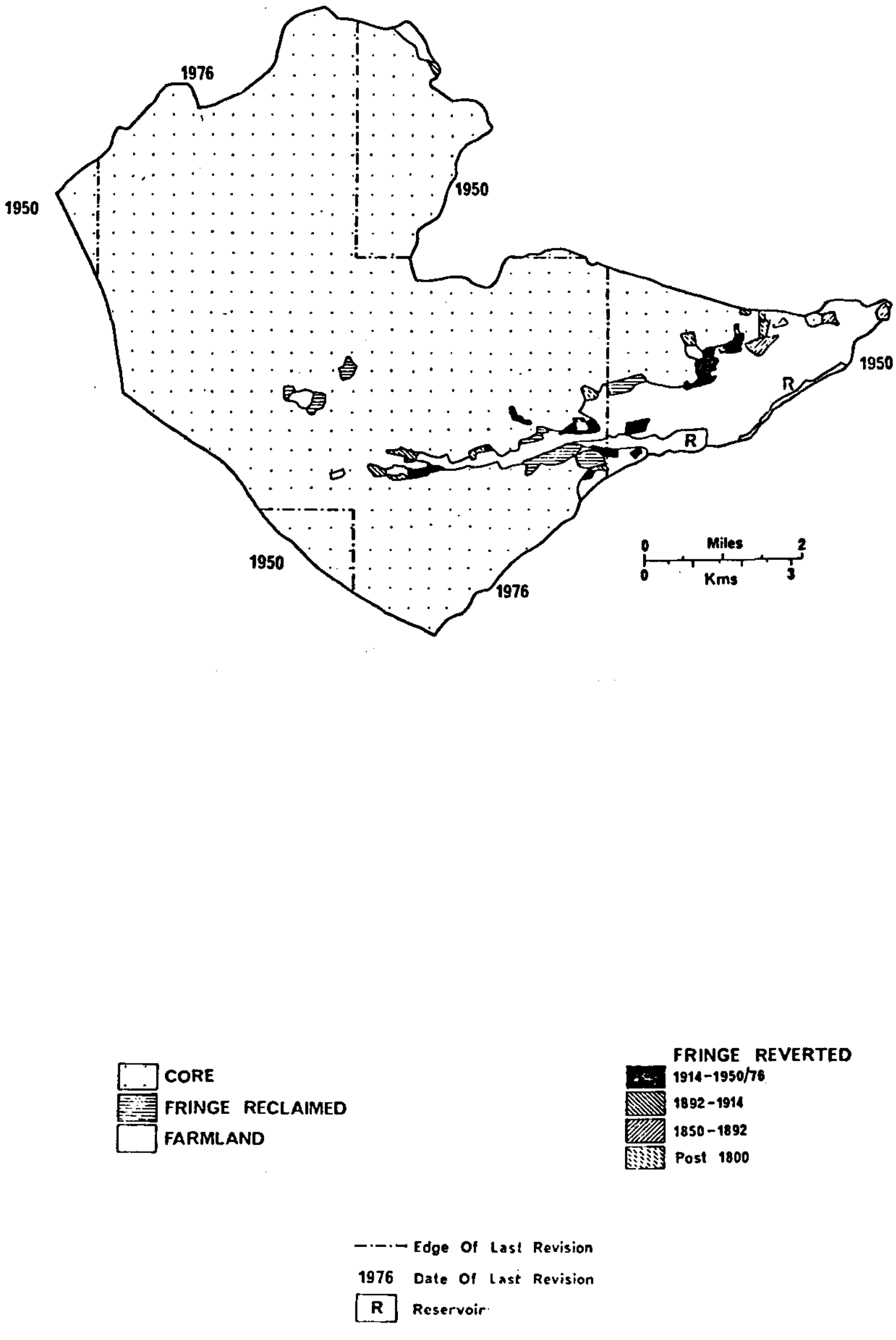
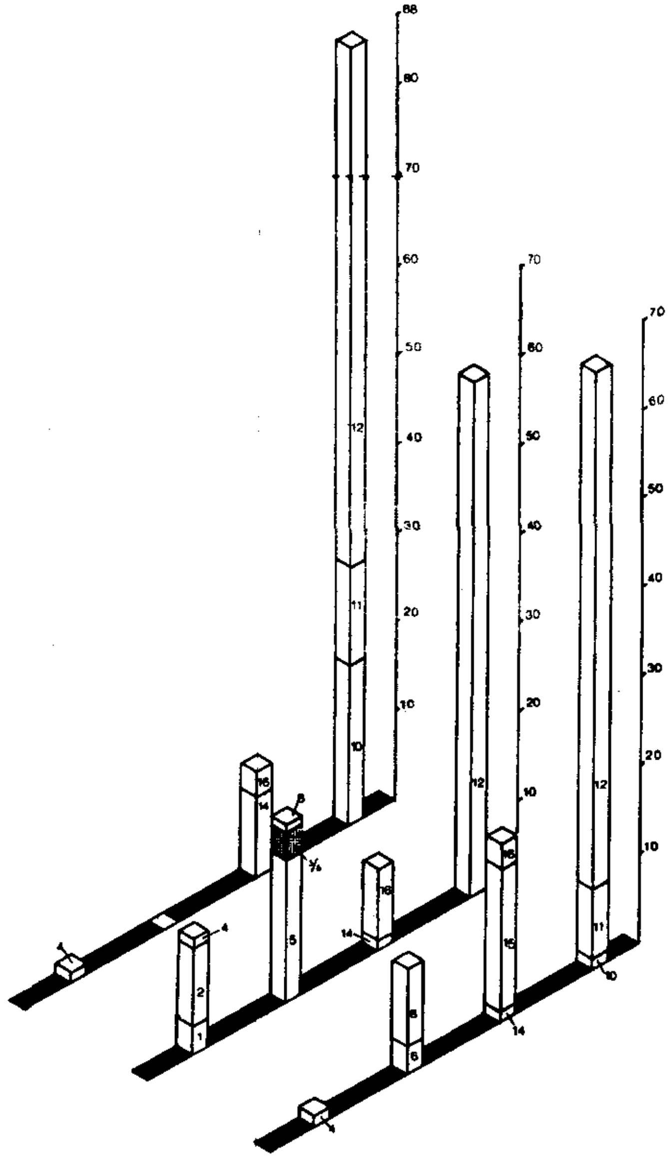


FIGURE 2.5 MOORLAND CORE, FRINGE AND FARMLAND - LUNEDALE



## FIGURE 2.6 VEGETATION CLASS FREQUENCY AT MAIN SITES - LUNEDALE



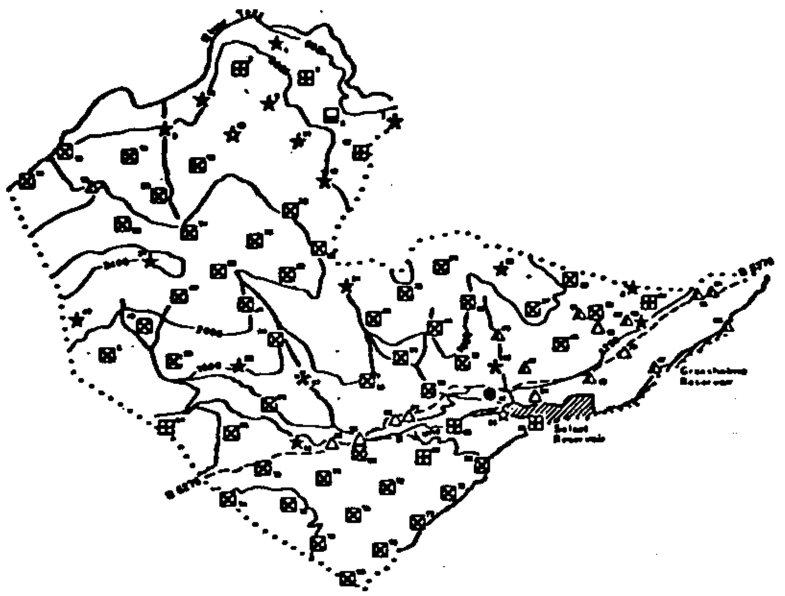
| Vegetation Group | Class | | % Main Sites in Vegetation Class 1 | 2 | 3 |
|---|---|---|---|---|---|
| Improved Pastures | 1 | Lolium/Holcus/Pteridium | - | 3 | - |
| | 2 | Lolium Grassland | - | 9 | - |
| | 4 | Herb rich Lolium Grassland | 1 | 1 | 1 |
| Rough Pastures | 5 | Agrostis/Juncus | - | 16 | - |
| | 6 | Festuca/Juncus | 3 | - | - |
| | 8 | Festuca/Agrostis | 9 | 1 | - |
| | 5/6 | Agrostis/Juncus or Festuca/Juncus | - | 3* | - |
| Grassy Heaths | 14 | Festuca/Vaccinium | 1 | 1 | 9 |
| | 15 | Festuca/Nardus/Vaccinium | 16 | - | - |
| | 16 | Festuca/Nardus/Molinia | 3 | 8 | 3 |
| Shrubby Heaths | 10 | Vaccinium/Calluna | 1 | - | 18 |
| | 11 | Nardus/Sphagnum/Calluna | 8 | - | 11 |
| | 12 | Eriophorum/Calluna | 58 | 58 | 58 |

1. Recorded Main Sites, 1978
2. Predicted Changes at Main Sites if Agriculture Increased, 10 + years.
3. Predicted Changes at Main Sites if Agriculture Decreased, 10 + years.

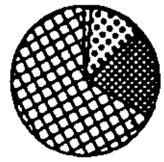
* Under a regime involving intensification of agriculture Class 16, Festuca/Nardus/Molinia, could move towards either Class 5, Agrostis/Juncus or the closely related Class 6, Festuca/Juncus. This change is indicated on the relevant column of the histogram by the shaded area.

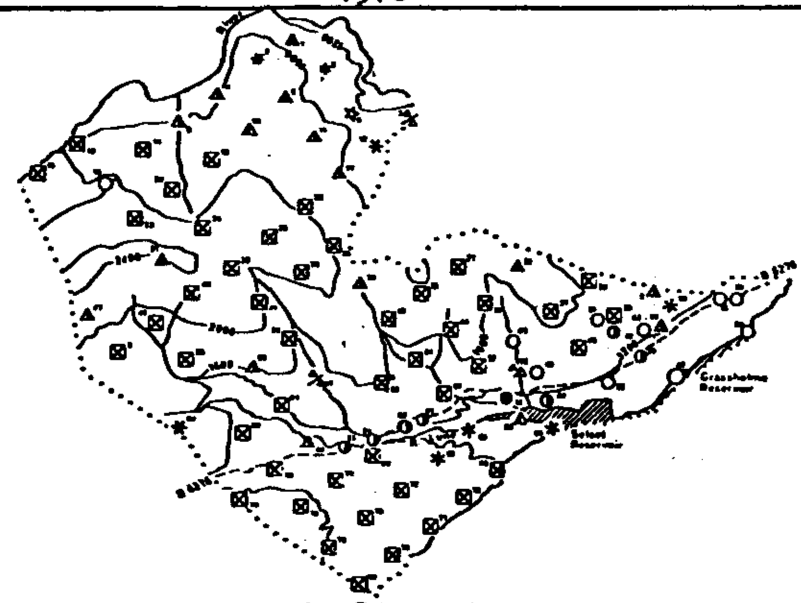
FIGURE 2.7 LOCATION AND CLASSIFICATION OF VEGETATION MAIN SITES - LUNEDALE

Overall Frequencies of Vegetation Groups

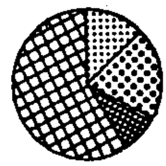


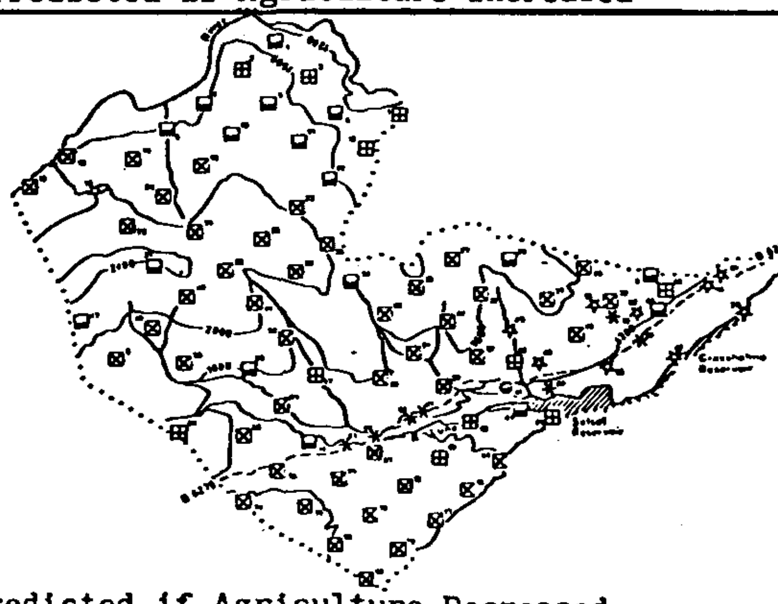
1978



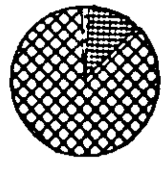


Predicted if Agriculture Increased





Predicted if Agriculture Decreased



KEY TO FIGURE 2.7

| Group | Class | |
|---|---|---|
| Group 1. Improved Pastures | Class 1 : | Lolium/Holcus/Pteridium |
| | Class 2 : | Lolium |
| | Class 3 : | Lolium/Trifolium |
| | Class 4 : | Herb — rich Lolium |
| Group 2. Rough Pastures | Class 5 : | Agrostis/Juncus |
| | Class 6 : | Festuca/Juncus |
| | Class 7 : | Agrostis/Holcus |
| | Class 8 : | Festuca/Agrostis |
| Group 3. Grassy Heaths | Class 14: | Festuca/Vaccinium |
| | Class 15: | Festuca/Nardus/Vaccinium |
| | Class 16: | Festuca/Nardus/Molinia |
| Group 4. Shrubby Heaths | Class 9 : | Calluna/Molinia/Vaccinium |
| | Class 10: | Vaccinium/Calluna |
| | Class 11: | Nardus/Sphagnum/Calluna |
| | Class 12: | Eriophorum/Calluna |
| | Class 13: | Calluna |

KEY TO FIGURES 2.7 AND 2.8

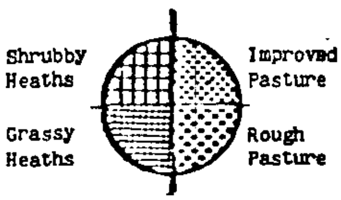
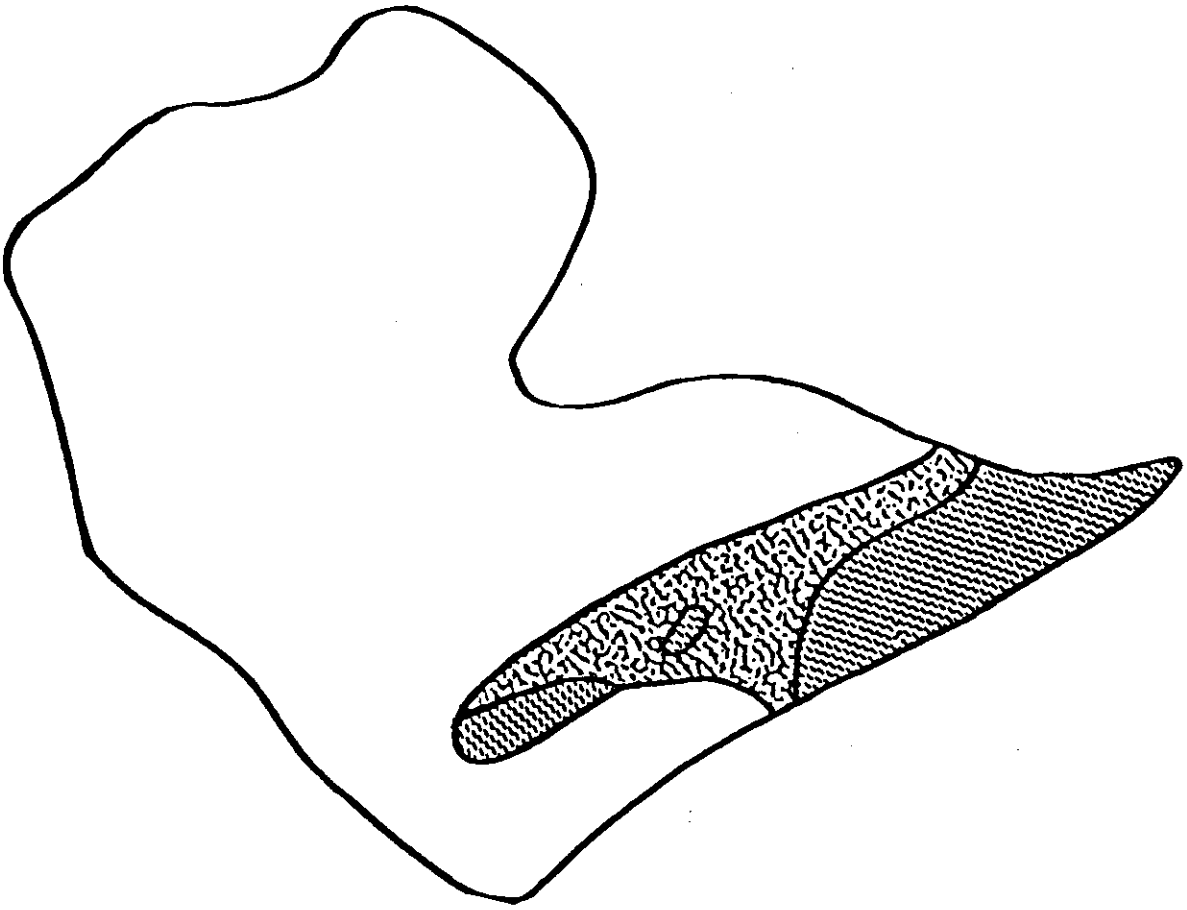


FIGURE 2.8 LAND GROUP-VEGETATION GROUP ASSOCIATIONS-LUNEDALE



VEGETATION GROUP FREQUENCIES AT SITES IN LAND GROUPS

PREDICTED CHANGES AT MAIN SITES

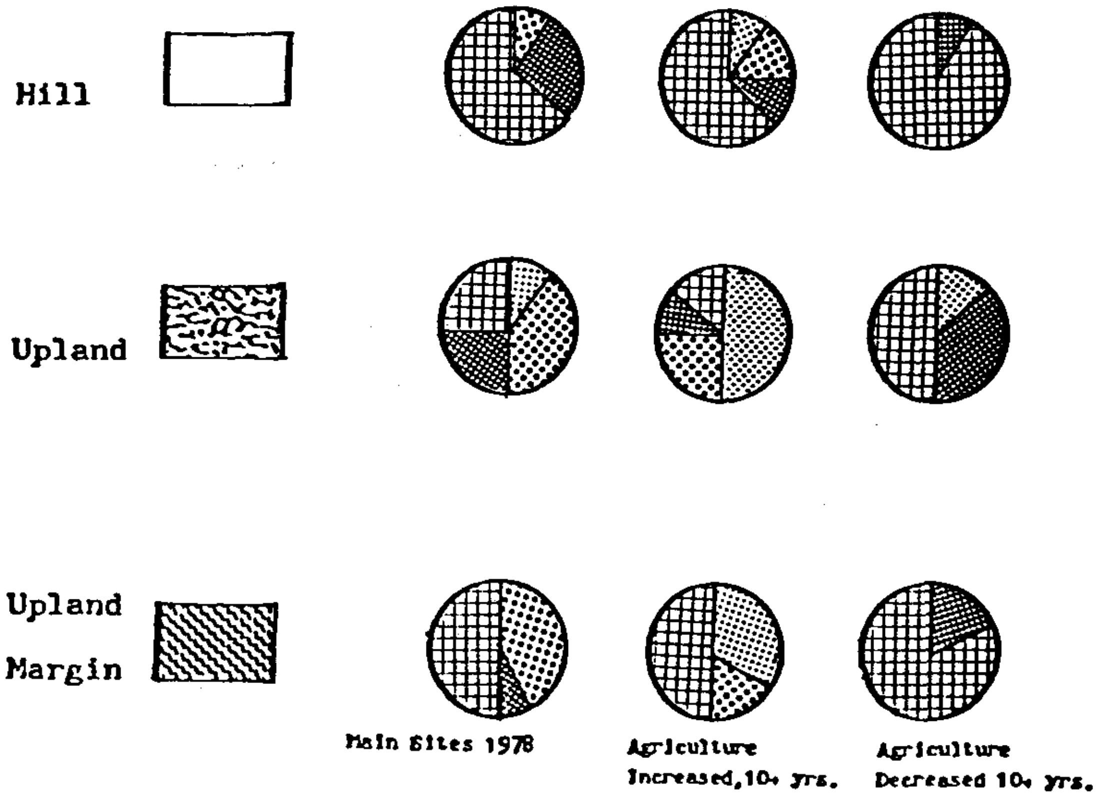
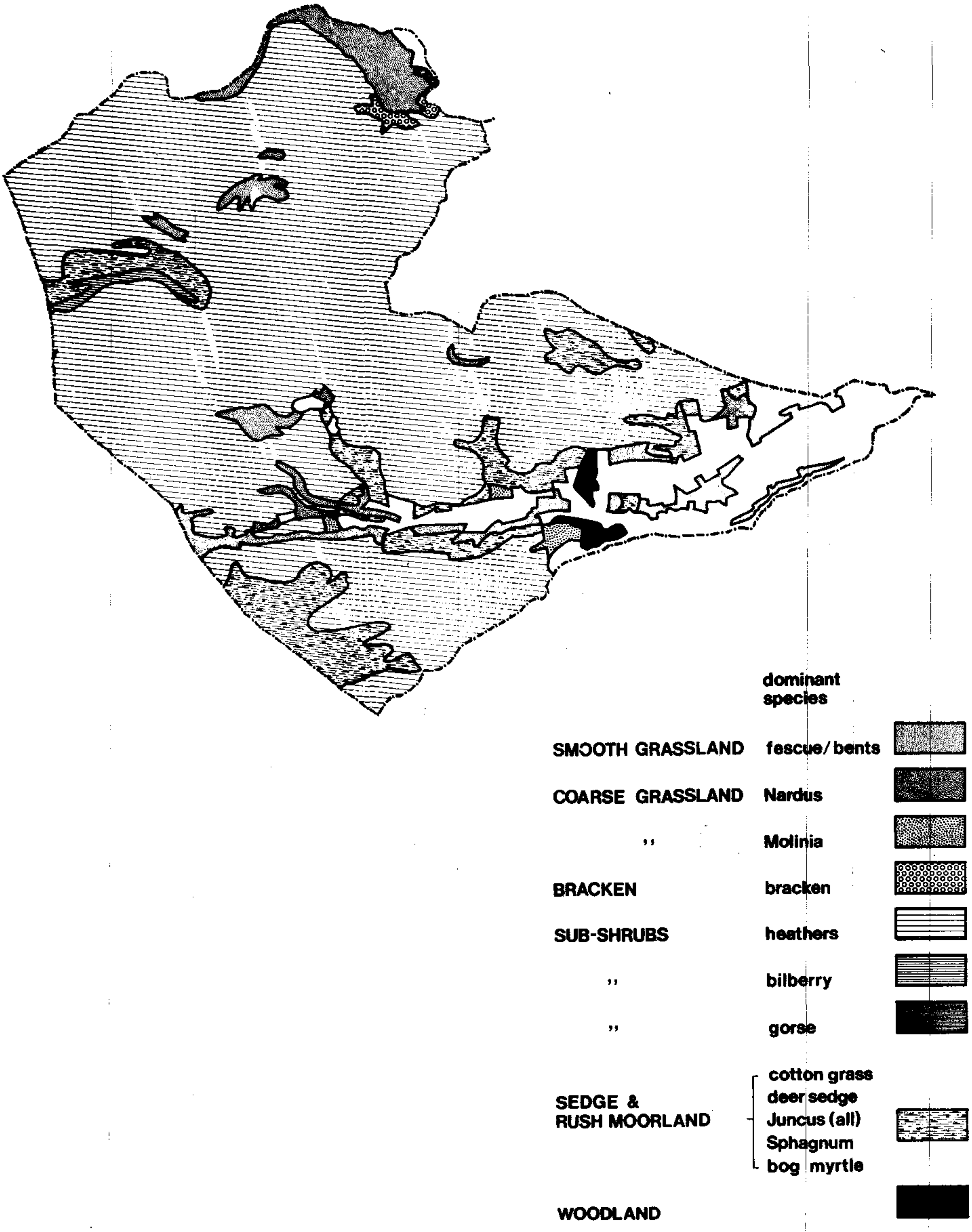
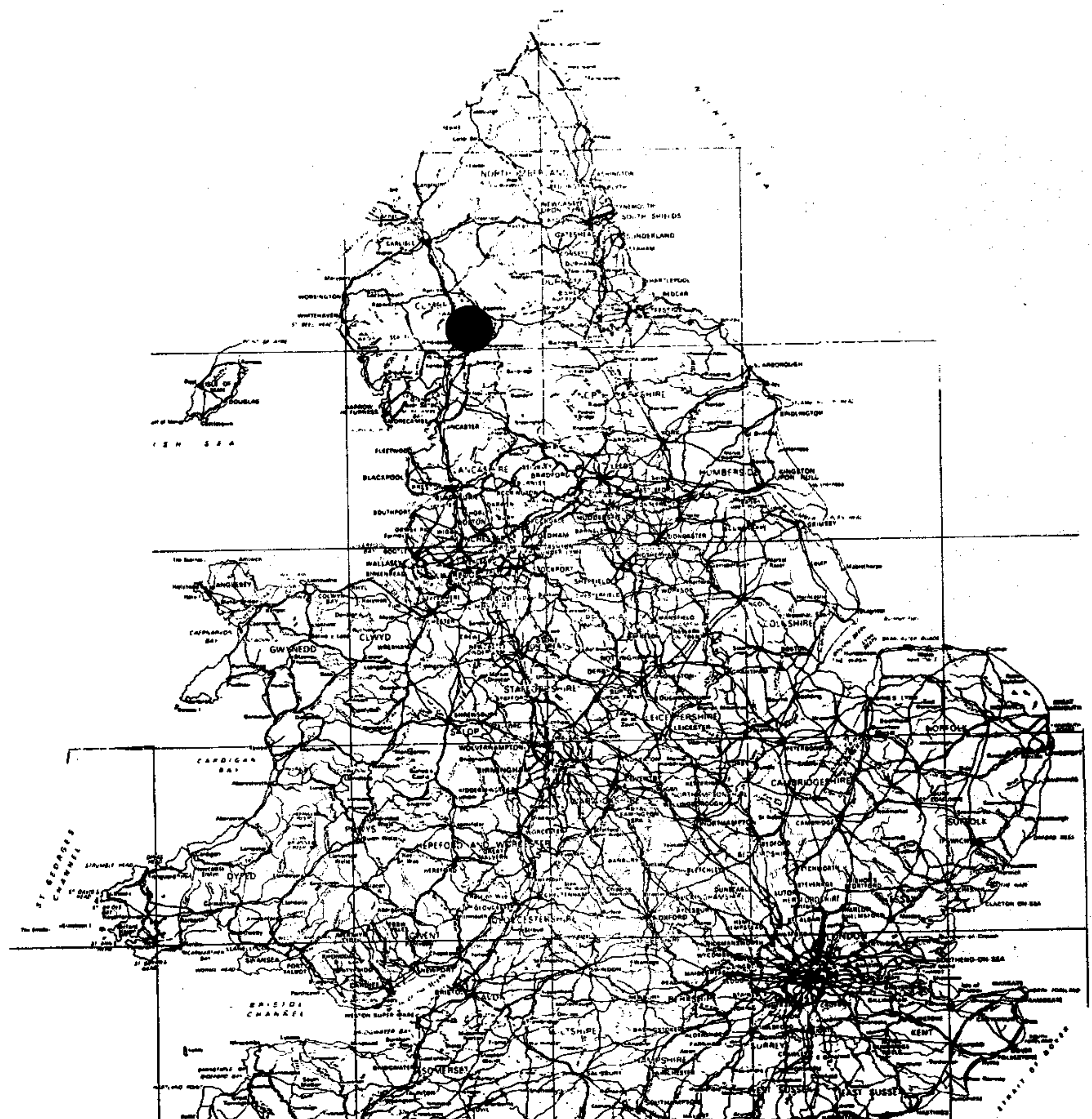


FIGURE 2.9 UPLAND LANDSCAPES STUDY VEGETATION MAP OF LUNEDALE




(Map by Geoffrey Sinclair, Environmental Information Services)

# SHAP — SHAP RURAL



SHAP - PLATE 1

South western end of Haweswater Reservoir. Closely grazed _Festuca_/_Agrostis_ grassland, class 8, occupies the foreground. Scattered deciduous trees that occur along old field boundaries cut by the shoreline are also found in the narrow tributary valley in the background. Rock outcrops above with scree below and thin soils throughout typify the steep slopes above the road. The trial conifer planting shows how the landscape could be changed by afforestation.
(Photo by P.Ainsworth)

FIGURE 3.1 THE STUDY AREA OF SHAP RURAL AND SHAP

## STUDY AREA 3: SHAP RURAL AND SHAP, CUMBRIA

### PHYSICAL ENVIRONMENT

The parishes of Shap and Shap Rural (Figure 3-1) are situated in Cumbria on the eastern edge of the Lake District region and cover 113 $km^2$. The area falls partly within the Lake District National Park, with on the west the large parish of Shap Rural inside the Park and on the east the small parish of Shap outside it. The study area boundary in the northwest runs through the enlarged lake that is the reservoir of Haweswater (Plate 1). The village of Shap is about equidistant on the main A6 road from the towns of Penrith to the north and Kendal to the south. Altitude zones are shown in Figure 3-2. A small sector with altitudes mainly below 244 m (800 ft) occurs along the shore of Haweswater and near Rosgill. The eastern and northern parts of the area are dominated by moderate altitudes (244-427 m, 800-1 400 ft) while altitudes in the southwestern third of the area are mainly above 427 m (1 400 ft), with the highest point, at High Street on the western border, reaching 828 m (2 715 ft). Slopes are dominantly gentle to moderate ($<11^{o}$) over much of the area, but are mainly steep and very steep ($>11^{o}$) in the highest ground in the west and centre (Part I, Plate 5), that runs westwards from around the head of Swindale and the course of Mosedale Beck.

Climatically, in relation to other study areas, Shap, like Lunedale, can be considered cold and wet (Part I, 2.32), with January and October mean temperatures estimated as 0.7 and 8.0$^{o}$C. The annual average of daily sunshine hours is 3.0 and the number of days of snow lie around 35, but there is a strong contrast between colder conditions on the high hills in the west and a somewhat better climate on the limestone plateau in the east (see temperature considerations in Part I, 2.31). Rainfall varies substantially across the area, with rainfall sectors running approximately northwesterly to southeasterly (Figure 3-3). The eastern third has fairly high rainfall (1 201-1 600 mm, c. 48-64 in pa) and the southwestern third very high rainfall (2 201-3 200 mm, c. 88-120 in pa). The length of the growing season for grass in the region including Shap is given in Smith (1976) as 190 days (26 April-2 November) at an average altitude of 341 m.

Geologically the area is sharply divided into a smaller northeastern sector, approximately east of a line from Rosgill to Shap Wells, and the remainder of the area. In the northeast are rocks of the Carboniferous Limestone Series, mainly limestones but with a conglomerate at the base. Most of the remainder of the area is occupied by a complex of Ordovician rocks, principally volcanic. The most widespread rock types are andesitic lavas and ashes of the Borrowdale Volcanic Series, a group of rocks that dominates the central Lake District. Mudstones with interbedded ashes, now called the Eycott Group but formerly classed with the Skiddaw Slates, are present in the 'Bampton Inlier', which extends along and west of the boundary of the Carboniferous rocks in the north for some 4 km around Tailbert, with a width up to c.2 km west of Rosgill. The southern tip of the area, south of a line from Wasdale Head to High House Fell, is occupied by rocks of Silurian age in the Stockdale Shale group, again mudstones and shaley and slaty sedimentary rocks. Northeast of these is the industrially important Shap Granite intrusion of Shap Fells and Long Fell. The southern and eastern third of the area is mapped as mainly covered by glacial drift but with some shallow soils over limestone in the east, and peat in the south. The central and western parts are shown as drift free but the high valleys (eg Mardale) include glaciated landforms and minor drift deposits while shallow peat occurs particularly on gently sloping areas. From the national soil map, the area of limestone gives, in the extreme northeast, east of Shap village, a mapping unit dominated by poorly drained mineral soils, Gleys, with associated Brown Earths on glacial drift. The remainder of the limestone sector has soils of a unit dominated by Brown Earths, with associated shallow soils and limestone pavement. The greater part of the area, off the limestone rocks, is mapped as dominated by moorland soils, mainly Peaty Podzols, with associated Peaty Gleys, Rankers and Peats.

The agricultural land classification map shows grade 4 land in the northeastern quarter of the area, east of the River Lowther from Rosgill to Sleddale, with extensions westwards to Haweswater, Swindale and into Wet Sleddale, with a very small extent of the higher quality grade 3 in the extreme northeast. The remainder of the parish, including the southeastern sector of Hardendale Fell although this overlies Carboniferous rocks, is in the lowest quality class, grade 5.

Topographic characteristics are outlined in Figure 3-4. The road network is concentrated in the northeastern third of the area, with arms running alongside Haweswater and into Swindale and Wet Sleddale. Buildings have a similar distribution, concentrated on Shap village and Rosgill, but also present in Swindale and Wet Sleddale. Intensive agriculture, as assessed by sectors with frequent field boundaries, is seen to be particularly concentrated north of Shap village and westwards through Rosgill to the mouth of Haweswater.

Land types, as classified for the study areas as a whole, (Part I, 4.11-4.17) have distributions in Shap that are shown in Figure 3-5. Upland margin land is only a minor element, mainly present around Rosgill and in the lower parts of Swindale and Wet Sleddale. The upland land group occupies the Carboniferous Limestone area of the northeast and the valleys of Haweswater, Swindale and Wet Sleddale. On the limestone, upland plateau is prominent, while the valley sectors are mostly steep upland. The hill land group covers most of the southwestern half of the area, with steep hill most important in the west, and the hill land type widespread in the east (Part I, Plate 4). In its extent of steep hill, the most 'montane' land type (Part I, Plate 5), Shap is second only to Alwinton (Part I, Table 4-36).

LAND-USE HISTORY

Remains of late prehistoric and Roman period hut-circle complexes occur in the southeast on the shallow soils typical of the granite outcrops, showing there to have been early settlement in this upland area. Agricultural effort in medieval times rested largely on the activities of Shap Abbey, founded in 1150, associated with which there was cultivation around Shap village and the creation of sheep farms on the lower hill land. During the 16th to 18th centuries freehold farmers with small holdings and grazing rights on the moorland typified Lake District farming. These farms in Shap were being gradually amalgamated into larger estates, such as that of the Lowther family who acquired Rosgill and Shap Estates in the late 17th century. The sheep flocks on the hill farms then were usually owned by the landlord, who let them with the farm, the tenant having to leave a specified number of animals bred in this flock on the farm at the end of his tenancy. In this way, the Herdwick sheep characteristic of the area remained on the traditional rough grazing of their own farms through many generations (Darley 1964).

High agricultural prices during the early 19th century, gradual improvement of communications to market centres, (the turnpike road over Shap dates from 1753 and the railway from 1846) and enclosure of commons were responsible for considerable improvements in land management especially on the Lowther Estate which had the resources and will to implement improvement programmes. As well as their limited extents of enclosed land, many farms depended on access to commons over which farmers had the right to graze unlimited numbers of stock. Most commons were on the higher moors and fells, but some occupied lower ground. They were exploited for fuel, and regulations were often introduced in an attempt to control the manner and rate at which peat was taken. A high priority of the Lowther family, particularly in the first quarter of the 19th century when wool prices were high, was to enclose the commons in order to increase productivity of the rough pastures and thus raise stock numbers as well as the quality of the sheqp flocks.

Management on the lower fell ground was accordingly intensified. Walls of up to 4 feet 6 inches high were erected, and attempts were made to improve soil drainage on the fellsides. In the spring after drainage improvements had been carried out the vegetation was pared from the ground, burned in heaps, and the resulting ashes, mixed with lime were spread over the exposed soil. Public lime kilns were built in Shap and elsewhere to supply lime for such reclamations. When grain prices were particularly high, some reclaimed land was sown with a succession of grain crops. When yields fell too low for profit the land was left to grass. Even where a green crop, such as turnips, rye, clover or potatoes for seed, was sown after each corn crop, there was a tendency 'to keep the plough going to the ultimate deterioration of the land' (Garnett 1912).

Mardale and Wet Sleddale were described in the 19th century as narrow strips of productive pasture in an area otherwise made up of sterile, thin acidic soils, supporting only rough pasture. On account of their high rainfall and poor drainage, many of the pastures had to be managed in the form of long leys. If left for more than a few years, the grass became 'over-mastered' by mosses. At such times, it was the practice to plough them up and plant crops of corn until the moss had been destroyed, whereupon the land was allowed to revert to grass.

Much of the reclaimed land resulting from the Lowther Estate activity earlier in the 19th century fell into disuse soon after 1870 and any further intakes from the moor were on a quite insignificant scale. During the present century, dairying has become increasingly important and, by 1955, accounted for 75% of farm income in Westmorland. Nevertheless, sheep rearing remained the most important farming activity on the higher ground, and the character of the upland vegetation continued to reflect the pattern of sheep grazing. Owing to rising labour costs and the difficulty of recruiting shepherds, sheep have been allowed to grazed more freely, with the result that they select and over graze more palatable species, and leave coarser herbage, thereby leading to a marked increase in <u>Molinia</u>, <u>Nardus</u> and bracken.

The extent of tillage over the 1900-1960 period peaked in this area around 1920 and has fallen since (Part I, Figure 4-4). Cattle and sheep numbers dropped abruptly between 1935 and 1940 (Part I, 4.45 and Figures 4-5, 4-6) as a result of direct loss of farmsteads and farmland to the Haweswater Reservoir, and the indirect reduction of stock on the higher land that this loss brought about. ULS (1979) calculate the total area of crops and grass to have hardly changed between 1859 and 1978 (26.2 to 25.6% of the area), while the area of woodland has gone up slightly from 3.0 to 3.6% between these same years.

This area was surveyed by the Ordnance Survey first in 1858-59 and their large scale maps were revised in 1897, 1913 and between 1962 and 1976. As shown in Figure 3+6, about 7 600 ha (67% of the area) have been identified from these maps as moorland core (see Part I, 4.47-4.55). The moorland fringe covers 644 ha (6% of the area) (Part I, Table 4-6) of which 78 ha represent moorland that has been afforested. In Shap, moorland fringe is widely distributed in relation to land types, 24% in the hill land group, but 60% in the upland land group, with relatively the highest amount in steep upland (31% of fringe in 13% of the area). 26 ha of moorland have been reclaimed for agriculture. 540 ha of moorland reclaimed in the 19th century have subsequently reverted to moorland again, particularly in Wet Sleddale. The remaining 27% of the area is farmland, except for a few tracts of long established woodland, including Naddle Forest in a subsidiary valley south of Haweswater, scheduled by the Nature Conservancy Council as a Site of Special Scientific Interest (SSSI).

Considering land-uses other than agriculture, the area became a minor tourist centre in the early 19th century and continued so through the early 20th century, starting with the Shap Wells Hotel opened in 1820, and expanding due to the convenience of the railway and main road for access and the consequent further provision of hotel and other accommodation in Shap itself. It still has this interest, with the A6 road and Haweswater as access and main attraction respectively but most through traffic has now gone to the M6 motorway and thus bypasses the village. Pressure on this peripheral part of the Lake District is much less than on the more famous central lakes and valleys of the National Park. Industrially, the Shap granite quarries remain active, producing mainly crushed rock as roadstone (Part I, Plate 4), while limestone quarries produce lime and limestone for agriculture and the steel industry. Finally, water supply is a prominent use of the area. As well as Haweswater, purchased by Manchester Corporation in 1925, the enlarging of which to a reservoir between 1927 and 1941 (Part I, 4.40) destroyed the farming community of Marsdale, Wet Sleddale also has a much smaller reservoir.

VEGETATION

The frequencies of vegetation classes at the 115 main sites recorded in 1977 are shown in Figure 3-7 and the locations and vegetation classes of these sites are given in Figure 3-8.

Vegetation in the northeastern corner of Shap differs sharply from that elsewhere in the study area. In this upland plateau sector, with Gley and Brown Earth soils associated with glacial drift and limestone outcrops, the vegetation at the recorded sites principally consists of improved pastures (present at 19% of recorded sites in the area as a whole). Rough pasture sites, which are 14% of the total recorded, are more dispersed. Agrostis/Holcus grassland, class 7, sites occur south and east of the village. Plate 43 in Part I shows a contrast between improved and rough pasture at a management boundary in Shap. Rough pastures of class 5 (Agrostis/Juncus grassland) occur at sites along the valley floor of Swindale, probably reflecting the poorer drainage of Peaty Gley soils frequent here in contrast to the typically better drained soils over limestone in the northeast.

Moorland vegetation is characteristic of most of the area, both on the more rounded hills (fells) to the south and on the typically craggy Lake District mountains in the west. Heath vegetation was present at almost two-thirds of the recorded sites in 1977. Festuca/Nardus/Molinia grassy heath, class 16, at 24% of sites, and Nardus/Sphagnum/Calluna shrubby heath, class 11, at 26% of sites, were almost equally prominent. A further 17% of sites had vegetation of 5 other heath classes.

Woodland is sparse in most of Shap and the visual impression this gives is emphasized by the general lack of hedges and hedgerow trees, most of the field boundaries in the farmland sector consisting of dry-stone walls or fences. Ten of the 12 woodlands examined fall in the upland acid woodland category (Part I, Table 3-4). The other 2 are classifiable as lowland basic woodlands and occur on the limestone in the northeast of the parish.

Table 3-1 shows the association between vegetation classes at main sites in 1977 and the land types in this study area. Figure 3-9 includes a schematic illustration of the relationship between land groups and vegetation groups, using a sketch of land group distribution based on Figure 3-5. Only 2 out of 57 sites in the hill land are pastures, while sites in the upland land group are about 60% pastues and only 10% shrubby heaths, and the small area of upland margin land contains 5 pasture sites and one grassy heath site.

POTENTIAL VEGETATION CHANGE

In considering the likelihood of vegetation change in Shap several stabilising influences are present. The major part of the area lies within the Lake District National Park so that the policies of the Lake District Planning Board are bound to have a major impact on land management. For example it is questionable whether a welcome would be given to large scale afforestation, which is a potential land-use over the lower hill ground in the centre and south of the area. Common land and conservation considerations also act against substantial forestry here, although on simple assumptions in Part I (see Table 5-19) the land with forestry potential is assessed as 42% of the area. In spite of this, immediate future tree planting is likely to be on a small scale for amenity purposes or for wind-breaks.

Another influence is that of the Lowther Estate which manages the fells to the southeast of Shap as grouse moor, so that in this sector, as long as the current burning regime is maintained, shrubby heaths will survive. In the northwest there is the Haweswater water catchment area. Here the management policies of the North West Water Authority are for stability in land-use, and conservation interests have a similar objective. In the ULS report on Shap (ULS 1979) farmers interviewed as part of the social survey indicated that they were content to operate their farms along established lines for the foreseeable future, thus adding a further factor suggesting general stability against major change in the area. The ULS analysis of the rough grazing sectors, using ADAS criteria for hill land classification, records 75% as generally not improvable though mainly of some grazing value, and only 17% as 'improvable'.

The vegetation changes that could occur on ecological grounds, if social, landscape, and other considerations tending to stability were overridden or changed, and agricultural land-use intensified or declined, can be assessed in a uniform way in accord with the general principles of change discussed in Part I (5.74-5.77 and Figure 5-4) and summarised in Appendix 2. In Shap, grassy heath class 16 (Festuca/Nardus/Molinia heath) and shrubby heath class 11 (Nardus/Sphagnum/Calluna heath) are the most frequently occurring vegetation classes. Under a reduced level of agricultural activity Festuca/Nardus/Molinia grassy heath would move towards Nardus/Sphagnum/Calluna shrubby heath in wetter situations or to class 10 Vaccinium/Calluna heath where soils were more freely drained. The continuation of this trend depends substantially on soil drainage. In wetter sites change could continue to Eriophorum/Calluna heath, class 12, but on better drained soils it would be unlikely that this stage would be reached, the vegetation probably holding at Vaccinium/Calluna heath. Intensified agricultural management would probably cause a trend away from grassy heaths towards rough pastures of class 5 (Agrostis/Juncus grassland) and class 6 (Festuca/Juncus grassland). Existing sites of Nardus/Sphagnum/Calluna heath, class 11, could show a reverse trend to that discussed above, with a move towards Festuca/Nardus/Molinia heath, class 16. It is not expected that the improved pastures of class 4 (herb-rich Lolium grassland) at sites located in the north of Shap would be allowed to deteriorate.

Figure 3-8 gives maps illustrating the changes predicted at main sites on purely ecological grounds, without consideration of local environment or management factors, as a result of moderate levels of gradual intensification or decline in agricultural land-use. Figure 3-7 includes the differences that these predicted changes would produce in the frequency of vegetation classes at recorded main sites. Remembering that local factors have not been considered in making these generalised predictions, and that ownership, status and farmer's intentions all tend to stability, it is estimated from these predictions of what can be thought of as maximum probable changes on ecological grounds that intensification of agriculture to a moderate degree in Shap could lead to an overall increase in the proportion of rough pastures at the recorded sites from 14 to 33%. A small increase in the proportion of improved pasture sites (19 to 23%) and small decrease in the proportion of grassy heath sites (33 to 30%) could also occur. These changes would be balanced by a sharp decrease in the proportion of shrubby heaths at the recorded sites from 34 to 4%. Moderate decline in agricultural use would produce falls in the proportions of all vegetation groups except shrubby heaths. These would be expected to increase from their present occurrence at 34% of recorded sites to 67% of sites. Grassy heaths would show the largest proportional decrease, from 33 to 11%, followed by rough pastures with a fall from their present occurrence at 14% of sites to only 5%. Improved pastures could be expected to remain relatively unchanged (from 19% of recorded sites to 17%). In considering the overall impact of these predicted vegetation changes on the landscape, the predictions following an increase in agricultural activity involve a change in vegetation group at 75% of the recorded main sites, while a decline in agricultural activity would involve change at 49% of the sites.

Predicted changes in the proportions of vegetation groups at main sites in each land group are included in Figure 3-9. Sites in the hill land group remain mainly heaths under both predictions. In the upland land group, pastures could expand substantially under intensified agriculture, while in the upland margin, shrubby heaths could become prominent if agriculture declined.

Table 3-2 correlates ITE vegetation classes (at main sites recorded in 1977 and at additional sites from 1979 (Part I, 5.66-5.67)) with the ULS mapping units in which they occur, the distribution of which is shown in the ULS vegetation map reproduced here as Figure 3-10. There is rather more divergence between these vegetation assessments than is the case in most other areas. In general the prominent ITE classes occur in a range of ULS units while these units include a spread of ITE classes. Some situations are readily explained. For example class 11, Nardus/Sphagnum/Calluna shrubby heath, occurs almost equally in the ULS units of 'coarse grassland/Nardus' and 'sub-shrubs/heathers', a consequence of these 2 units representing a judgement on the degree of cover of 2 species which are both of high constancy in the ITE class. Table 3-3 shows how the balance of vegetation groups in each ULS mapping unit would alter if vegetation change followed the predictions discussed above. Because of the complexity of relationships between ULS units and ITE classes in this area no clear cut picture is possible of contrasts between the character of the units now and as they could be predicted to become.

## CONCLUSION

Extensive major agricultural or afforestation changes from the present quite sharp farmland-moorland contrast appear unlikely in Shap, in part because of its environment and also because of its ownership and National Park status. Land management policies are likely to be directed towards maintaining the present status quo. In an economic and social climate that could accept lessened agricultural use and more emphasis on recreational and conservation aspects, then shrubby heaths could expand at the cost of the present grazed grassy heaths and ultimately even of some of the rough pastures. In the eastern part of the area agriculture would be sustained at its present level. Forestry is an option over much of the lower hill ground, if landowners wanted this and landscape conservation interests found it acceptable or were overruled. The scale of potential change predicted on standard ecological grounds is unlikely to be achieved or even approached in practice if the present management policies are maintained.

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TABLE 3-1 CORRELATION OF VEGETATION CLASSES AND LAND TYPES - SHAP

| Vegetation Group and Class | | Land Group and Type: Hill | | | Upland | | | Upland Margin (6) |
|---|---|---|---|---|---|---|---|---|
| | | Steep Hill (1)* | Hill (3) | High Plateau (4) | Steep Upland (5) | Upland (7) | Upland Plateau (8) | |
| Improved Pastures | 1 | | | | | | 1 | 1 |
| | 2 | | | | 1 | 2 | 6 | |
| | 3 | | | | | | 1 | |
| | 4 | | | | | 2 | 6 | 2 |
| Rough Pastures | 5 | | | | | | | |
| | 6 | 1 | | | 1 | 2 | 1 | 1 |
| | 7 | | | | | 1 | 2 | |
| | 8 | 1 | | | 3 | | 2 | 1 |
| Grassy Heaths | 14 | 2 | | | 1 | 1 | 2 | |
| | 15 | 2 | | | | 1 | 2 | |
| | 16 | 12 | 5 | 1 | 8 | | 1 | 1 |
| Shrubby Heaths | 9 | 1 | | | 1 | | | |
| | 10 | 1 | | | 1 | | | |
| | 11 | 3 | 20 | 5 | | | 2 | |
| | 12 | 2 | 1 | | 1 | | | |
| | 13 | | | | | | | |

As number of sites of each vegetation class located in each land type.
* Land type numbers as used on computer maps, Figure 3-5.

TABLE 3-2 CORRELATION OF ULS VEGETATION MAPPING UNITS AND ITE VEGETATION CLASSES - SHAP

| ULS Mapping Unit | Number of ITE Sites in Area of ULS Unit | ITE Vegetation Class: Improved Pastures | | | | Rough Pastures | | | | Grassy Heaths | | | Shrubby Heaths | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 14 | 15 | 16 | 9 | 10 | 11 | 12 | 13 |
| Smooth Grassland | 16 | | | | | 1 | 4 | 2 | | 1 | 2 | 3 | | 1 | 2 | | |
| Coarse Grassland/*Nardus* | 25 | | 1 | | | | | | 4 | 1 | 1 | 7 | | 1 | 9 | 1 | |
| Coarse Grassland/*Molinia* | 3 | | | | | | | | | | | 3 | | | | | |
| Bracken | 6 | | | | | | 1 | | 1 | 1 | | 2 | | | 1 | | |
| Sub-shrubs/Heathers | 16 | | 1 | | | | 1 | | | 3 | | 1 | 1 | 1 | 7 | 1 | |
| Sub-shrubs/Bilberry | 2 | | | | | | | | | | 2 | | | | | | |
| Sub-shrubs/Gorse | | | | | | | | | | | | | | | | | |
| Sedge & Rush Moorland | 29 | | | | | | | | 1 | | | 14 | | | 12 | 2 | |
| Farmland | 41 | 2 | 6 | 1 | 11 | 3 | 5 | 2 | 4 | 3 | 1 | 3 | | | | | |

As number of recorded sites in each ITE vegetation class that are located in each ULS unit

TABLE 3-3 PREDICTIONS OF CHANGE IN THE BALANCE OF VEGETATION GROUPS AT SITES LOCATED IN ULS MAPPING UNITS - SHAP

| ULS Mapping Unit | ITE Vegetation Groups | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Improved Pastures | | | Rough Pastures | | | Grassy Heaths | | | Shrubby Heaths | | |
| | A | B | C | A | B | C | A | B | C | A | B | C |
| Smooth Grassland | | 7 | | 7 | 6 | 2 | 6 | 3 | 5 | 3 | | 9 |
| Coarse Grassland/*Nardus* | 1 | 5 | 1 | 4 | 9 | | 9 | 10 | 4 | 11 | 1 | 20 |
| Coarse Grassland/*Molinia* | | | | | 3 | | 3 | | | | | 3 |
| Bracken | | 2 | | 2 | 3 | | 3 | 1 | 2 | 1 | | 4 |
| Sub-shrubs/Heathers | 1 | 2 | 1 | 1 | 4 | | 4 | 9 | 1 | 10 | 1 | 14 |
| Sub-shrubs/Bilberry | | | | | 2 | | 2 | | | | | 2 |
| Sub-shrubs/Gorse | | | | | | | | | | | | |
| Sedge & Rush Moorland | | 1 | | 1 | 14 | | 14 | 12 | 1 | 14 | 2 | 28 |
| Farmland | 20 | 34 | 17 | 14 | 7 | 5 | 7 | | 12 | | | 7 |

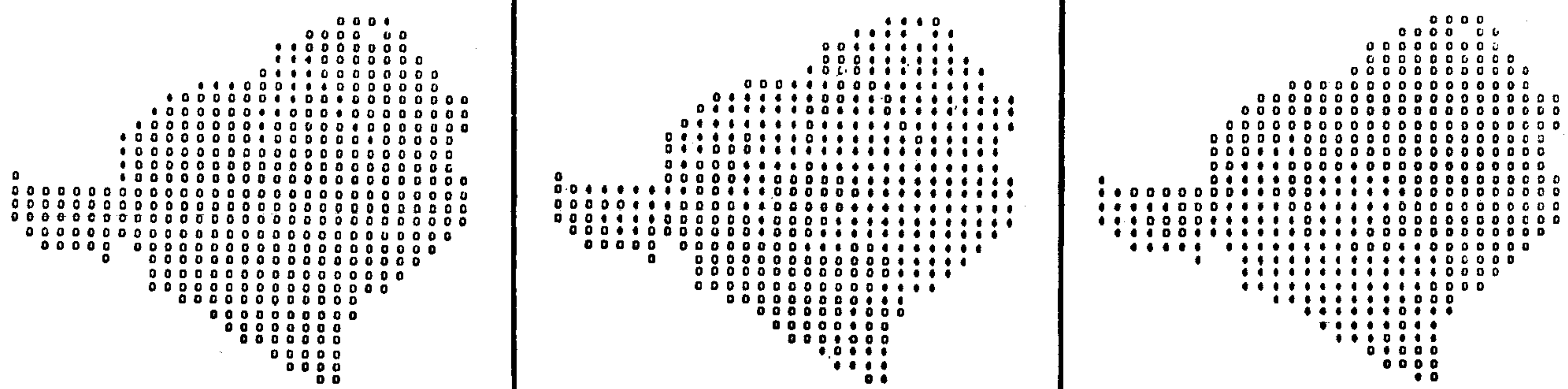
As number of recorded sites falling in each ITE vegetation group that are located in each ULS unit

A - situation as recorded

B - predicted balance of vegetation if agricultural use increased, 10+ yrs

C - predicted balance of vegetation if agricultural use decreased, 10+ yrs

FIGURE 3.2 ALTITUDE SECTORS - SHAP



+ Dominantly Altitudes < 244m(800ft)

+ Dominantly Altitudes 244-427m(800-1400ft)

+ Dominantly Altitudes >427m(1400ft)

FIGURE 3.3 RAINFALL SECTORS - SHAP

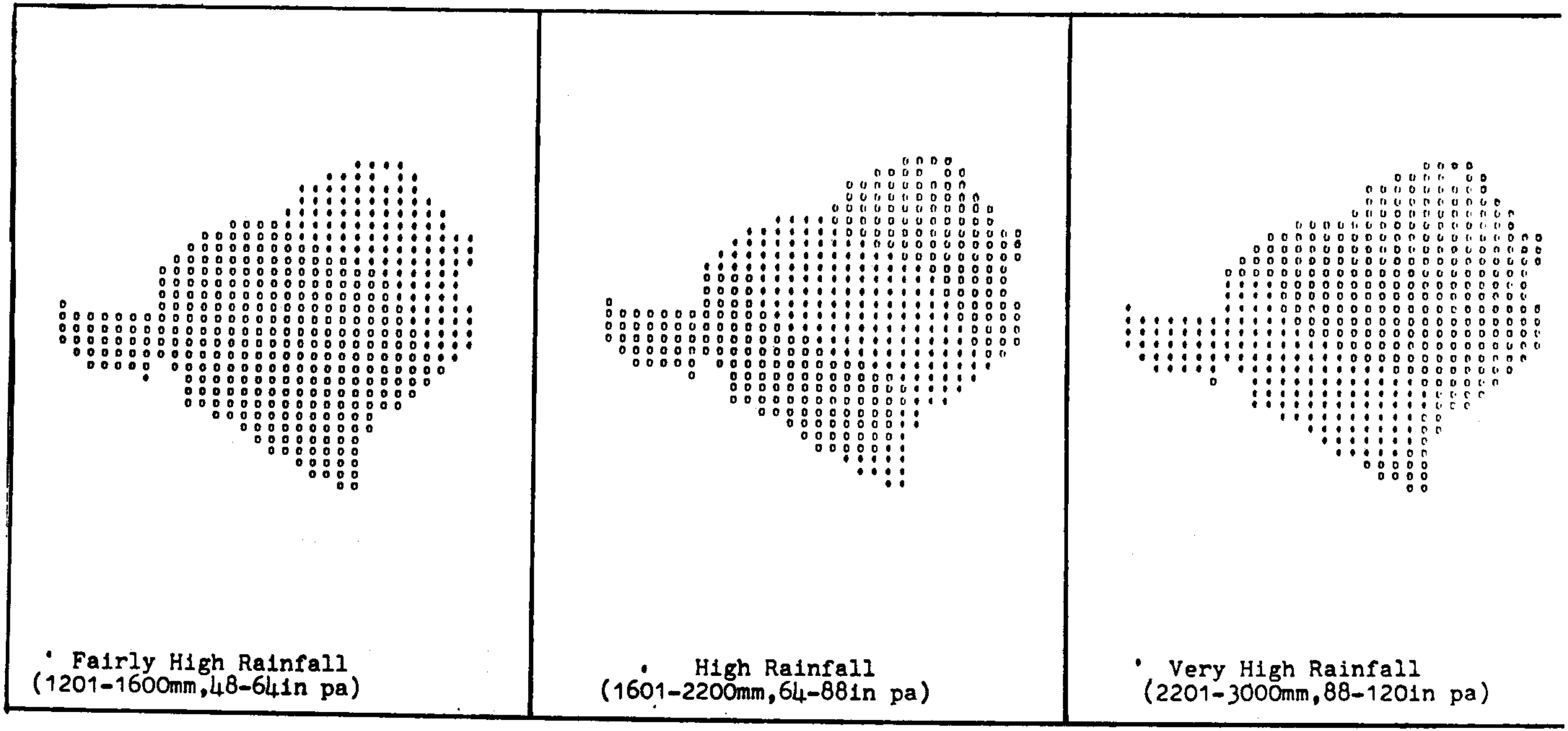


FIGURE 3.4 TOPOGRAPHIC CHARACTERISTICS - SHAP

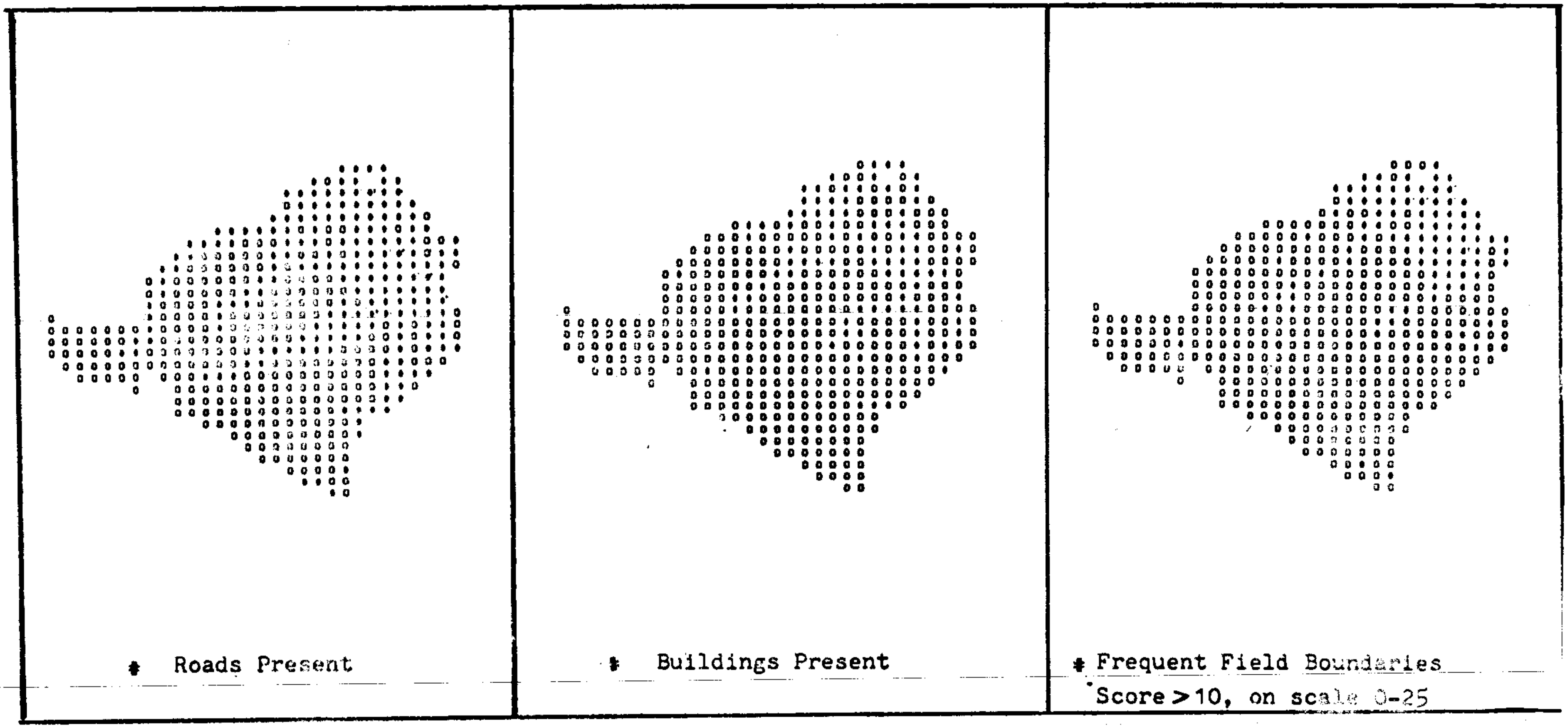


FIGURE 3.5 LAND TYPES – SHAP

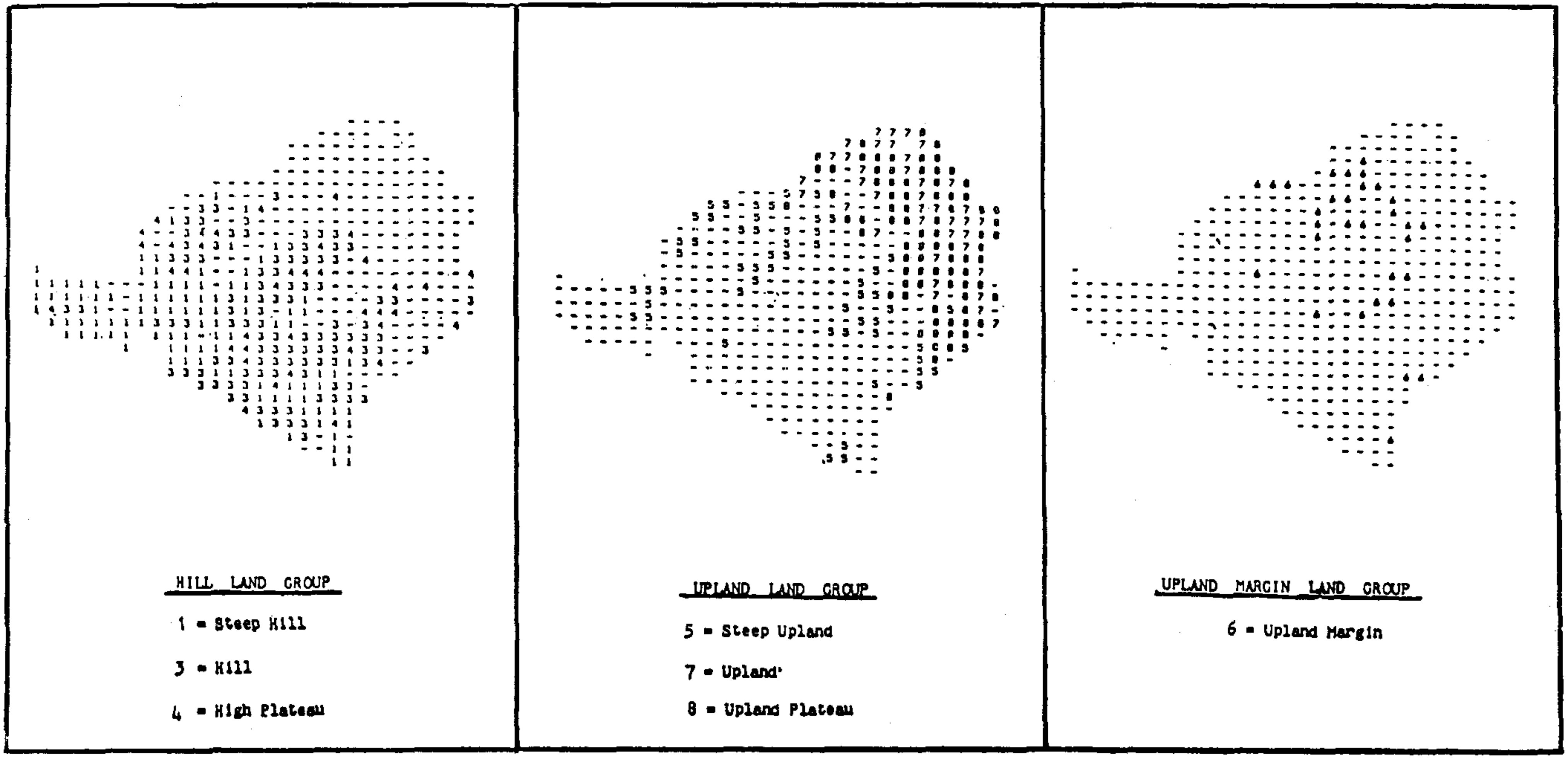
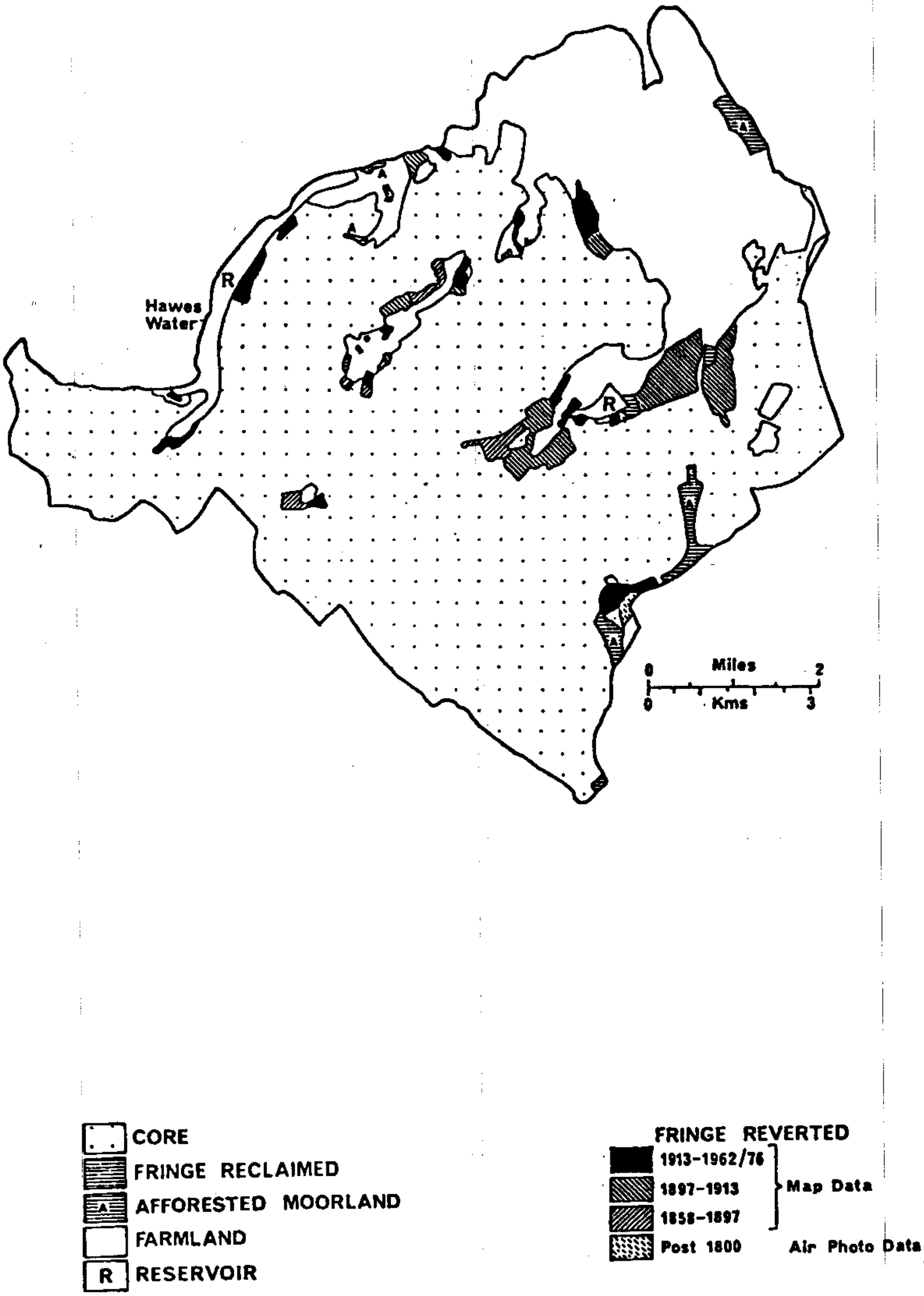
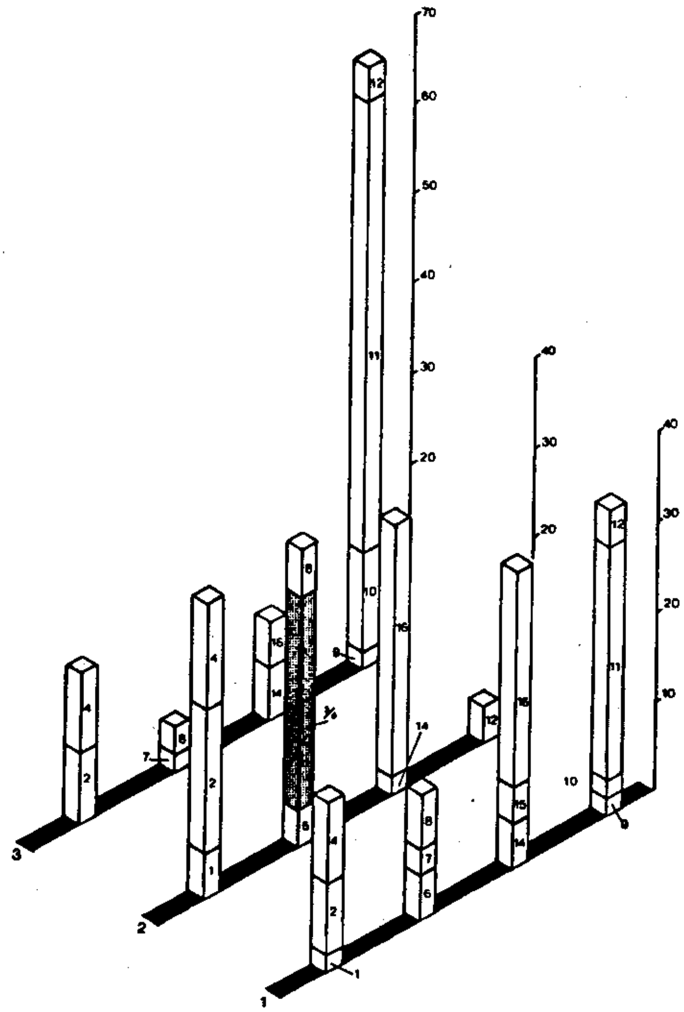


FIGURE 3.6 MOORLAND CORE, FRINGE AND FARMLAND - SHAP



# FIGURE 3.7 VEGETATION CLASS FREQUENCY AT MAIN SITES - SHAP



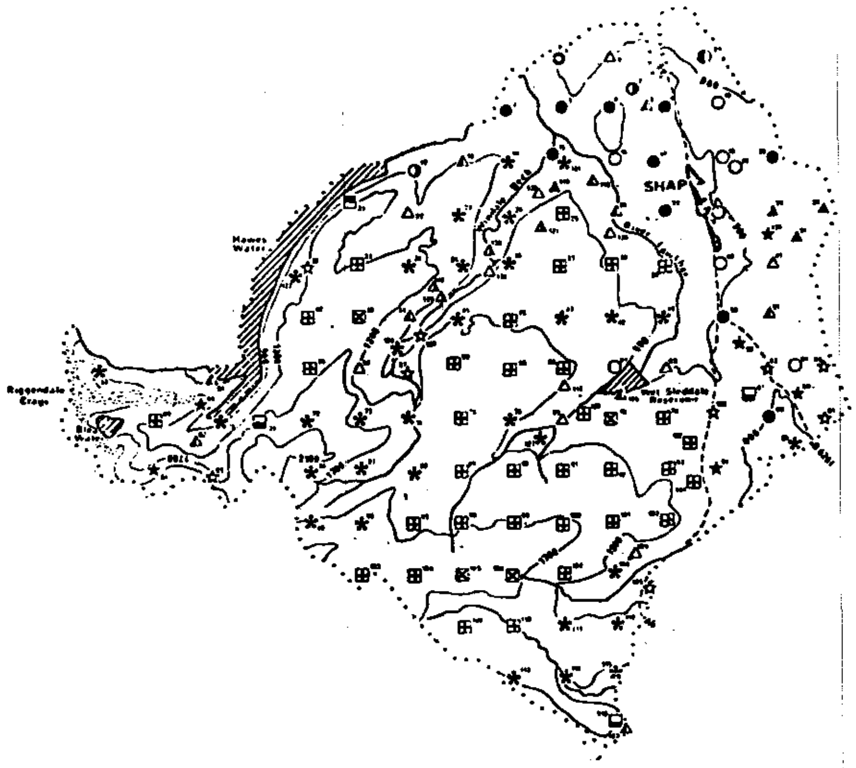

| Vegetation Group | Class | | % Main Sites in Vegetation Class 1 | 2 | 3 |
|---|---|---|---|---|---|
| Improved | 1 | Lolium/Holcus/Pteridium | 2 | 5 | - |
| Pastures | 2 | Lolium Grassland | 8 | 16 | 8 |
| | 4 | Herb rich Lolium Grassland | 9 | 12 | 9 |
| Rough | 5 | Agrostis/Juncus | - | 4 | - |
| Pastures | 6 | Festuca/Juncus | 5 | - | - |
| | 7 | Agrostis/Holcus | 3 | - | 2 |
| | 8 | Festuca/Agrostis | 6 | 5 | 3 |
| | 5/6 | Agrostis/Juncus or Festuca/Juncus | - | 24* | - |
| Grassy | 14 | Festuca/Vaccinium | 5 | 2 | 6 |
| Heaths | 15 | Festuca/Nardus/Vaccinium | 4 | - | - |
| | 16 | Festuca/Nardus/Molinia | 24 | 28 | 5 |
| Shrubby | 9 | Calluna/Molinia/Vaccinium | 2 | - | 2 |
| Heaths | 10 | Vaccinium/Calluna | 2 | - | 11 |
| | 11 | Nardus/Sphagnum/Calluna | 26 | - | 50 |
| | 12 | Eriophorum/Calluna | 4 | 4 | 4 |

1. Recorded Main Sites, 1977
2. Predicted Changes at Main Sites if Agriculture Increased, 10 + Years.
3. Predicted Changes at Main Sites if Agriculture Decreased, 10+ years.

* Under a regime involving intensification of agriculture Class 16, Festuca/Nardus/Molinia, could move towards either Class 5, Agrostis/Juncus, or the closely related Class 6, Festuca/Juncus. This change is indicated on the relevant column of the histogram by the shaded area.

FIGURE 3.8a LOCATION AND CLASSIFICATION OF VEGETATION MAIN SITES

SHAP




1977

Overall Frequencies of Vegetation Groups

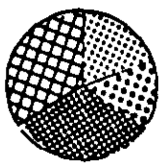
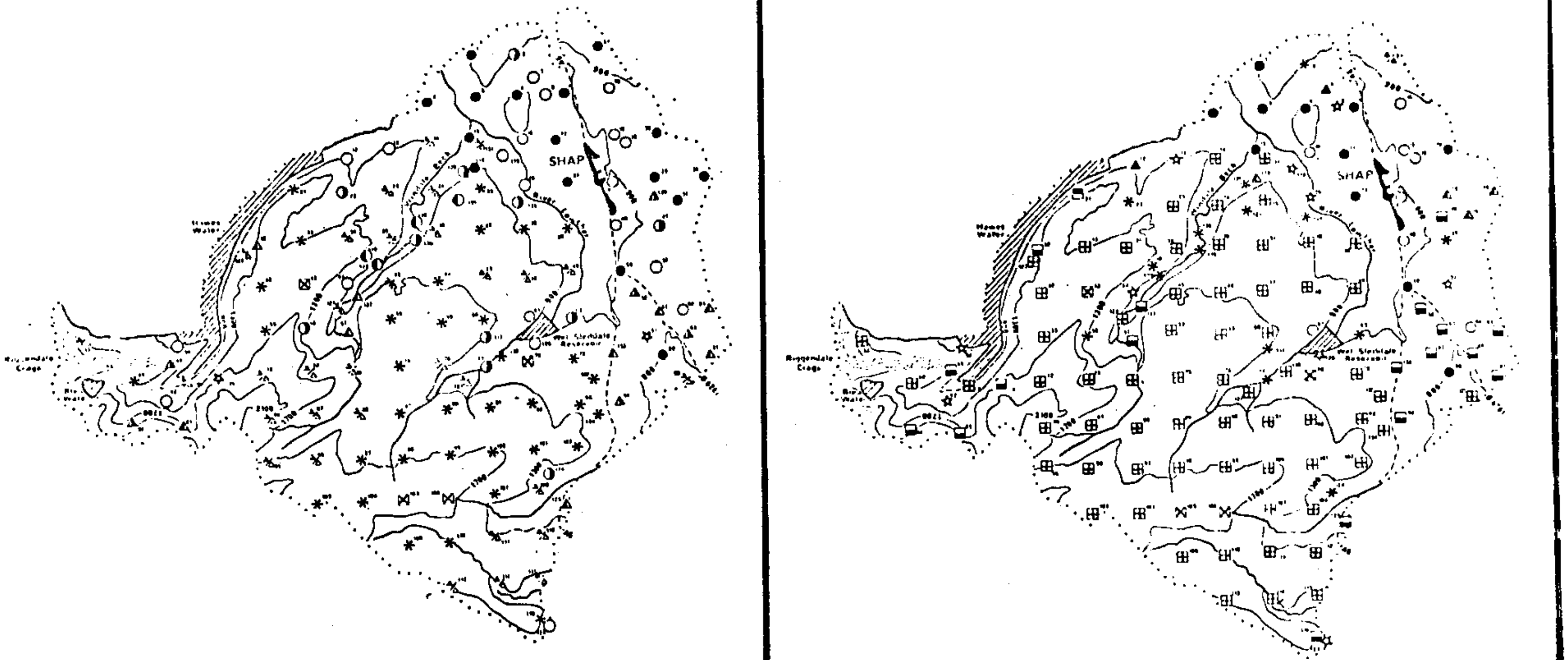


FIGURE 3 .8b LOCATION AND CLASSIFICATION OF VEGETATION MAIN SITES - SHAP




Predicted if Agriculture Increased

Predicted if Agriculture Decreased

Overall Frequencies of Vegetation Groups

KEY TO FIGURE 3.8

| | | |
|---|---|---|
| Group 1. Improved Pastures | Class 1 : | Lolium/Holcus/Pteridium |
| | Class 2 : | Lolium |
| | Class 3 : | Lolium/Trifolium |
| | Class 4 : | Herb — rich Lolium |
| Group 2. Rough Pastures | Class 5 : | Agrostis/Juncus |
| | Class 6 : | Festuca/Juncus |
| | Class 7 : | Agrostis/Holcus |
| | Class 8 : | Festuca/Agrostis |
| Group 3. Grassy Heaths | Class 14: | Festuca/Vaccinium |
| | Class 15: | Festuca/Nardus/Vaccinium |
| | Class 16: | Festuca/Nardus/Molinia |
| Group 4. Shrubby Heaths | Class 9 : | Calluna/Molinia/Vaccinium |
| | Class 10: | Vaccinium/Calluna |
| | Class 11: | Nardus/Sphagnum/Calluna |
| | Class 12: | Eriophorum/Calluna |
| | Class 13: | Calluna |

KEY TO FIGURES 3.8 AND 3.9

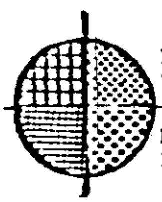
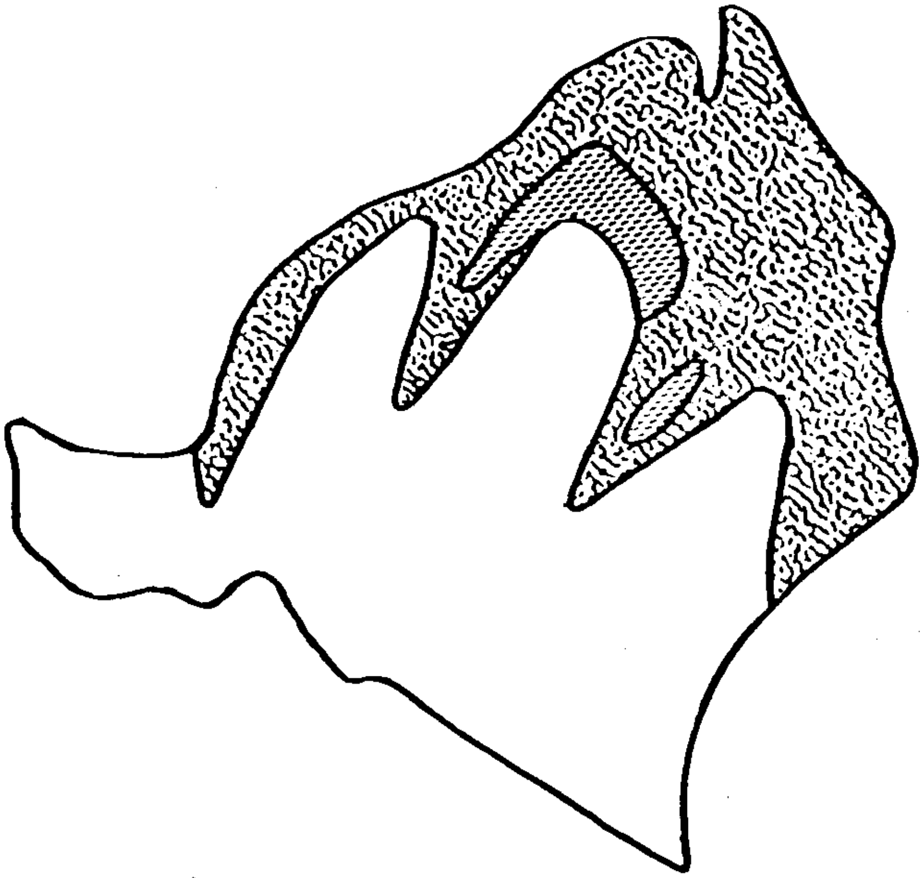


FIGURE 3.9 LAND GROUP-VEGETATION GROUP ASSOCIATIONS- SHAP



VEGETATION GROUP FREQUENCIES AT SITES IN LAND GROUPS

PREDICTED CHANGES AT MAIN SITES

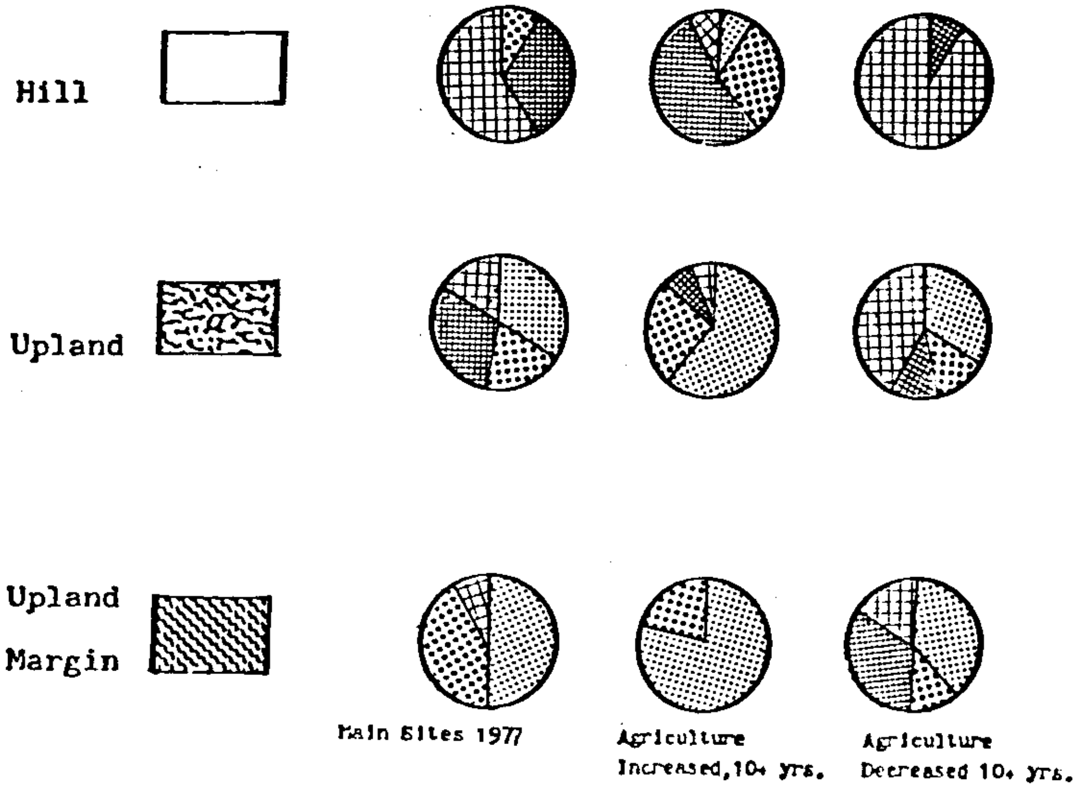
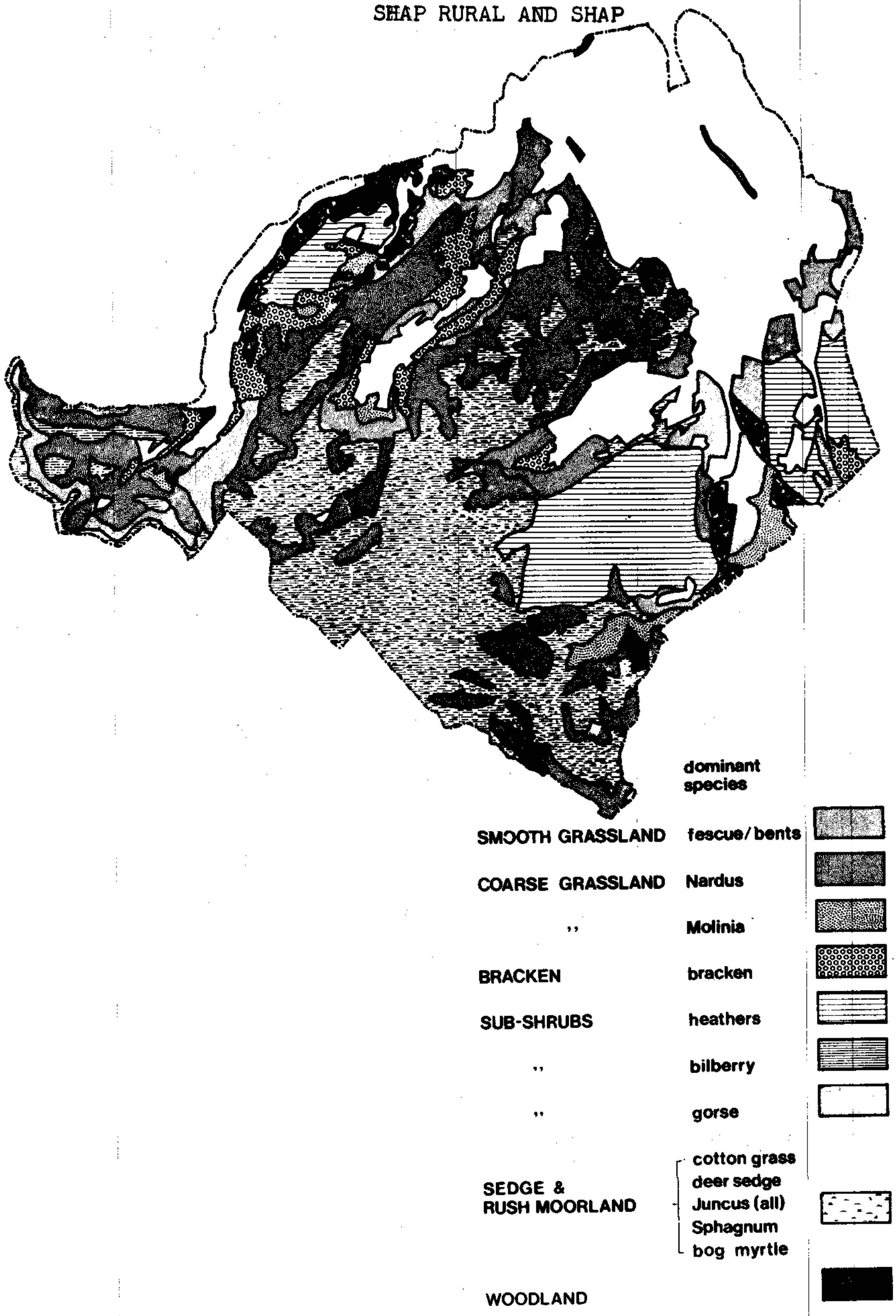
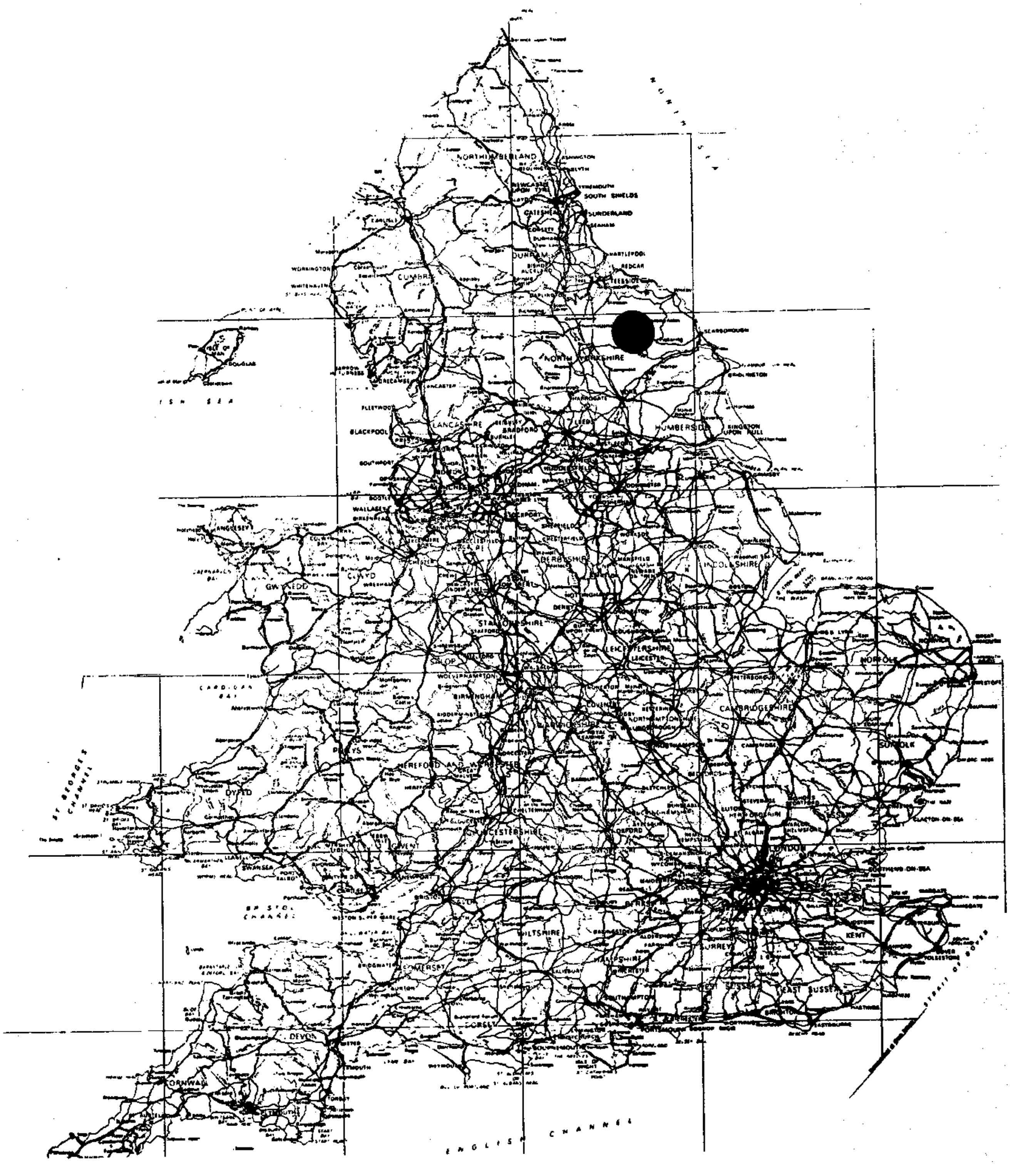


FIGURE 3.10 UPLAND LANDSCAPES STUDY VEGETATION MAP OF SHAP RURAL AND SHAP



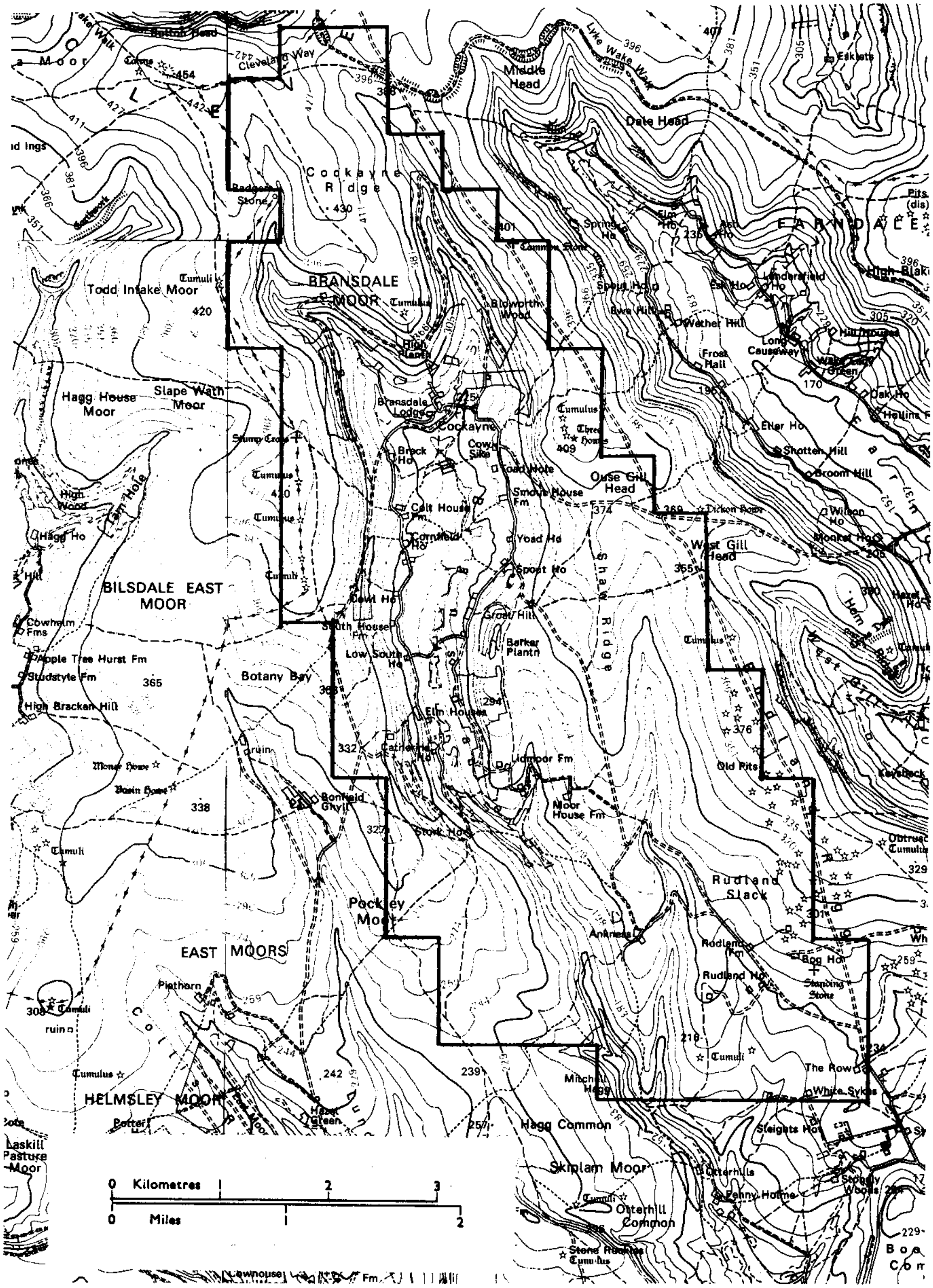

(Map by Geoffrey Sinclair, Environmental Information Services)

# BRANSDALE


NORTHUMBERLAND
SOUTH SHIELDS
SUNDERLAND
DURHAM
CUMBRIA
NORTH YORKSHIRE
HUMBERSIDE
LANCASHIRE
BLACKPOOL
LINCOLNSHIRE
LEICESTERSHIRE
CAMBRIDGESHIRE
NORFOLK
SUFFOLK
DYFED
GWYNEDD
HEREFORD AND WORCESTER
WILTSHIRE
SOMERSET
DEVON
CORNWALL
SURREY
WEST SUSSEX
EAST SUSSEX
KENT
LONDON
ENGLISH CHANNEL

General view along Bransdale. Farmlands along the valley floor carry improved pastures. The head of the valley is infilled by a conifer plantation. On the higher ground of the moorland ridges Vaccinium/Calluna heath, class 10, is frequent. Bracken-infested rough pastures of Festuca/Agrostis grassland, class 8, occupy the foreground.
(Photo by J. Dale)

FIGURE 4.1 THE STUDY AREA OF BRANSDALE



## STUDY AREA 4: BRANSDALE, NORTH YORKSHIRE

### PHYSICAL ENVIRONMENT

The study area of Bransdale (Figure 4-1), covering 32 $km^2$, is centrally situated in the North York Moors region and lies entirely within the North York Moors National Park. The nearest town is Kirkbymoorside to the south, on the Thirsk-Pickering road (A170). Bransdale is an enclosed wide floored valley (Plate 1 and Part I, Plate 6) drained by the Hodge Beck, that is aligned approximately north-south between Cockayne Ridge and Ankness Ridge. Long moorland crests flank the valley on its eastern and western sides. The valley floor lies mainly below 244 m (800 ft) and the flanking moorland ridges are generally below 427 m (1 400 ft), except for a small sector near Cockayne Head in the north (Figure 4-2). Gentle and moderate slopes dominate the area, with narrow bands of steeper slopes particularly prominent near the valley head.

Climatically, relative to the range in the study areas, Bransdale is moderately cold and dry (Part I, 2.32). The annual average of daily sunshine hours is 3.5, with January and October mean temperatures estimated as 1.5 and 9.0°C, and an annual average of 20 days with snow lying. The study area is split into 2 distinct rainfall sectors. The southern half has low rainfall (801-1 000 mm, c. 32-40 in pa) and the northern half has moderate rainfall (1 001-1 200 mm, c. 40-48 in pa) (Figure 4-3). In Smith (1976) the length of the growing season in the district which includes Bransdale, at an average altitude of 172 m is given as 230 days (6 April-22 November).

Bransdale is situated entirely on rocks of Jurassic age. Within this geological system, Lias rocks, mainly non-calcareous shaly sediments, occupy the valley floor. The upper valley slopes and the ridge-top sectors overlie siliceous 'grits' (hard sandstones) of the Lower Oolite (Great Oolite Series). The study area is mapped as drift free except for peat cover over the moorland plateau at its northern end. The central valley floor and its lower slopes, approximately between Moor House Farm and Cockayne, have been mapped on the national soil map as dominated by Gleys (poorly drained mineral soils) with associated Brown Earths. The remainder of the area is shown as dominated by Peaty Podzols. The shaly Jurassic rocks on weathering produce fine grained soil material which limits the percolation of rain water and accounts for there being a high proportion of poorly drained soils in a relatively dry area. Relatively low temperatures reduce the loss of water by evaporation and this serves also to increase water retention in these soils.

On the national agricultural land classification map the valley floor from near Cockayne southwards to almost the study area limit beyond Ankness is mapped as grade 4. The remainder, apart from some 'other use' land of woods and plantations, is classed in the lowest category, grade 5.

Topographically, although Figure 4-4 suggests a widespread road network, many mapped roads lead only to individual farms. The through road pattern is one of a circuit of minor roads on the valley floor (Part I, Plate 29) reached by limited access either directly from the Kirkbymoorside direction or over the moors from Helmsley. The absence of any road outlet to the north is clear, although an unmetalled track along Rudland Rigg on the eastern boundary of the area leading towards Stokesley was an important through route in earlier times. Figure 4-4 also emphasises the concentration of habitation and intensive farming in the central valley.

Land type distribution in the area (Figure 4-5) follows the physiographic and settlement pattern previously outlined. A central sector of the upland margin land type (accounting for 28% of the area) is flanked by land in the upland group (covering 42% of the area), particularly of the steep upland type in the west, and upland plateau in the east. Hill land is concentrated on Cockayne Ridge in the north and around Shaw Ridge in the east.

## LAND-USE HISTORY

The natural vegetation of the North York Moors region was woodland, which would have been thinner on higher ground and therefore more easily cleared by early man, such clearance beginning in the Bronze Age. Together with subsequent grazing and cultivation, woodland clearance led, as a result of increased removal of plant nutrients, to further impoverishment of inherently relatively infertile soils over the Jurassic sandstone which is the basis of the moorland ridges. Forest thus became confined to the lower parts of the dales relatively early in the history of this area. The successive retreats from higher ground that were forced on farmers as its productivity declined began to create economic and social pressures for the clearance of valley woodland, pressures which varied through Iron Age and Roman times. However the dale floors in general remained heavily wooded or became re-forested. When Rievaulx Abbey was founded in 1145, each dale was described still as "a trough avoided by the traveller, more or less impenetrable in its lower levels, thinly farmed on the flanks" (McDonnell 1963). In early surveys of Bransdale a clear distinction was always drawn between the east and west sides of the valley, separated by swampy ground with tangled wood on the valley floor. This situation was a barrier that caused parish boundaries to follow the stream courses. The present boundaries of Bransdale running along the ridges were not established until the 19th century, when the valley floor had become a unified central focus of settlement.

The economic value of the dale woodlands is reflected in a grant of the bark of trees growing in the Forest of Bransdale that was given to Kedholme Priory in the mid-12th century. Rural life depended on supplies of fuel and timber as much as on locally produced food crops. Because of this interest in maintaining woodland productivity no village community developed in the dale. It was recorded in 1282 (Waites 1957) that the population was scattered among small clearings in the wood, engaged in animal rearing, some cultivation and perhaps also in iron smelting. By Elizabethan times, there were strident criticisms of the inroads being made into the woodlands of the North York Moors by a metal smelting industry based on the iron-bearing Lias rocks which occurred in many outcrops around the deeply cut dales. Farming emphasis then was still concentrated in stock rearing from farmsteads high on the dale sides.

The dissolution of the monasteries may have led to a decline in the intensity and regularity of grazing of the higher moors, and a greater concentration on valley resources. Chapman (1961) has described in detail the "gradual creeping outward of each individual farm, whose occupier was possibly immune from criticism because his neighbours were similarly engaged and his works added to the rent of his landlord". William Marshall (1788) commented that there had been no need to jealously guard the common moor or to introduce any form of stinting (control on stock numbers), because the number of grazing animals on the moor in summer was severely controlled by the amount of fodder that could be given them on the lower ground during winter and early spring.

Earlier clearings in the wood have survived as small fields, enclosed by hedges, in the dale bottoms. Larger fields from later enclosures, bounded by stone walls, occur surrounding these and on the higher slopes. Because of the subsistence nature of most farms, little effect resulted locally from agricultural booms and depressions until the late 19th century, and therefore there was comparatively little change in farm layout, size and land-use over a couple of hundred years.

By the mid-19th century, the moorland edge in many of the dales reached 244-290 m (800-950 ft) and very little woodland remained. Farra (1961) estimated that about 100 ha of moorland were cultivated or otherwise improved in Bransdale between 1750 and 1850. Some plantations were established. The pattern of land-use in the 19th century is illustrated by the Tithe Commutation Survey of 1848 (Figure 4-6) and an estate survey of 1870 (Figure 4-7).

Mining of poor quality coal from shallow pits was a feature of activity in Bransdale (Part I, 4.37 and Plate 7) over a long period from at least the early 18th century to the 1920s. Now the pits which resulted from the later phases of this mining are a conspicuous industrial archeaology feature in the southeast of the parish.

The area was mapped by the Ordnance Survey first in about 1850, and subsequently revised by them on at least 4 occasions. From these surveys and a consideration of recent air photographs, Figure 4-8 shows the distribution of moorland core, moorland fringe and farmland over the past 150 years or so. About 1 900 ha (almost 60% of the area) consists of moorland core, and 375 ha (12%) is moorland fringe, of which 185 ha are afforested. The extent of improved land that has reverted to moorland since 1950 is similar to that which did so in the previous century. In the sectors always mapped as moorland, air photographs suggest, from the evidence of visible plough ridges, that a very small extent (some 50 ha) has been subject to cultivation disturbance in the past. The non-afforested moorland fringe in Bransdale is mainly associated with upland margin and steep upland land types. These contain respectively 43 and 38% of the fringe, though comprising 28 and 16% of the total area.

Agricultural statistics for 1900-1965 given for many areas in Part I are not available for Bransdale. ULS (1980) calculate a fall in the area of crops and grass from 25% of the area to 22% between 1848 and 1976 and an increase in woodland (including forest plantations) from 3 to 9% of the area over the same period.

## VEGETATION

In Bransdale 88 vegetation main sites were examined in 1977. Figure 4-9 shows the frequency of vegetation classes at these sites, and Figure 4-10 plots site locations and vegetation classes.

Vegetation sites on the tops of the flanking ridges in Bransdale are mainly shrubby heaths. <u>Vaccinium</u>/<u>Calluna</u> heath, class 10 (Part I, 3.18 and Plates 37, 38) is the most frequent, accounting for 35% of all recorded sites. This together with class 11, <u>Nardus</u>/<u>Sphagnum</u>/<u>Calluna</u> heath (Part I, Plates 39, 40), at 6% of sites, and class 12, <u>Eriophorum</u>/<u>Calluna</u> heath, at 2% of sites, makes shrubby heaths 43% of the vegetation sites recorded in Bransdale. A further 34% of sites carried grassy heaths (Part I, 3.6), mainly <u>Festuca</u>/<u>Vaccinium</u> heath, class 14, and <u>Festuca</u>/<u>Nardus</u>/<u>Molinia</u> heath, class 16 (at 18 and 15% of sites respectively). The grassy heaths have a diffuse distribution along the valley sides in comparison to a more concentrated location of the shrubby heaths, whilst rough pastures (Part I, 3.14) (at 11% of sites) and improved pastures (Part I, 3.12) (at 12% of sites) are to be found in the valley bottom. The rough pastures were all of one class, Festuca/Agrostis grassland, class 8 (Part I, Plates 25, 26, 29). As far as the moorland ridge crests are concerned, their landscape is dominated by heather, Calluna vulgaris, a major species of the 3 shrubby heath categories recorded. The steep valley sides have a high proportion of bracken, an important visual element among the species which comprise the grassy heaths here.

Woodland recorded at 15 sites in Bransdale is almost all (14 sites) upland acid woodlands, with a single example of a lowland acid woodland.

Table 4-1 gives the association between vegetation classes at main sites in the grassland-moorland range and the land types in Bransdale. Figure 4-11 shows the representation of vegetation groups at the recorded sites situated in each land group, with a sketch of land group distribution based on Figure 4-5. Heath vegetation is prominent in all land groups, with grassy heaths particularly frequent in the upland margin sectors, and shrubby heaths in the upland and hill sectors.

## POTENTIAL VEGETATION CHANGE

In the Upland Landscapes Study report (ULS 1979) Bransdale is described as enclosed farmland with surrounding moorland, the latter being considered most vulnerable to change. Rights along sheep 'strays' (the access routes between farms and moor) are said at present to be falling into disuse, jeopardizing the balance within the present system of moor management aimed jointly at stock grazing and grouse rearing. Revitalization of the sheep stray rights is said to be in the mutual interest of the major land owning bodies (The National Trust and the Feversham Estate), in order to conserve the Bransdale landscape of contrasting farmland and moorland in something like its present form through an equitable balance between farming and sporting interests.

Almost all the moorland is potentially suitable for afforestation. Simple assumptions of forestry and agriculture potential in Part I (Table 5-19) calculate the potential farmland as 45% of the area and forest land as 53%. However, apart from the present ownership policies, National Park policies would be important factors affecting this option for change. In practice, limited additional plantings to those already made may take place around the headwaters of Hodge Beck and its tributary of Bloworth Slack. The greater part of the present rough grazing land is considered by ULS to fall into the 'improvable' or 'improvement limited' categories, with only a minor part 'unimprovable' when classified by the criteria being tested by ADAS as a hill land classification scheme.

Shrubby heath vegetation, Vaccinium/Calluna heath, class 10, has been previously noted as the most frequent class recorded in Bransdale. Under conditions of decreased agricultural activity this class is predicted to remain unchanged, while with more intensive grazing it could change to Festuca/Vaccinium grassy heath, class 14. At sites which now carry this grassy heath, under a declining agriculture this trend would be reversed to lead to Vaccinium/Calluna shrubby heath. If Festuca/Vaccinium grassy heath is more intensively managed, the trend is for a rough pasture to develop, probably Festuca/Agrostis grassland, class 8. The other frequently occurring grassy heath, Festuca/Nardus/Molinia heath (class 16) is predicted under a declining agriculture to change to Nardus/Sphagnum/Calluna shrubby heath, class 11, while agricultural intensification would change it towards either Agrostis/Juncus grassland, class 5, or Festuca/Juncus grassland, class 6, rough pasture types not recorded in Bransdale at sites examined during the 1977 survey. Such rough pasture classes might be expected to appear as at least a temporary phase, perhaps followed, if drainage improved, by the establishment of Festuca/Agrostis grassland, class 8. As in each area account, these hypothetical vegetation class changes are based on the general principles outlined in Part I (5.74-5.77 and Figure 5-4) and summarised in Appendix 2 rather than being the result of consideration of local conditions at each site.

Vegetation classes which could develop on these general ecological grounds at main sites in Bransdale as a result of agricultural land-use are shown in Figure 4-10. Figure 4-9 gives the differences these predicted changes would produce in the frequency of vegetation classes at recorded main sites. Intensification increases pastures notably and almost removes shrubby heaths, while grassy heaths would be unaltered in proportion but change their location. A declining agriculture is predicted as leading to a substantial increase in shrubby heaths and a fall in all other groups, assuming no spread of scrub woodland or forestry planting, both likely options in the event of a decline in agriculture. In considering the overall impact of these hypotheses of gradual change as a result of expansion or contraction in agricultural intensity of land-use, on the increasing agriculture hypothesis 86% of the recorded sites in Bransdale are estimated as changing their vegetation group, while in a declining agriculture situation, 51% of sites would change.

The impact of these predicted changes on the balance of vegetation groups in land groups in the study area is illustrated in Figure 4-11. Intensification of agriculture in Bransdale is predicted to lead to the extinction of shrubby heath vegetation in the upland and upland margin land groups and to a substantial reduction of this vegetation group in the hill land sector. The counterbalancing effect would be overall increases in improved pastures and rough pastures at the recorded sites. Agricultural decline could make shrubby heaths a more prominent component of both upland and upland margin vegetation.

The ULS vegetation map of Bransdale is given here in Figure 4-12. Treating the ITE main sites (with those additionally recorded in 1979, Part I, 5.66-5.67) as sample points within these units, Table 4-2 shows the relationship of site classification to mapping unit. A particularly prominent ULS mapping unit in this area is 'bracken'. Because bracken can be associated with a wide range of other plant species, it is seen that the ULS 'bracken' map unit includes substantial representations of one rough pasture class, 2 grassy heath classes and one shrubby heath class. 'Farmland' as a unit appears to include a wider range of vegetation classes in this area than it typically does, 22% of them heath sites (the overall picture for the 12 study areas is tabulated and problems of correlation discussed in Appendix 3). Table 4-3 shows the balance of vegetation groups that would occur in each ULS mapping unit if the changes took place that are predicted above on general principles following agricultural intensification or decline. For example the widespread 'bracken' unit, now from the ITE classification dominantly a heath category, could become mainly a pasture unit in the agricultural intensification prediction.

## CONCLUSION

It is probable that in Bransdale the policies of the National Park Authority, The National Trust and the Feversham Estate will combine to sustain the present situation of a sharp moorland-farmland contrast. Resolution of the present problem of declining use of the sheep-stray rights for access between farms and moors is said to be in the interests of all 3 bodies as one means of conserving the vegetation character of the present landscape. Management, rather than inherent physical conditions, is the key to the existence of the present vegetation pattern in this area. If current management is not maintained, in a prosperous agriculture situation heaths will largely disappear through cultivation and increased grazing pressures, or, in a declining upland agriculture situation, heaths could expand but afforestation of the upper slopes and ridges would be a likely alternative option. In either event, changes could be substantial because environmental limitations to change are relatively unimportant.

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TABLE 4-1 CORRELATION OF VEGETATION CLASSES AND LAND TYPES - BRANSDALE

| Vegetation Group and Class | | Land Group and Type | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Hill | | | Upland | | | Upland Margin (6) |
| | | Steep Hill (1)* | Hill (3) | High Plateau (4) | Steep Upland (5) | Upland (7) | Upland Plateau (8) | |
| Improved Pastures | 1 | | | | | | | 1 |
| | 2 | | | | | | | |
| | 3 | | | | 2 | | | 2 |
| | 4 | | | | 1 | | | 4 |
| Rough Pastures | 5 | | | | | | | |
| | 6 | | | | | | | |
| | 7 | | | | | | | |
| | 8 | | | | 3 | | 2 | 5 |
| Grassy Heaths | 14 | 1 | | 2 | 2 | 2 | 3 | 6 |
| | 15 | | | | 1 | | | |
| | 16 | | | 1 | 5 | | 2 | 5 |
| Shrubby Heaths | 9 | | | | | | | |
| | 10 | 3 | 5 | 2 | 6 | | 13 | 2 |
| | 11 | | | | | | 4 | 1 |
| | 12 | 1 | | 1 | | | | |
| | 13 | | | | | | | |

As number of sites of each vegetation class located in each land type.
* Land type numbers as used on computer maps, Figure 4-5.

'ABLE 4-2 CORRELATION OF ULS VEGETATION MAPPING UNITS AND ITE VEGETATION CLASSES - BRANSDALE

| ULS Mapping Unit | Number of ITE Sites in Area of ULS Unit | ITE Vegetation Class | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Improved Pastures | | | | Rough Pastures | | | | Grassy Heaths | | | Shrubby Heaths | | | | |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 14 | 15 | 16 | 9 | 10 | 11 | 12 | 13 |
| Smooth Grassland | | | | | | | | | | | | | | | | | |
| Coarse Grassland/*Nardus* | 6 | | | | | | | | 1 | 2 | | 1 | | 2 | | | |
| Coarse Grassland/*Molinia* | | | | | | | | | | | | | | | | | |
| Bracken | 45 | | | | 1 | | | | 7 | 8 | 1 | 13 | | 13 | 2 | | |
| Sub-shrubs/Heathers | 26 | | | | | | | | 1 | 6 | | | | 16 | 1 | 2 | |
| Sub-shrubs/Bilberry | | | | | | | | | | | | | | | | | |
| Sub-shrubs/Gorse | | | | | | | | | | | | | | | | | |
| Sedge & Rush Moorland | 4 | | | | | | | | | | | | | 2 | 2 | | |
| Farmland | 18 | 1 | | 4 | 5 | | | | 4 | | | 3 | | 1 | | | |

As number of recorded sites in each ITE vegetation class that are located in each ULS unit

TABLE 4-3 PREDICTIONS OF CHANGE IN THE BALANCE OF VEGETATION GROUPS AT SITES LOCATED IN ULS MAPPING UNITS - BRANSDALE

| ULS Mapping Unit | ITE Vegetation Groups | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Improved Pastures | | | Rough Pastures | | | Grassy Heaths | | | Shrubby Heaths | | |
| | A | B | C | A | B | C | A | B | C | A | B | C |
| Smooth Grassland | | | | | | | | | | | | |
| Coarse Grassland/*Nardus* | | 1 | | 1 | 3 | | 3 | 2 | 1 | 2 | | 5 |
| Coarse Grassland/*Molinia* | | | | | | | | | | | | |
| Bracken | 1 | 8 | 1 | 7 | 22 | | 22 | 15 | 7 | 15 | | 37 |
| Sub-shrubs/Heathers | | 1 | | 1 | 6 | | 6 | 17 | 1 | 19 | 2 | 25 |
| Sub-shrubs/Bilberry | | | | | | | | | | | | |
| Sub-shrubs/Gorse | | | | | | | | | | | | |
| Sedge & Rush Moorland | | | | | | | | 4 | | 4 | | 4 |
| Farmland | 10 | 14 | 5 | 4 | 3 | 5 | 3 | 1 | 4 | 1 | | 4 |

As number of recorded sites falling in each ITE vegetation group that are located in each ULS unit

A - situation as recorded
B - predicted balance of vegetation if agricultural use increased, 10+ yrs
C - predicted balance of vegetation if agricultural use decreased, 10+ yrs

FIGURE 4.2 ALTITUDE SECTORS - BRANSDALE

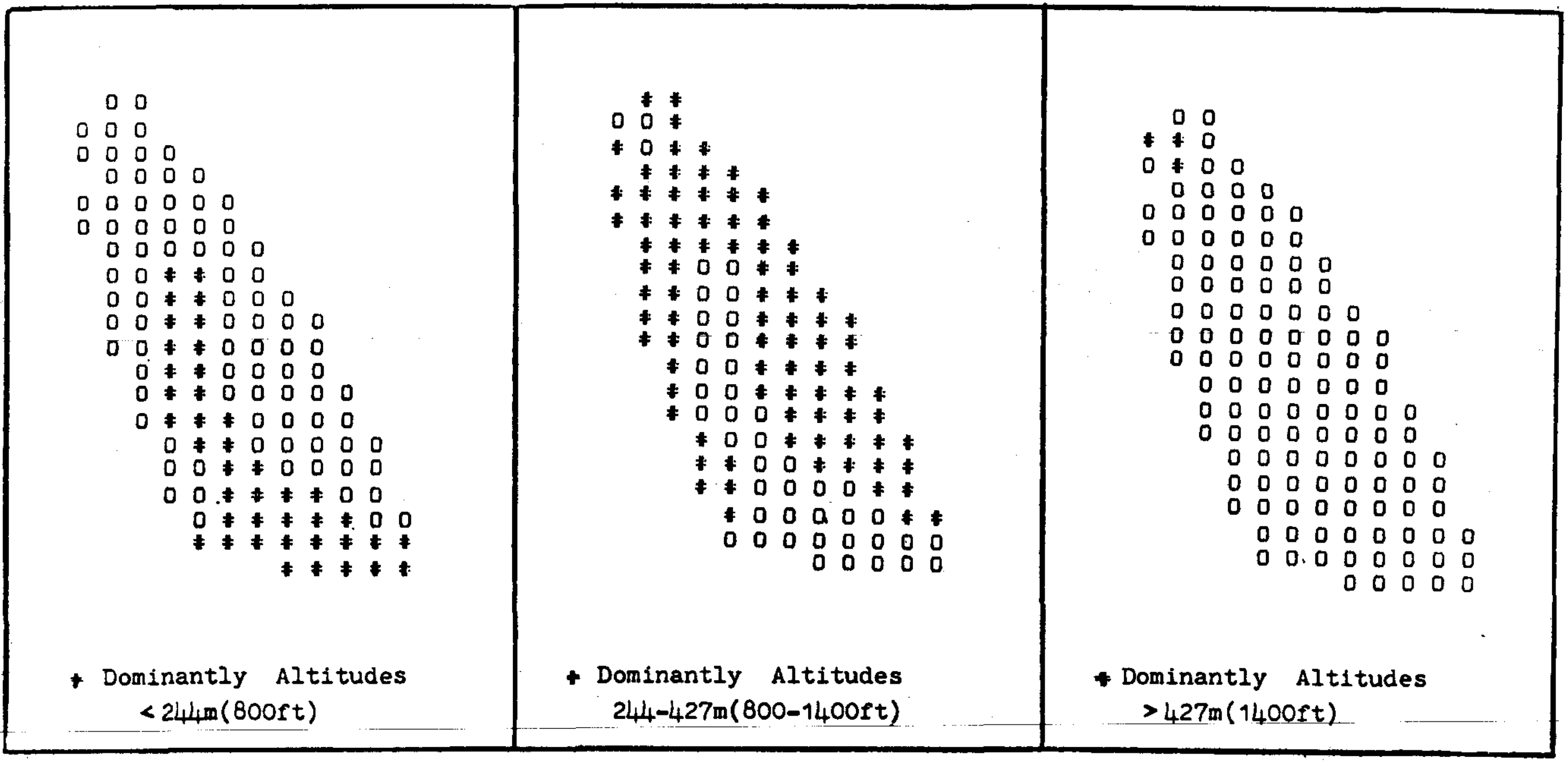
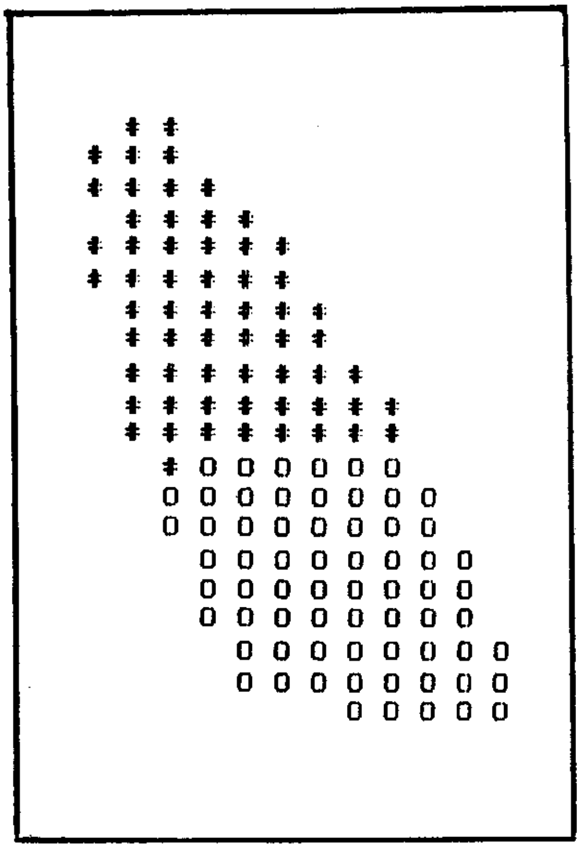


FIGURE 4.3 RAINFALL SECTORS - BRANSDALE



0 Low Rainfall (801-1000mm,32-40in pa)

# Moderate Rainfall (1001-1200mm,40-48in pa)

FIGURE 4.4 TOPOGRAPHIC CHARACTERISTICS - BRANSDALE

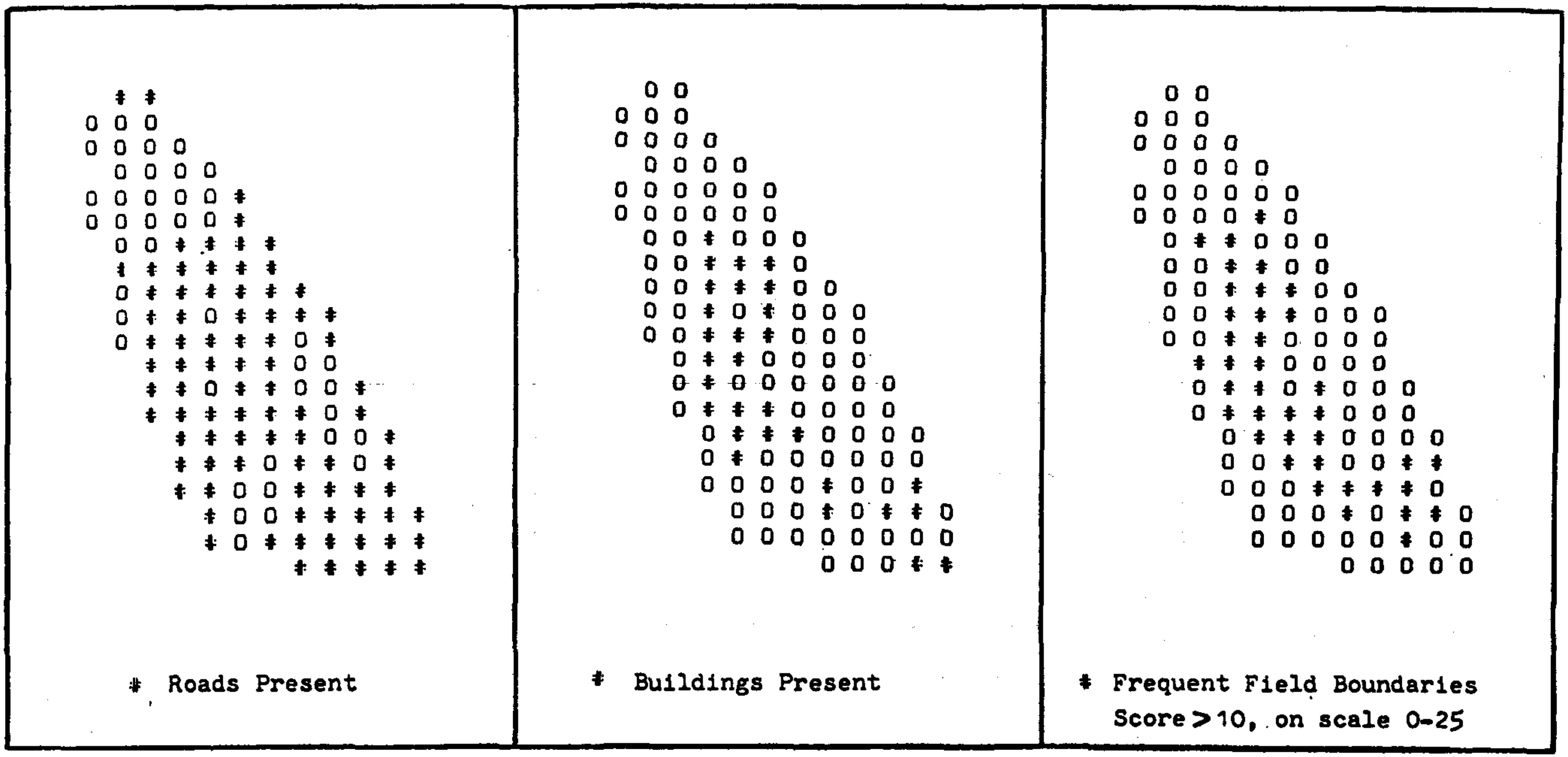


FIGURE 4.5 LAND TYPES - BRANSDALE

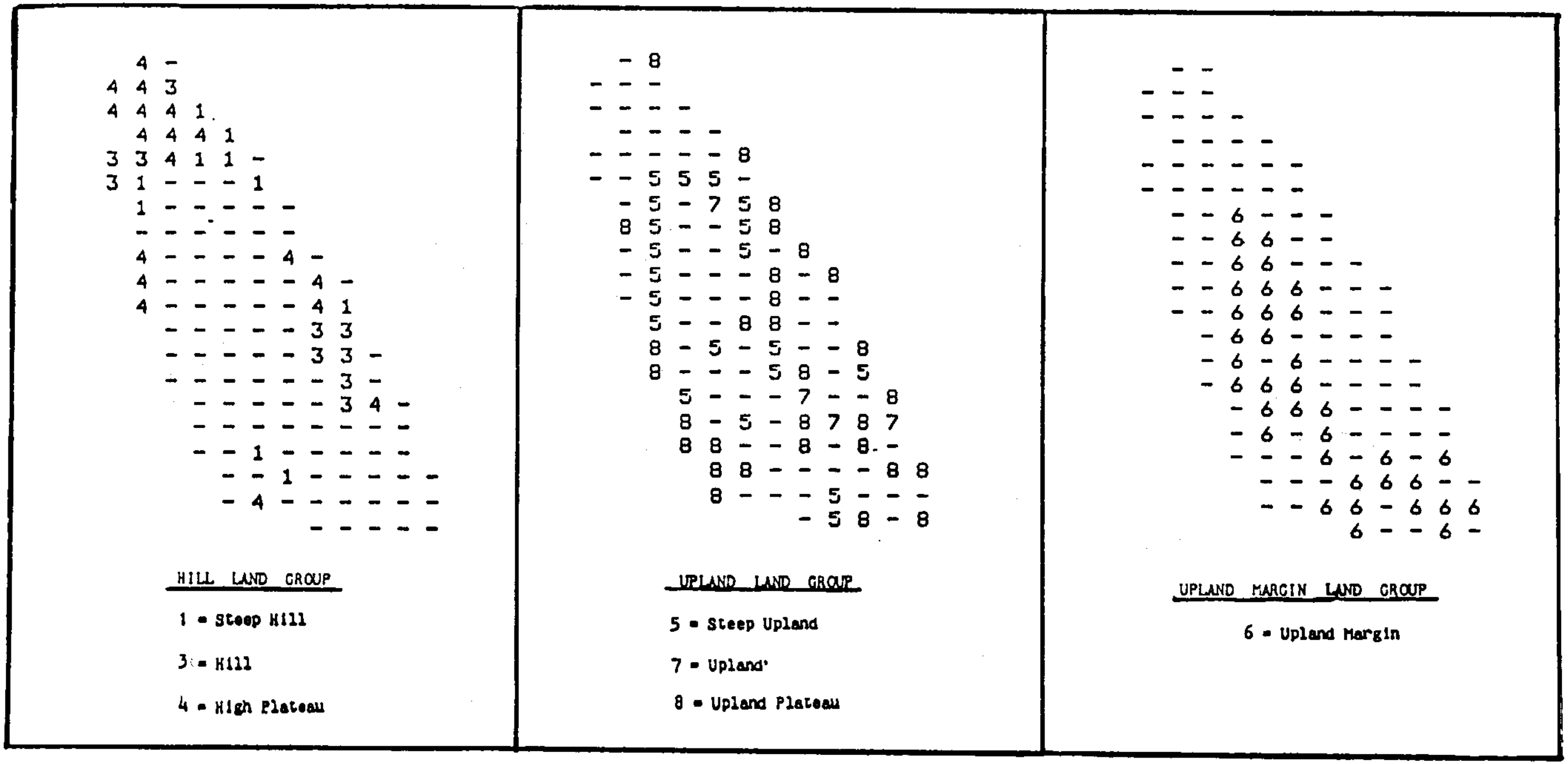


FIGURE 4.6 LAND USE AT THE TITHE COMMUTATION SURVEY OF 1848

BRANSDALE

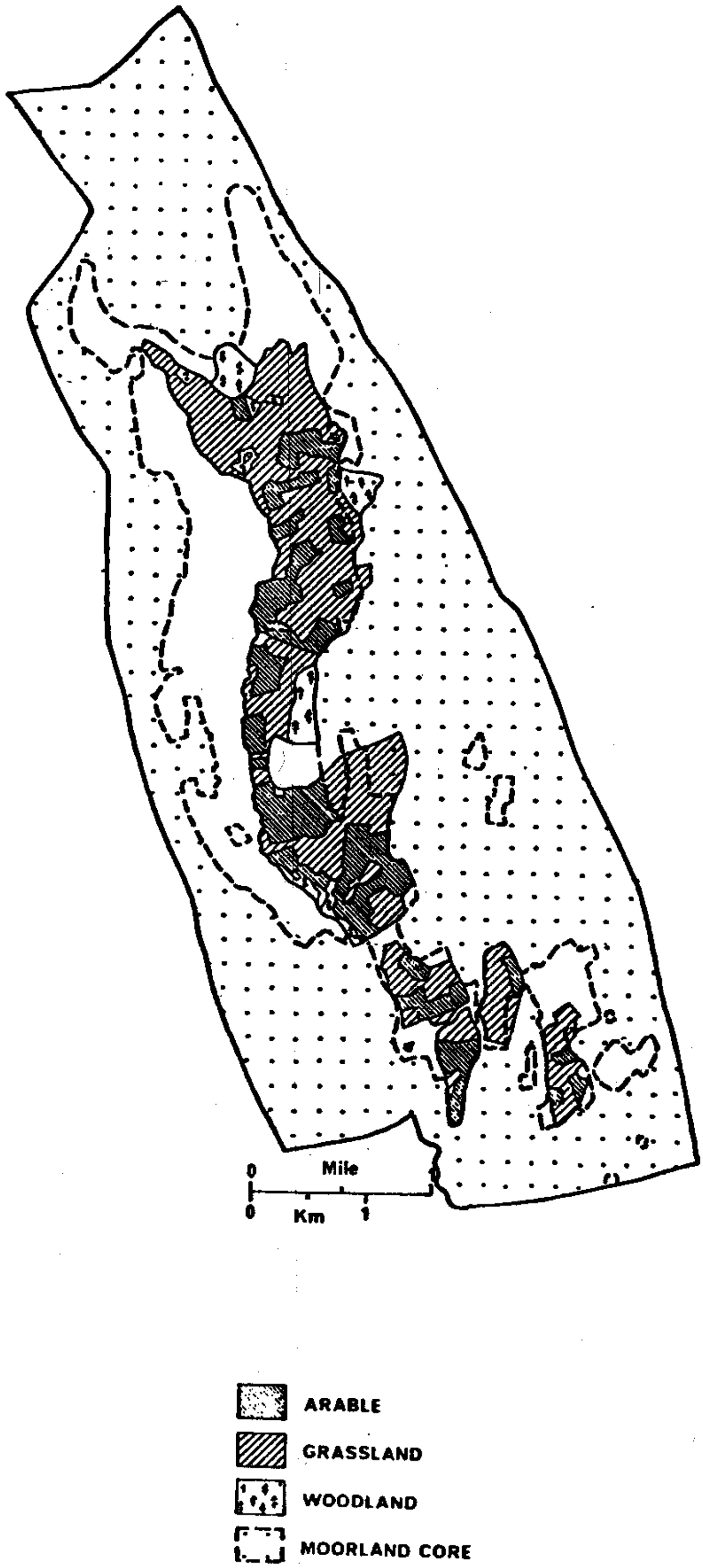


FIGURE 4.7 LAND USE AT AN 1870 ESTATE SURVEY - BRANSDALE

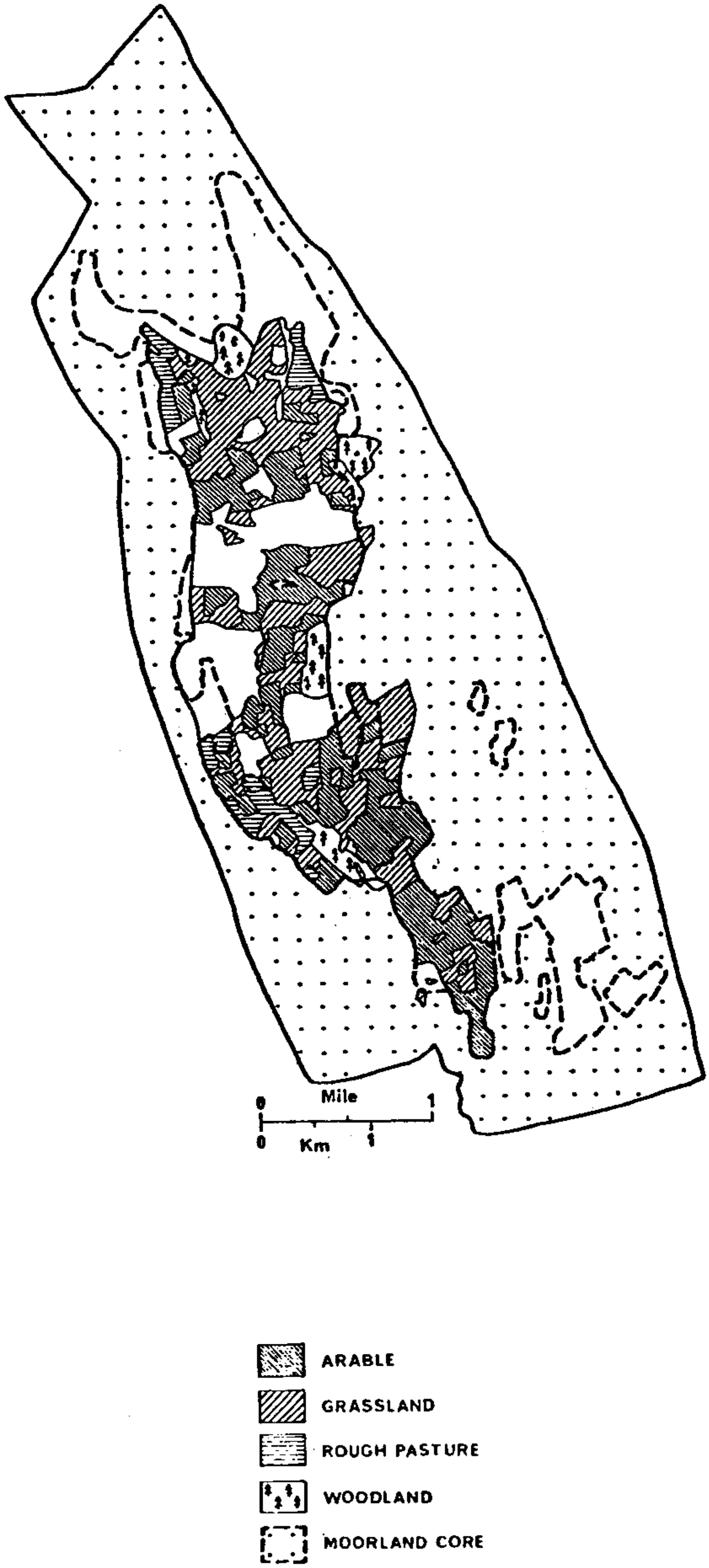
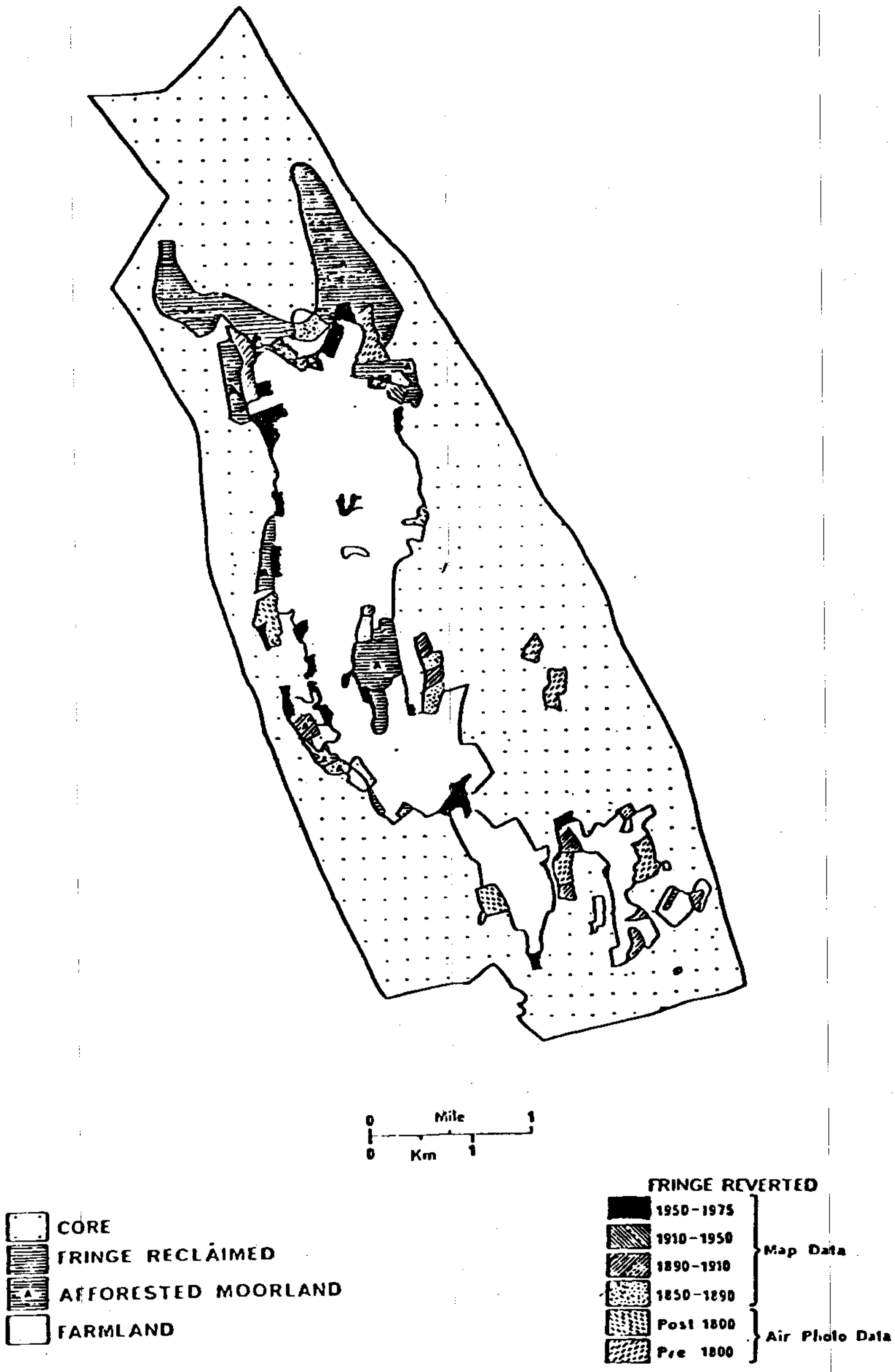
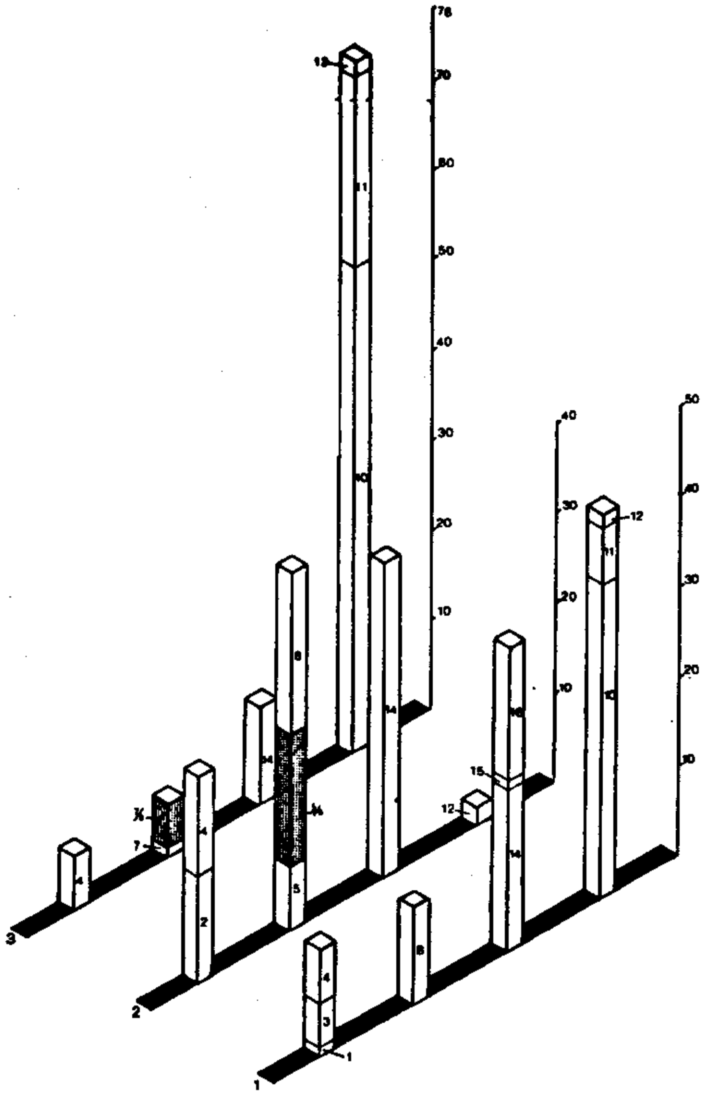


FIGURE 4.8 MOORLAND CORE, FRINGE AND FARMLAND - BRANSDALE



# FIGURE 4.9 VEGETATION CLASS FREQUENCY AT MAIN SITES - BRANSDALE

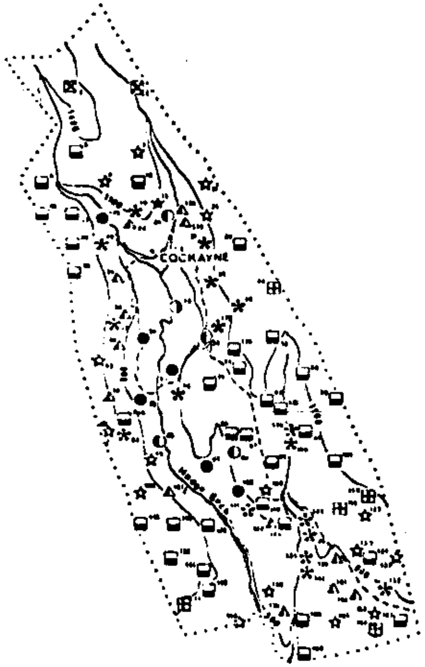


| Vegetation Group | Class | | % Main Sites in Vegetation Class 1 | 2 | 3 |
|---|---|---|---|---|---|
| Improved Pastures | 1 | Lolium/Holcus/Pteridium | 1 | - | - |
| | 2 | Lolium Grassland | - | 12 | - |
| | 3 | Lolium/Trifolium | 5 | - | - |
| | 4 | Herb rich Lolium Grassland | 6 | 11 | 6 |
| Rough Pastures | 5 | Agrostis/Juncus | - | 7 | - |
| | 7 | Agrostis/Holcus | - | - | 1 |
| | 8 | Festuca/Agrostis | 11 | 18 | - |
| | 5/6 | Agrostis/Juncus or Festuca/Juncus | - | 15* | - |
| | 7/8 | Agrostis/Holcus or Festuca/Agrostis | - | - | 5* |
| Grassy Heaths | 14 | Festuca/Vaccinium | 18 | 35 | 11 |
| | 15 | Festuca/Nardus/Vaccinium | 1 | - | - |
| | 16 | Festuca/Nardus/Molinia | 15 | - | - |
| Shrubby Heaths | 10 | Vaccinium/Calluna | 35 | - | 54 |
| | 11 | Nardus/Sphagnum/Calluna | 6 | - | 21 |
| | 12 | Eriophorum/Calluna | 2 | 2 | 2 |

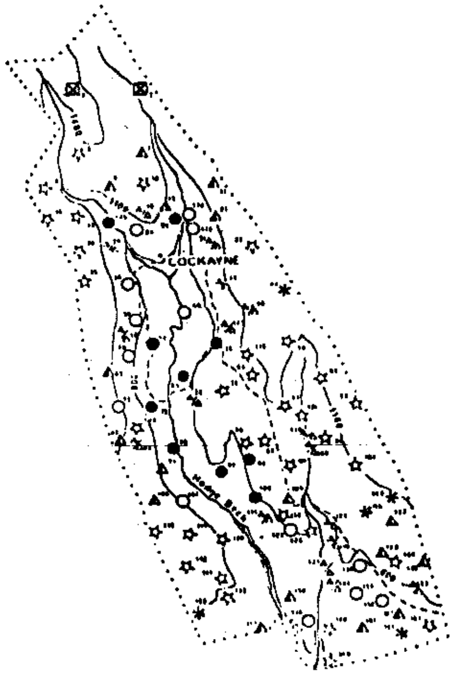
1. Recorded Main Sites, 1977.
2. Predicted Changes at Main Sites if Agriculture Increased, 10 + years.
3. Predicted Changes at Main Sites if Agriculture Decreased, 10 + years.

Under a regime involving intensification of agriculture Class 16, Festuca/Nardus/Molinia, could move towards either Class 5, Agrostis/Juncus, or the closely related Class 6, Festuca/Juncus. Similarly, with a reduction in the level of agricultural activity, Class 3, Lolium/Trifolium could move towards Class 7, Agrostis/Holcus or Class 8, Festuca/Agrostis. These changes are indicated on the relevant columns of the histogram by the shaded areas.

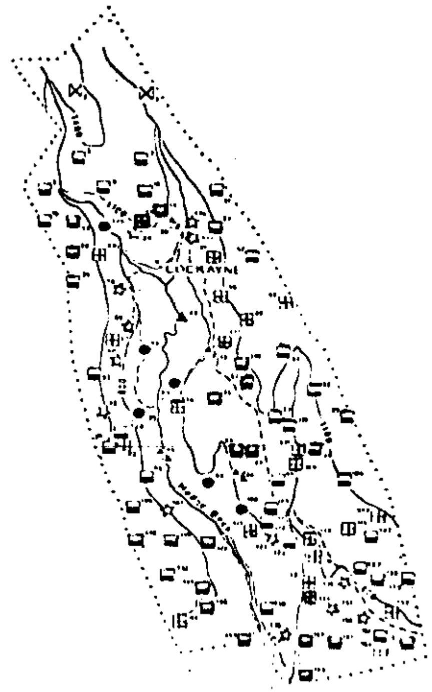
FIGURE 4.10 LOCATION AND CLASSIFICATION OF VEGETATION MAIN SITES - BRANSDALE




1977

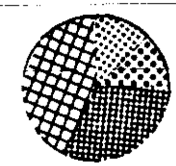


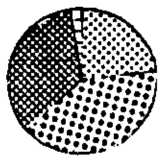

Predicted if Agriculture Increased

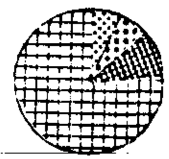



Predicted if Agriculture Decreased

Overall Frequencies of Vegetation Groups







KEY TO FIGURE 4.10

| | | |
|---|---|---|
| Group 1. Improved Pastures | Class 1 : | Lolium/Holcus/Pteridium |
| | Class 2 : | Lolium |
| | Class 3 : | Lolium/Trifolium |
| | Class 4 : | Herb – rich Lolium |
| Group 2. Rough Pastures | Class 5 : | Agrostis/Juncus |
| | Class 6 : | Festuca/Juncus |
| | Class 7 : | Agrostis/Holcus |
| | Class 8 : | Festuca/Agrostis |
| Group 3. Grassy Heaths | Class 14: | Festuca/Vaccinium |
| | Class 15: | Festuca/Nardus/Vaccinium |
| | Class 16: | Festuca/Nardus/Molinia |
| Group 4. Shrubby Heaths | Class 9 : | Calluna/Molinia/Vaccinium |
| | Class 10: | Vaccinium/Calluna |
| | Class 11: | Nardus/Sphagnum/Calluna |
| | Class 12: | Eriophorum/Calluna |
| | Class 13: | Calluna |

KEY TO FIGURES 4.10 AND 4.11

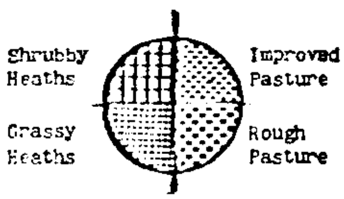
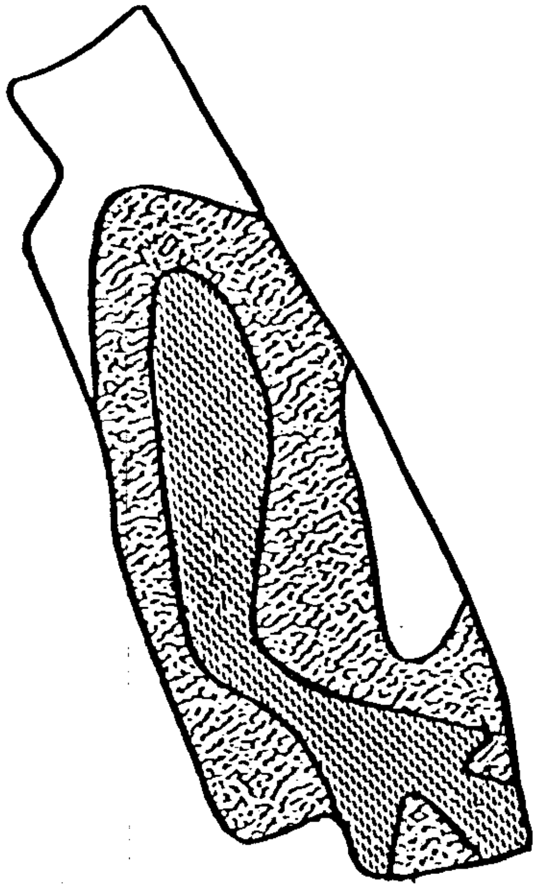


FIGURE 4.11 LAND GROUP-VEGETATION GROUP ASSOCIATIONS-BRANSDALE



VEGETATION GROUP FREQUENCIES AT SITES IN LAND GROUPS

PREDICTED CHANGES AT MAIN SITES

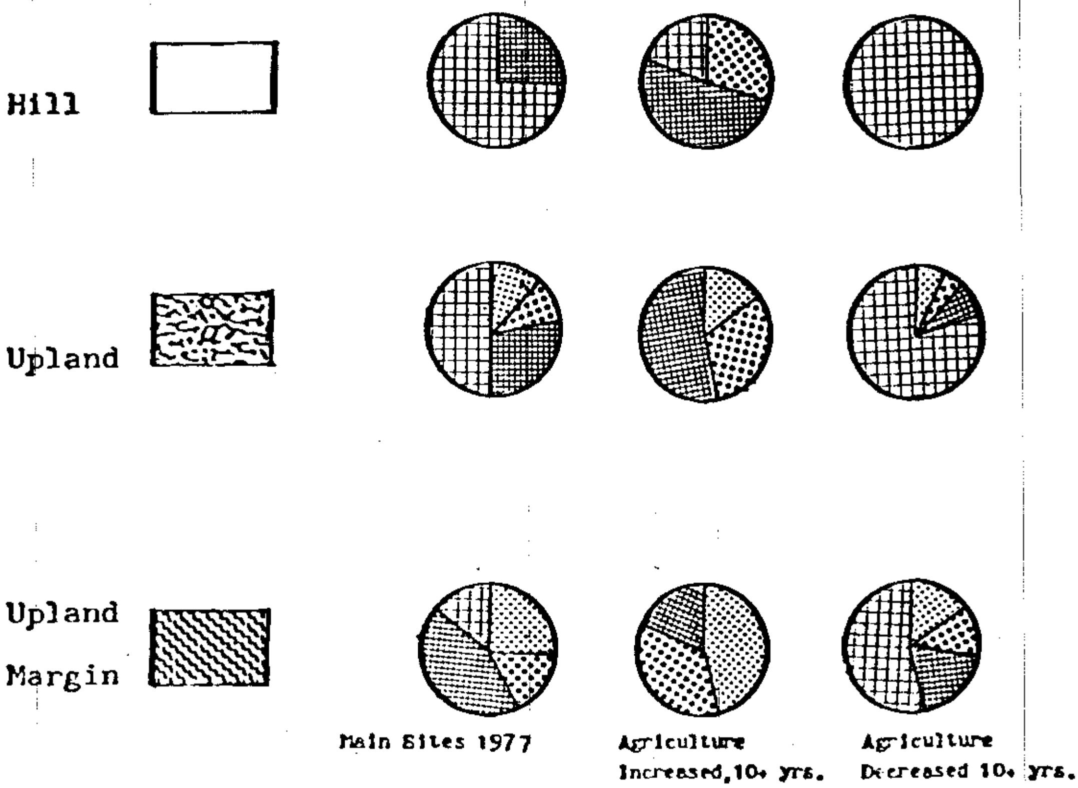
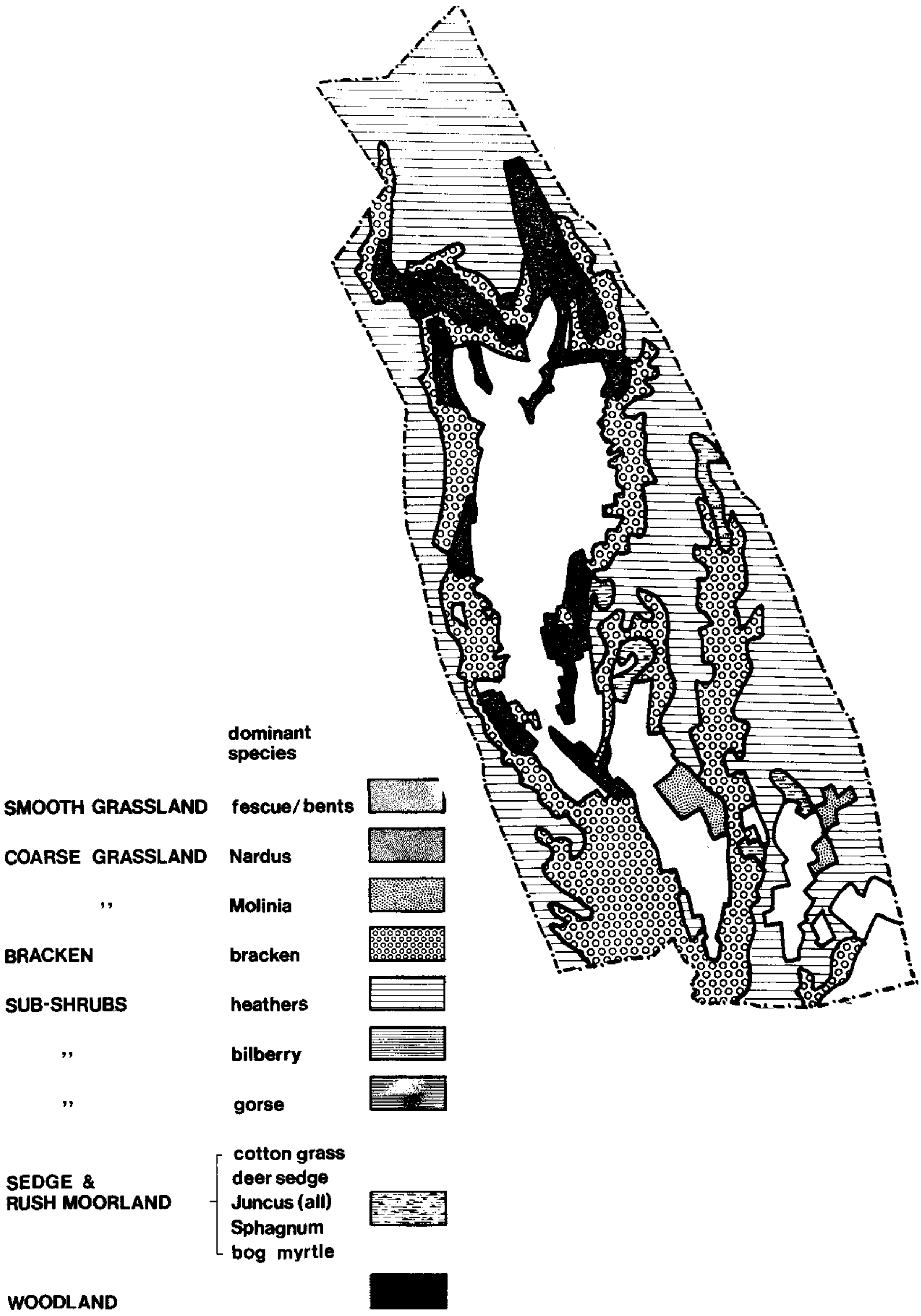
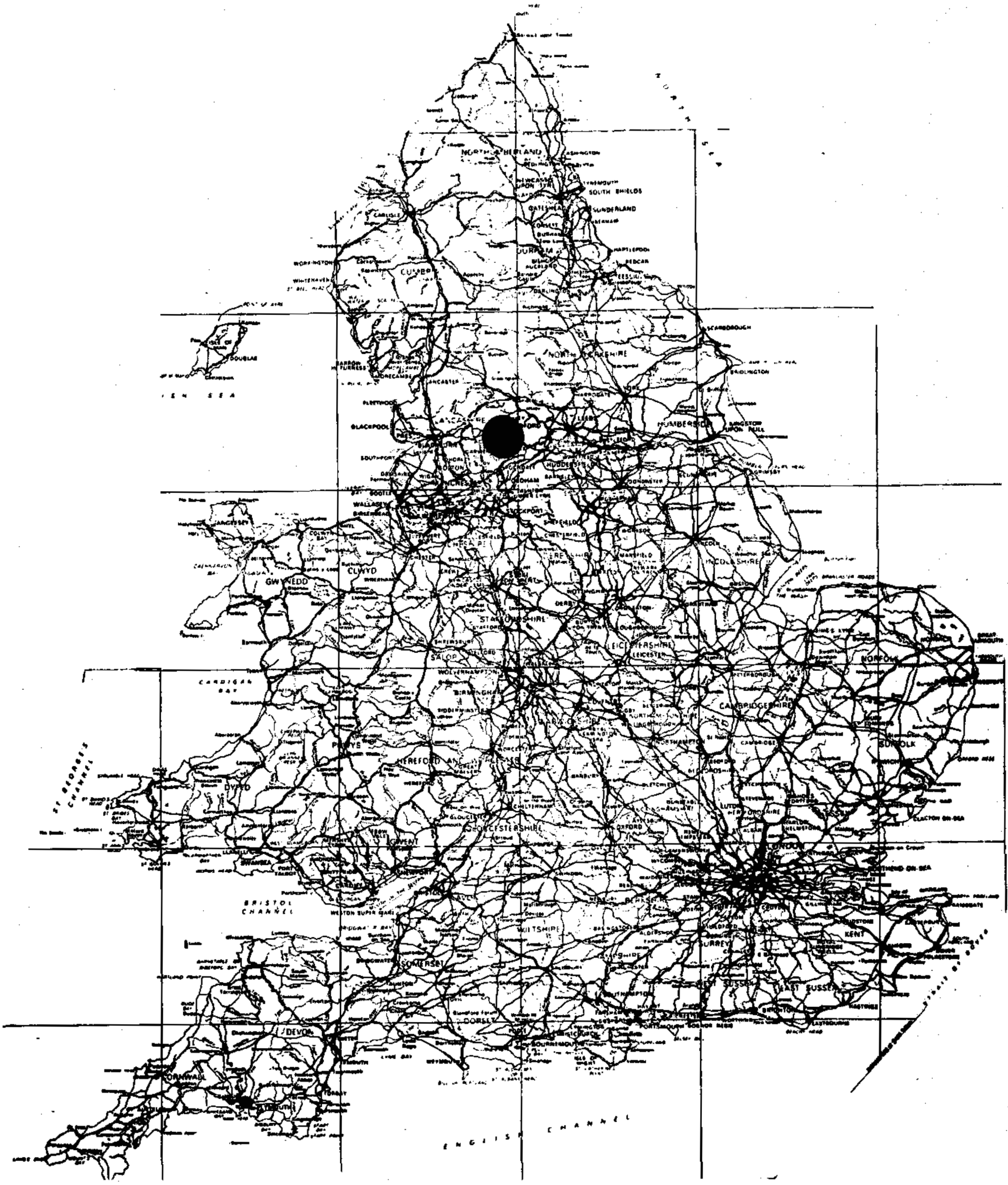


FIGURE 4.12 UPLAND LANDSCAPES STUDY VEGETATION MAP OF BRANSDALE

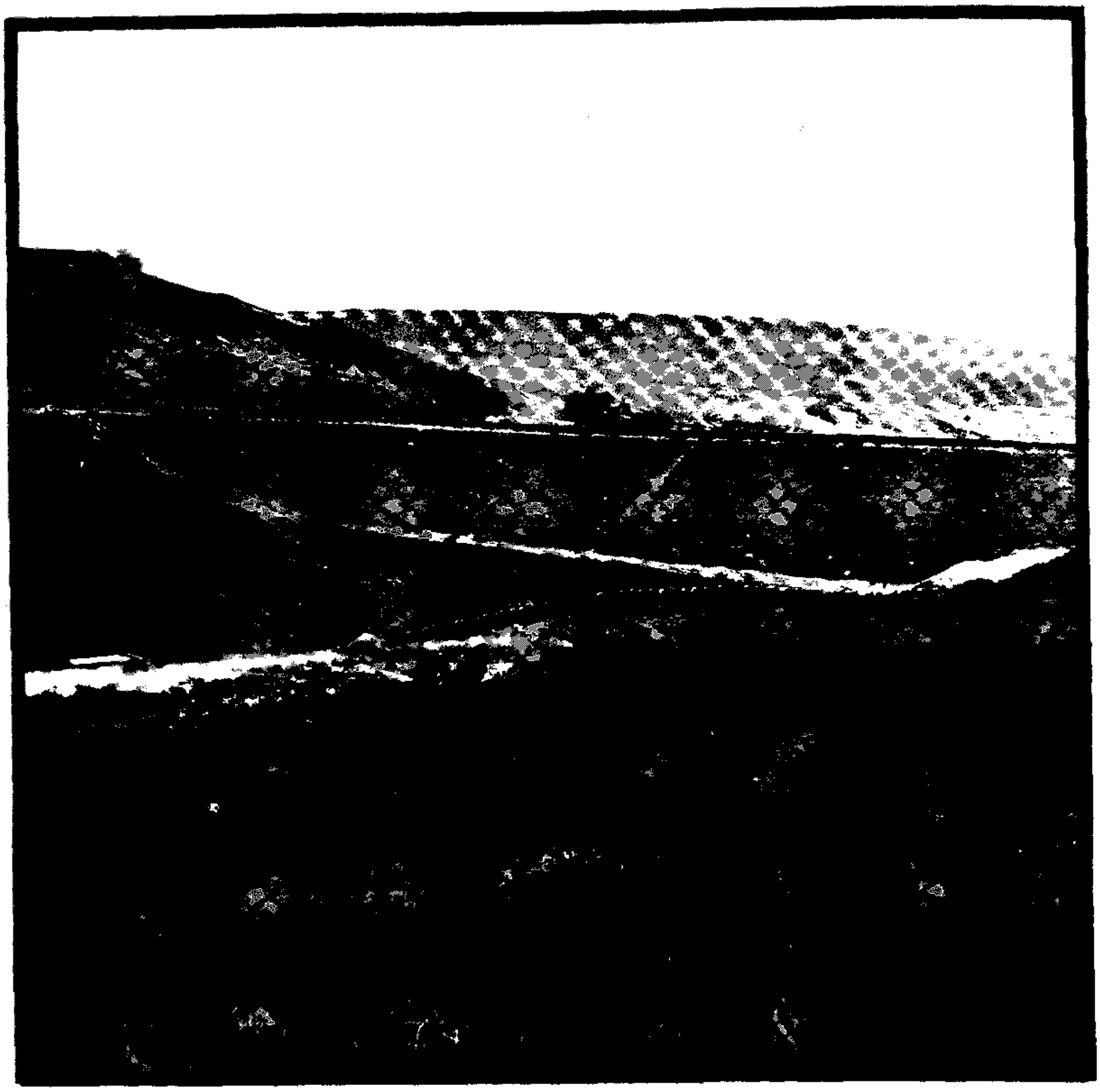



(Map by Geoffrey Sinclair, Environmental Information Services)

# HEPTONSTALL

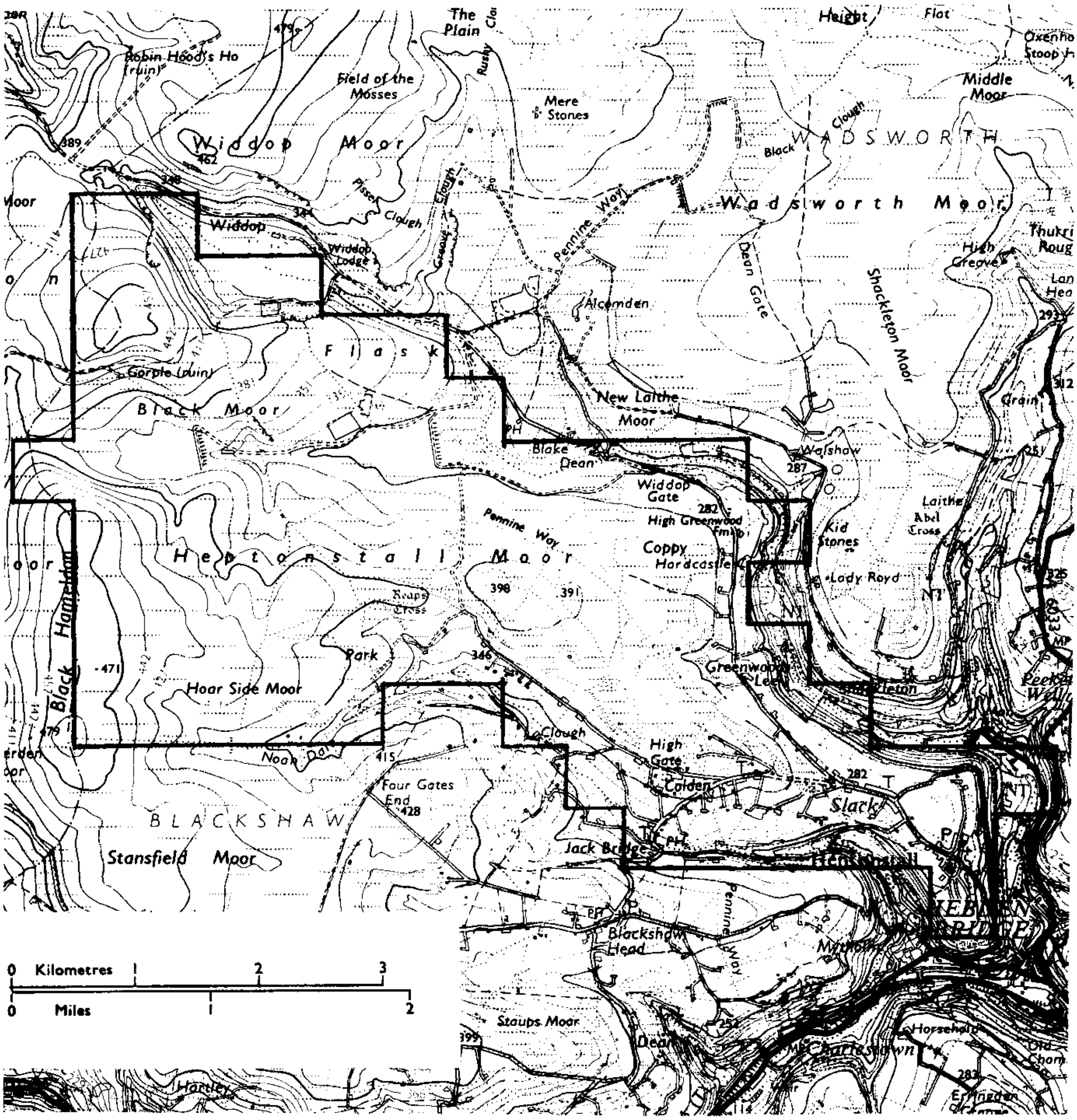


HEPTONSTALL - PLATE 1



In the mid-distance is the earth dam of Widdop Reservoir on the northern boundary of the study area. Relatively heavily-grazed grassland on the drier embankment contrasts with relatively lightly-grazed wetter rough pasture vegetation in the foreground (Festuca/Juncus grassland, class 6). Around the reservoir is abandoned farmland with a trial conifer plantation. The skyline ridge carries mainly Eriophorum/Calluna shrubby heath, class 12, and other shrubby heaths.
(Photo by J.Dale)

FIGURE 5.1 THE STUDY AREA OF HEPTONSTALL



# STUDY AREA 5: HEPTONSTALL, WEST YORKSHIRE

## PHYSICAL ENVIRONMENT

The study area of Heptonstall (Figure 5-1) covering 23 $km^2$, is situated in the Southern Pennine region between Burnley and Halifax. At its eastern edge the village of Heptonstall is perched above the town of Hebden Bridge (Part I, Plate 8). The parish extends northwestwards over rising moorland (Plate 1 and Part I, Plate 9) to its western edge on the Pennine watershed and the Yorkshire-Lancashire county boundary at Black Hameldon. Altitudes between 244 and 427 m (800-1 400 ft) dominate almost the whole area, with small sectors of lower ground on the eastern margin and of higher land in the extreme west (Figure 5-2). Gentle and moderate slopes (<11°) characterise most of the area (Plate 1), but steep slopes flank the eastward draining valleys of the Colden and Hebden waters which form, or are close to, the parish boundaries in the east (Part I, Plate 8).

Climatically, in relation to the localities examined in this study, Heptonstall is classifiable as being moderately cold and wet (Part I, 2.32). The annual average of daily sunshine hours is 3.25, with mean daily temperatures for the area in January and October estimated as 1.5 and 8.7°C respectively, while the annual average of days with snow lying is given as 20. Heptonstall falls entirely within the fairly high rainfall category (1 201-1 600 mm, c. 48-64 in pa). The length of growing season estimated by Smith (1976) for the district which includes Heptonstall, at an average altitude of 287 m, is given as 209 days (16 April-11 November).

Geologically, the study area lies entirely on non-calcareous rocks of Carboniferous age in the Millstone Grit Group, a succession of shales and hard sandstones. The only drift cover mapped is a substantial sector with peat over the moorland plateau in the west. In conformity with the geological drift map, the national soil map shows the western half of the study area as dominated by Peat Soils with associated Peaty Gleys and Peaty Podzols. Over the eastern central sector a unit dominated by Peaty Gleys with associated Peat Soils, Gleys and Podzols is mapped, while around Heptonstall village there is a unit dominated by Podzolic Soils with associated Gleys, Brown Podzolic Soils and shallow rocky soils.

Agricultural land classification maps show the bulk of the area to be grade 5 with only small areas of rather better grade 4 land near the eastern margin.

Road and building distribution and the sectors with frequent field boundaries are shown in Figure 5-3. A through road passes close to the area's northern boundary but otherwise the moorlands cut off road access from the west, the road pattern being concentrated around the settlements of Heptonstall, Slack and Colden. Buildings are similarly concentrated, as is the sector in which intensive agricultural use is displayed by the field boundary pattern.

Land types identified in the study area (Figure 5-4) are dominantly in the 'upland' group (57% of the area) though there are hill and high plateau land types on the moorlands in the west, and some upland margin land in the settled, farmed sectors in the east.

## LAND-USE HISTORY

Heptonstall was historically a township of Halifax, one of the largest parishes in England (Hanson 1920), in the Manor of Wakefield. Early settlement concentrated on the broad shelf areas where massive Millstone Grit sandstones form a belt of gently sloping land between the high moorland and the deeply incut and originally thickly wooded valley slopes and floors. A modest start to agricultural improvement of the moorland in this area can be traced in records from the 12th century, when the Lords of the Manor of Wakefield founded 9 cattle 'vaccaries' on hillside benches with a southerly aspect. By the 13th century, some of the extensive enclosures made for summer cattle grazing had become subdivided into permanently occupied farms - a trend which soon gathered momentum. The settlement pattern in the Manor of Wakefield was well established by the late 13th century, and concentrated periods of moorland reclamation have been recognised from immediately before 1320 and in the late 15th century (Moorhouse 1979). Woodlands were carefully managed through this period and at least until the 17th century so as to sustain the production of timber and other woodland products. From the 16th to the 17th centuries, stone took over locally from timber as a building material and the now characteristic stone walls replaced earlier hedges (Moorhouse _op cit_).

As early as the 16th century a growing proportion of the township's wealth was derived from home industries based on wool (Part I, 4.36). The Halifax Act of 1555 referred to 'the great 'wasts' and moors, where the fertility of ground is not apt to bring forth any corn nor good grass, but in rare places', and went on to describe how the population had created a home industry in which wool was bought in the market and carried 'to their houses, some 3, 4, 5 and 6 miles off, upon their heads and backs, and so to make and convert the same either into yarn or cloth, and to sell the same, and so buy more wool'. An increase in population was associated with the establishment and growth of this home woollen industry, leading to pressure on food supplies and thus to intensification of land-use and management on the more accessible and amenable parts of the moors. On convenient unimproved moorland the farmers claimed rights and privileges including those of sheep pasture, peat cutting, and stone gathering for building and repairs. Exercising their limited rights to enclose the moorland, various Lords of the Manor increased their income by allowing their tenants to make small enclosures on the moor.

According to Crump (1939), the early 19th century was the 'Golden Age of Halifax farming', but as the centres of industry shifted from the uplands (Part I, 4.36) their population declined. Not only did hand weaving and combing finally disappear, losing sources of income for the upland settlements, but the small farmer lost both his immediate market for farm produce and a source of employment for his children as the mills and warehouses on the Pennine streams closed.

The area of land ploughed for oats and potatoes may have reached a maximum during the years up to 1870, after which there was a rapid decline. Although the uplands did not produce wheat, the lower prices for this grain as world wheat sources became available led to the end of oats grown in the uplands as a bread-corn, so that by 1900 hardly any oats were still grown in the Halifax area. Even the more accessible farmland suffered from neglect and the reversion of improved grasslands towards moor.

In the 20th century, between 1900 and 1965, the agricultural statistics given in Part I, Figures 4-5 and 4-6, show that cattle numbers have remained essentially unchanged in this area, and that sheep numbers have remained at a similar level since 1920. ULS (1980) suggest a significant fall in the area of crops and grass between 1850 and 1977, probably largely related to reservoir construction , but that no change in woodland extent has occurred between these dates. The survey of farm conditions and farmers' attitudes by ULS (1979) shows that energy and effort are there but farm size and situation prevent almost all the farm units from being truly economically viable as full time businesses, with particular difficulties now facing dairying, their main enterprise.

Heptonstall was surveyed by the Ordnance Survey first in 1850, and revisions of the published maps were made in 1890, 1900, 1934 and 1958. From these sources and air photographs Figure 5-5 shows the distribution of farmland, moorland core and moorland fringe since about 1800. The moorland core occupies 1 300 ha, and the moorland fringe 110 ha, of which about 20 ha represent those parts of the moorland that have been reclaimed for agriculture during the past 150 years or so. In Heptonstall, the moorland fringe has been concentrated in the upland and steep upland land types. These contain 53 and 27% of the moorland fringe, but comprise 29 and 14% respectively of the area.

Early botanical records investigated by Moss (1900) recorded a more rich and diverse local flora than that which exists today. Air pollution from the Lancashire cotton towns to the west may have been the cause of losing some species but the chief losses were caused by cultivation, drainage, burning and the reservoir schemes.

Apart from agriculture in the small farms in the east, a complex of other land-uses and interests now affects Heptonstall. Houses in the village and its subsidiary hamlets are being bought by people working in, or retired from, adjacent towns so that a resident community not dependent on the immediate locality for its livelihood, but often with a strong interest in its environment, is developing. From the recreation standpoint the Pennine Way long distance footpath runs approximately north-south across the centre of the area, bringing active recreation into the land-use picture. There are conservation interests directed to protection of the valley woodlands, and also of the industrial and domestic architecture of Heptonstall itself. Use of the moorland as a water supply catchment for the Gorple Reservoirs (Plate 1 and see Part I, 4-32 and Plate 9) is of major importance. Finally, but importantly, management of moorland by the Saville Estate is concerned with maintaining grouse shooting as a sporting enterprise.

## VEGETATION

The plant species present at 70 vegetation main sites were recorded in 1977 as described in Chapter 3 in Part I of this report. The locations and classification of the main sites are given in Figure 5-7 and the frequency of vegetation classes at these sites is shown in Figure 5-6.

In Heptonstall a marked vegetation contrast occurs across a boundary that runs approximately from Widdop Gate in the north to Clough in the south. West of this line the vegetation is essentially moorland in character, while to the east it is mainly improved and rough pastures. Moorland vegetation is more frequent than pastures at recorded sites, shrubby heaths (Part I, 3.18) accounting for 54% of sites and grassy heaths (Part I, 3.16) a further 11%. Eriophorum/Calluna heath, class 12, (27%) (Part I, Plate 41) and Vaccinium/Calluna heath, class 10, (23%) are the most prominent shrubby heath classes, others in this group making only a minor contribution. Of the improved pastures (Part I, 3.12), herb-rich Lolium grassland, class 4, (12%) and Lolium grassland, class 2, (9%) are dominant, and of the rough pastures (Part I, 3.14), Festuca/Agrostis grassland, class 8, (7%) is most frequent. Heavily and lightly grazed phases of rough pasture class 6, Festuca/Juncus grassland, are illustrated in Part I, Plates 27, 28 and 41.

Vegetation was also recorded at 14 woodland sites. These are classifiable predominantly as lowland acid woodlands (Part I, Table 3-4), which are located along the valley sides of Hebden Water and to a lesser degree, Colden Water. Dry acid oak woodland (7 of the 14 sites) is the commonest woodland class. Two sites are classified as upland acid woodlands.

Table 5-1 gives the association between vegetation classes at main sites in the grassland-moorland range and land types, while Figure 5-8 sketches the relationship between vegetation groups and land groups. Shrubby heaths, which were the only vegetation classes recorded at sites in the hill land group, occur widely also in the upland land group. Improved pasture sites are mainly located in the upland and upland margin land types.

## POTENTIAL VEGETATION CHANGE

The presence of water supply reservoirs has placed contraints on land-use over the adjacent moorland, and caused formerly improved land in their immediate vicinity to be abandoned. Moorland management has limited the grazing pressure in the interests of the water catchment, and another factor maintaining the moorland is the management requirement to ensure good heather regrowth for grouse. These management aspects, coupled with the natural environment of a peat cover over the western part of the study area under a relatively high rainfall, have sustained a sharp contrast between the western moorland and eastern farmland vegetation elements. Ninety per cent of the 'rough grazing' in Heptonstall is considered by ULS (1979) to fall in the generally unimprovable category and about 40% has 'some grazing value', using the criteria for hill land classification developed by the Agricultural Development and Advisory Service Resource Planning Group. Only small forest planting trials have taken place in the area. Simple assumptions of forestry potential (Part I, Table 5-19) give a high proportion of the area (50%) as of forestry potential, even after 40% is allocated to agriculture. Without necessarily accepting a potential of this size, if the Forestry Commission trials show airborne pollution to be no longer a limitation to conifer growth, then there is clearly an option for forestry expansion.

Herb-rich Lolium grassland, class 4, in the improved pasture group, is the most frequent vegetation class in the essentially agricultural southeast. Vaccinium/Calluna heath, class 10, and Eriophorum/Calluna heath, class 12, are, as noted above, the most frequently represented at the recorded sites. Trends of predicted vegetation change discussed in Part I (5.74-5.77 and Figure 5-4), summarised in Appendix 2, propose that under a declining agriculture the improved pasture of class 4 and the shrubby heaths of classes 10 and 12 would remain unchanged. Under an intensification of agricultural management with increased stocking rates the shrubby heaths of class 10 would tend to move to grassy heath, possibly Festuca/Vaccinium heath, class 14, whilst the wetter Eriophorum/Calluna heath of class 12 would not be affected. Rough pastures would be most vulnerable, moving towards improved pasture grassland under intensified management or to grassy heath with declining agricultural input. These predictions give resultant frequencies of vegetation classes that are included in Figure 5-6, and changes at individual sites shown in Figure 5-7.

In making these predictions of the outcome of moderate levels of agricultural intensification or decline on the vegetation classes at recorded main sites, local factors which could modify the general trends have not been able to be taken into consideration. With this reservation, the broad predictions for a maximum level of vegetation change through gradual management modification are that intensification of agriculture in Heptonstall could increase improved pastures at the recorded sites from 25 to 35% and grassy heaths from 11 to 27%, these changes being offset by halving the sites with shrubby heaths from 54 to 27%. Rough pastures would probably remain substantially unaltered in frequency but would occur at different locations. In a situation of agricultural decline, downward trends would occur in improved pastures (from 25% of recorded sites to 21%), rough pastures (from 10 to 5%), and grassy heaths (from 11 to 9%). The shrubby heaths would increase from 54 to 65% of sites.

On the intensified agricultural use predictions, 47% of the recorded sites would change their vegetation group, while in a declining agriculture situation, 26% of sites would change. An increase in agricultural intensity leading to gradual vegetation change is predicted therefore as likely to have a more widespread landscape effect on this area than decline would. This is a result of the already substantial frequency of shrubby heaths and improved pastures which would mainly be unaffected by agricultural decline.

The relationships between these predicted changes and land group distribution are included in Figure 5-8 (sketched from the detail of Figure 5-4). With an intensification of agriculture, main sites in the hill land sector are predicted as becoming approximately half grassy heaths and half shrubby heaths, rather than entirely shrubby heaths as at present. In the upland land, shrubby heaths would also decline and other vegetation groups increase, while sites in the upland margin would become around 80% improved pastures. In a declining agricultural situation the predictions would be for no change in the hill sector, and for a slight increase in heaths and decrease in pastures in the upland and upland margin sectors.

The ULS vegetation map of Heptonstall is reproduced as Figure 5-9. Correlation of ULS mapping units with ITE vegetation classes recorded at main sites in 1977 is set out in Table 5-2. Both 'coarse grassland/Molinia' and 'sedge and rush moorland' are prominent mapping units, and in these the recorded main sites are dominantly or entirely shrubby heaths. Table 4-3 shows the proportions of vegetation groups that could occur at the recorded sites in each ULS mapping unit, if the predictions of vegetation change after agricultural intensification or decline were followed. The overall impact of the predictions is limited in the most widespread mapping units.

## CONCLUSION

The water catchment policies of the Yorkshire Water Authority will continue to be a major controlling factor over the moorland of the western half of Heptonstall. Here the sporting interests of the Saville Estate will also help to ensure stable management. These factors suggest that the potential predicted changes from agricultural intensification are unlikely to be achieved and that the forestry option will not be pursued over the moorland. Such modification of the present situation as does take place is most likely to occur in the eastern half of the area. There the small agricultural holdings, which ULS indicates are generally under capitalised, will be under pressure due to national agricultural policies and market needs in the 1980s. Pig and poultry enterprises have had to be abandoned and now milk production is under threat. This suggests a possible general contraction in farm activity so that future farming could be less intensive than at present if the small units remain, or at a similar level if farm amalgamations lead to fewer but larger and more viable units. Farm decline could open up the argument for afforestation on declining farmland and its moorland fringe, with reversion initially moving the vegetation towards rough pastures and grassy heaths.

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TABLE 5-1 CORRELATION OF VEGETATION CLASSES AND LAND TYPES - HEPTONSTALL

| Vegetation Group and Class | | Land Group and Type: Hill | | | Upland | | | Upland Margin (6) |
|---|---|---|---|---|---|---|---|---|
| | | Steep Hill (1)* | Hill (3) | High Plateau (4) | Steep Upland (5) | Upland (7) | Upland Plateau (8) | |
| Improved Pastures | 1 | | | | 1 | | | |
| | 2 | | | | 1 | | | 5 |
| | 3 | | | | | 1 | | 1 |
| | 4 | | | | 1 | 6 | | 1 |
| Rough Pastures | 5 | | | | | 1 | | |
| | 6 | | | | | | | 1 |
| | 7 | | | | | | | 1 |
| | 8 | | | | 1 | 3 | | 1 |
| Grassy Heaths | 14 | | | | 1 | 1 | 2 | |
| | 15 | | | | | | | |
| | 16 | | | | 1 | 1 | | 1 |
| Shrubby Heaths | 9 | | | | | 1 | | |
| | 10 | 1 | 2 | 2 | 2 | 7 | 1 | 1 |
| | 11 | 1 | | | | 1 | | |
| | 12 | | 2 | 3 | 1 | 5 | 7 | 1 |
| | 13 | | | | | | | |

As number of sites of each vegetation class located in each land type.
* Land type numbers as used on computer maps, Figure 5-4.

TABLE 5-2 CORRELATION OF ULS VEGETATION MAPPING UNITS AND ITE VEGETATION CLASSES AT MAIN SITES - HEPTONSTALL

| ULS Mapping Unit | *Number of ITE* Main Sites in Area of ULS Unit | ITE Vegetation Class 1977 | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Improved Pastures | | | | Rough Pastures | | | | Grassy Heaths | | | Shrubby Heaths | | | | |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 14 | 15 | 16 | 9 | 10 | 11 | 12 | 13 |
| Smooth Grassland | | | | | | | | | | | | | | | | | |
| Coarse Grassland/*Nardus* | 4 | | | | | | | | 2 | 1 | | 1 | | | | | |
| Coarse Grassland/*Molinia* | 20 | | | | | 1 | | 1 | 1 | 3 | | | | 1 | 2 | 11 | |
| Bracken | 2 | | | | | | | | | | | | | 2 | | | |
| Sub-shrubs/Heathers | 5 | | | | | | | | | | | 1 | | 3 | | 1 | |
| Sub-shrubs/Bilberry | | | | | | | | | | | | | | | | | |
| Sub-shrubs/Gorse | | | | | | | | | | | | | | | | | |
| Sedge & Rush Moorland | 16 | | | | | | | | | | | | 1 | 8 | | 7 | |
| Farmland | 23 | 1 | 6 | 2 | 8 | | 1 | | 2 | | | 1 | | 2 | | | |

As number of recorded main sites in each ITE vegetation class that are located in each ULS unit

TABLE 5-3 PREDICTIONS OF CHANGE IN THE BALANCE OF VEGETATION GROUPS AT MAIN SITES LOCATED IN ULS MAPPING UNITS - HEPTONSTALL

| ULS Mapping Unit | ITE Vegetation Groups | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Improved Pastures | | | Rough Pastures | | | Grassy Heaths | | | Shrubby Heaths | | |
| | A | B | C | A | B | C | A | B | C | A | B | C |
| Smooth Grassland | | | | | | | | | | | | |
| Coarse Grassland/*Nardus* | | 2 | | 2 | 2 | | 2 | | 2 | | | 2 |
| Coarse Grassland/*Molinia* | | 3 | | 3 | 3 | 1 | 3 | 3 | 2 | 14 | 11 | 17 |
| Bracken | | | | | | | | 2 | | 2 | | 2 |
| Sub-shrubs/Heathers | | | | | 1 | | 1 | 3 | | 4 | 1 | 5 |
| Sub-shrubs/Bilberry | | | | | | | | | | | | |
| Sub-shrubs/Gorse | | | | | | | | | | | | |
| Sedge & Rush Moorland | | | | | | | | 9 | | 16 | 7 | 16 |
| Farmland | 17 | 20 | 14 | 3 | 1 | 3 | 1 | 2 | 3 | 2 | | 3 |

As number of recorded main sites falling in each ITE vegetation group that are located in each ULS unit

A - situation as recorded 1977
B - predicted balance of vegetation if agricultural use increased, 10+ yrs
C - predicted balance of vegetation if agricultural use decreased, 10+ yrs

FIGURE 5.2 ALTITUDE SECTORS - HEPTONSTALL

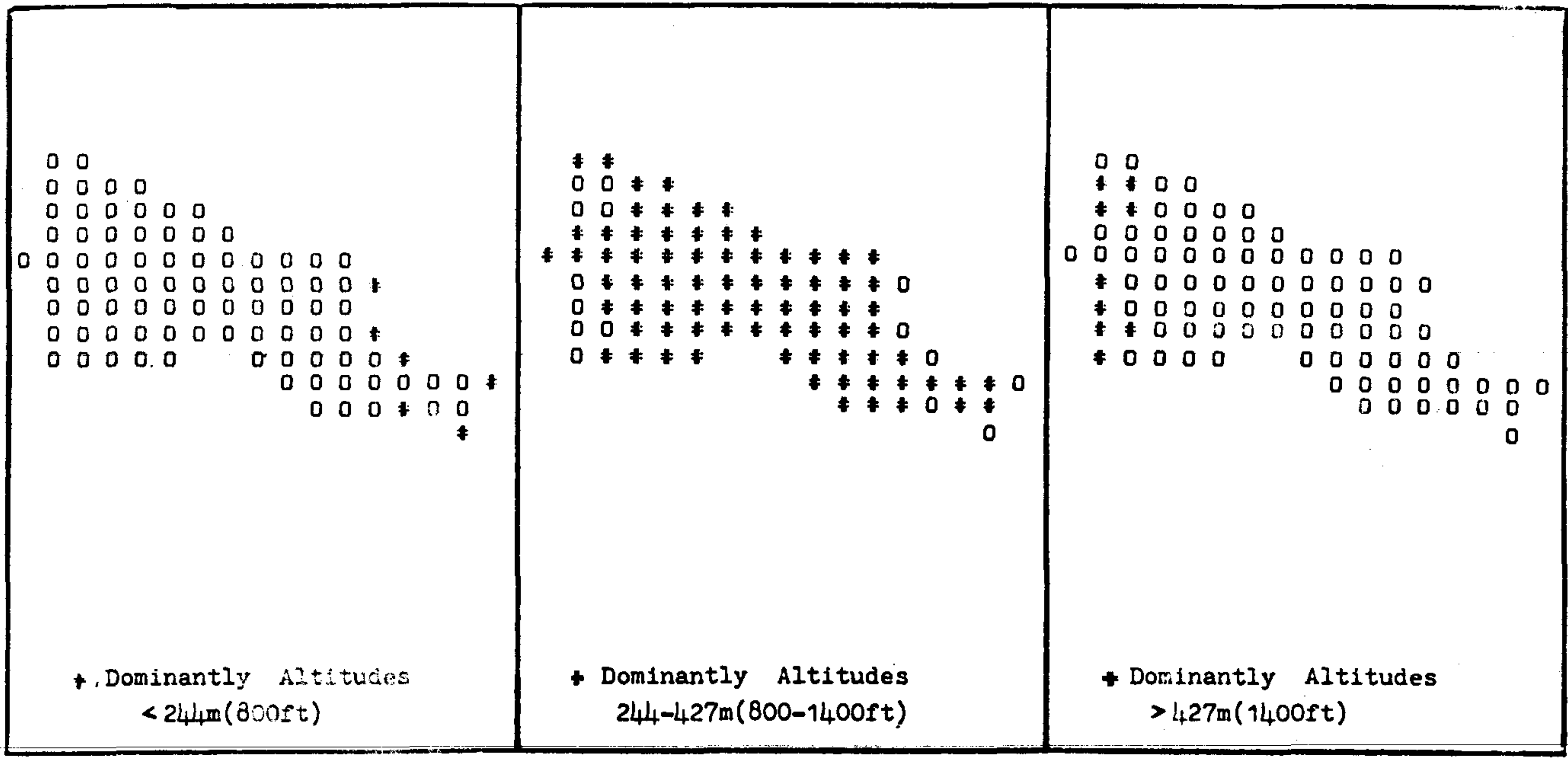


FIGURE 5.3 TOPOGRAPHIC CHARACTERISTICS - HEPTONSTALL

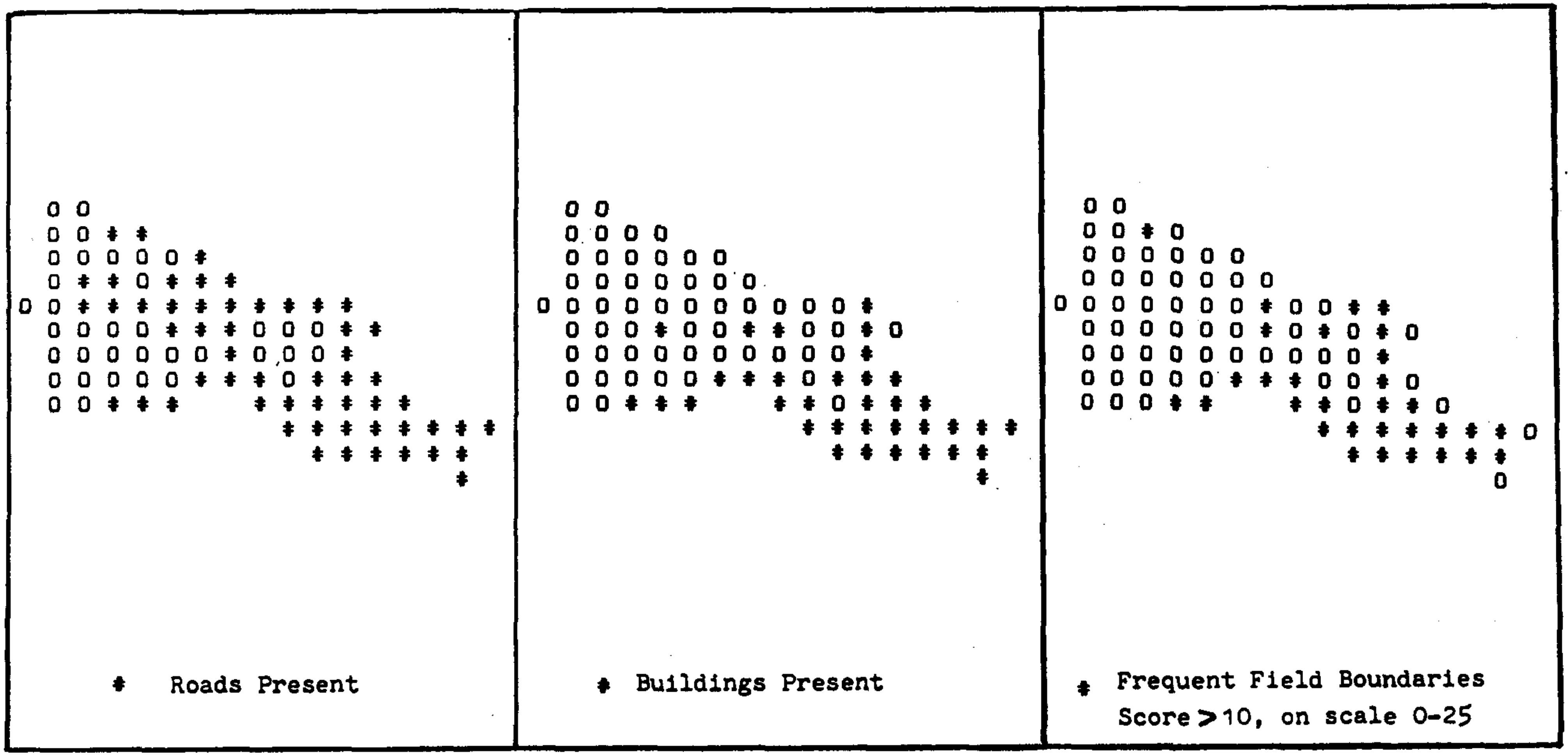


FIGURE 5.4 LAND TYPES - HEPTONSTALL

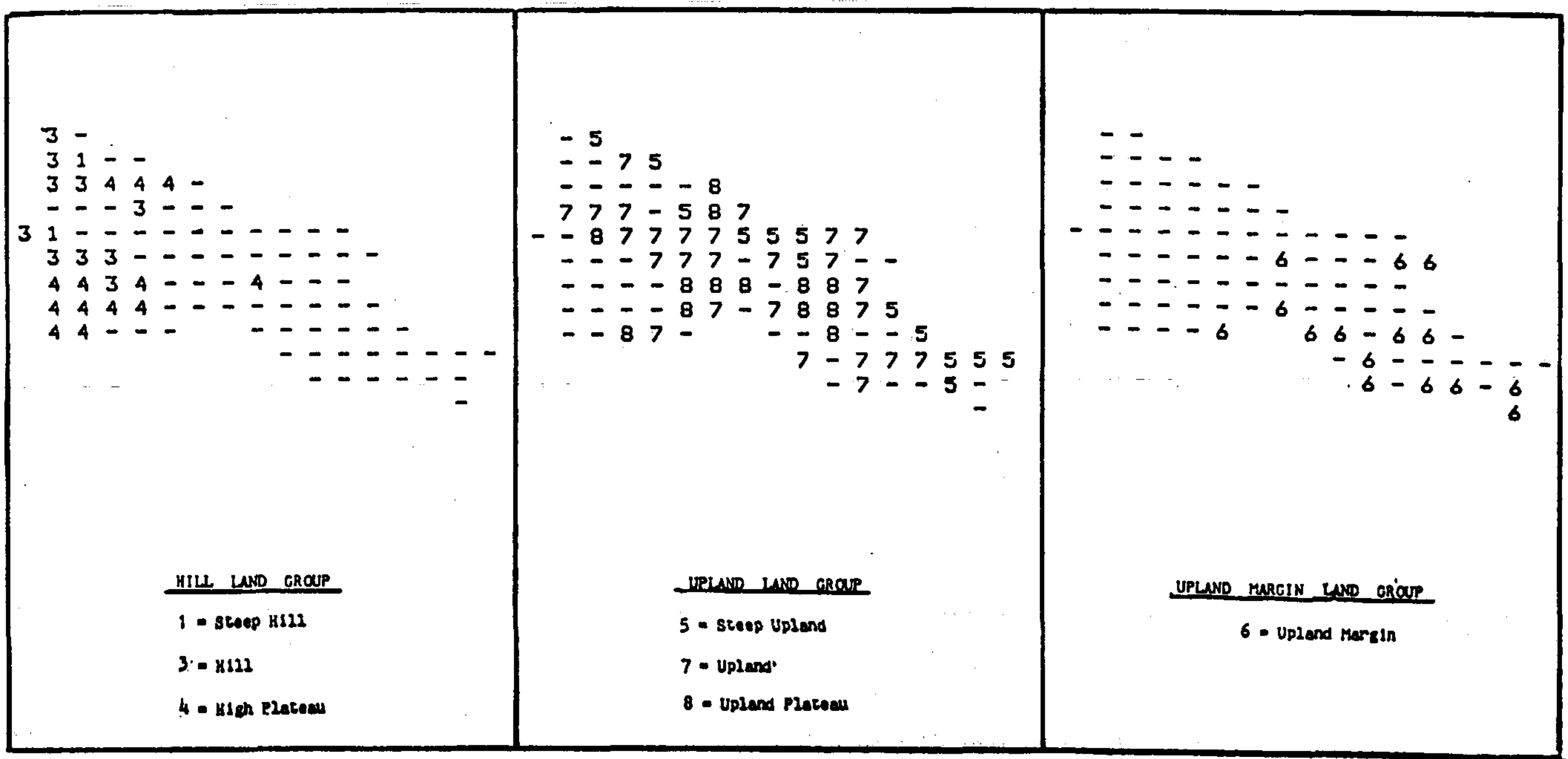
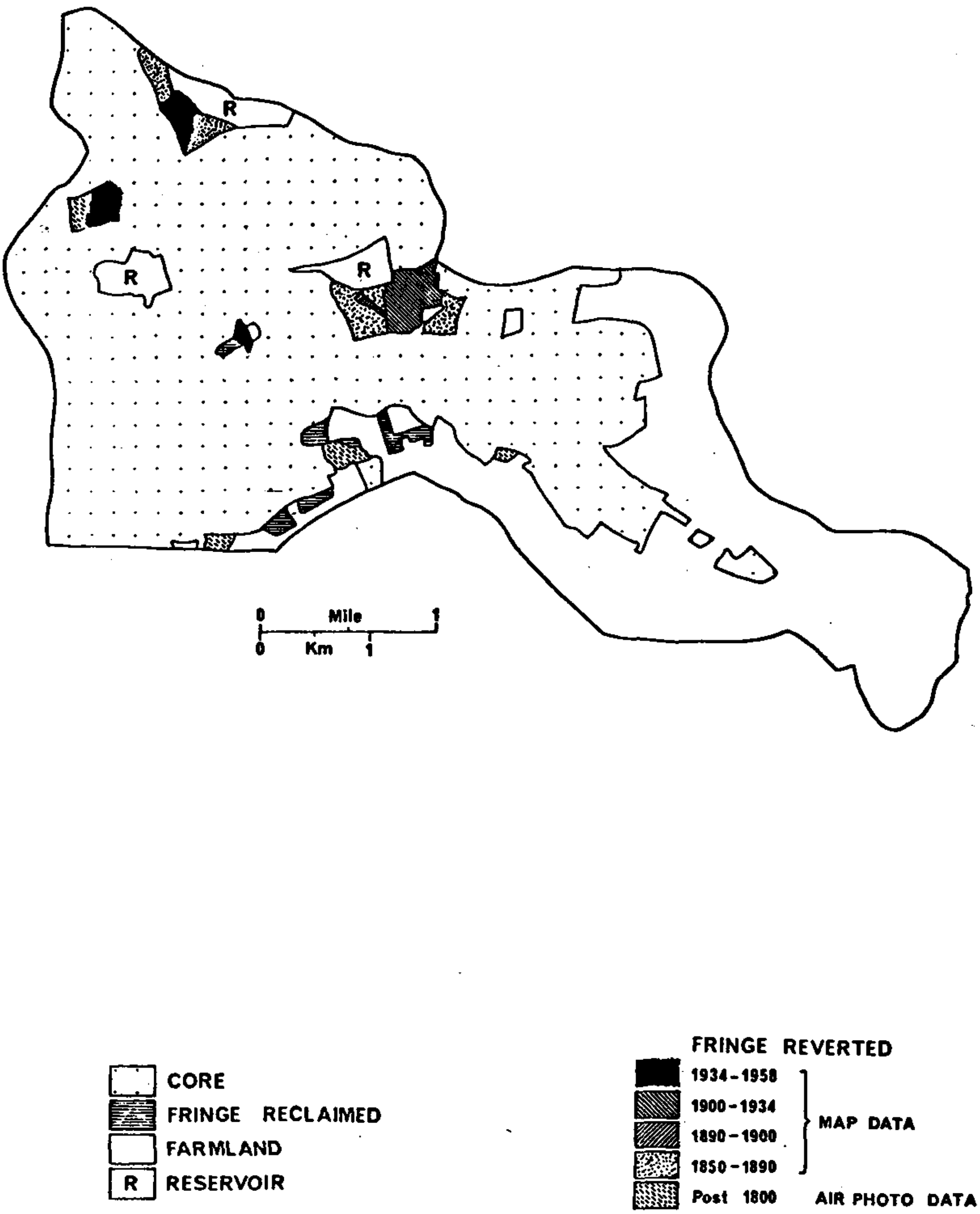
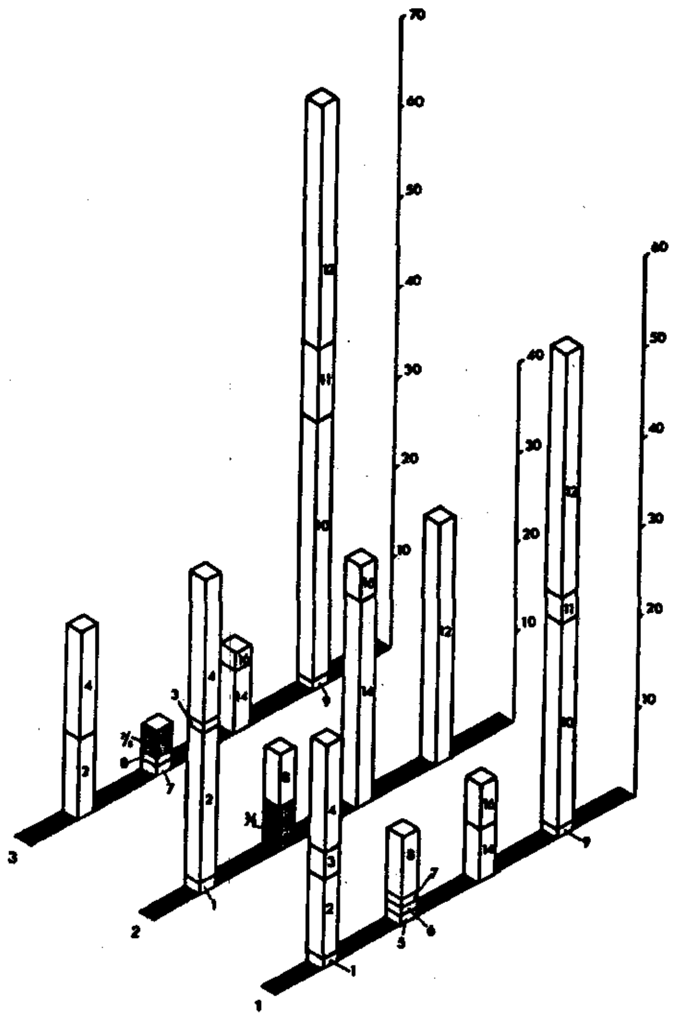


FIGURE 5.5 MOORLAND CORE, FRINGE AND FARMLAND - HEPTONSTALL



# FIGURE 5.6 VEGETATION CLASS FREQUENCY AT MAIN SITES - HEPTONSTALL

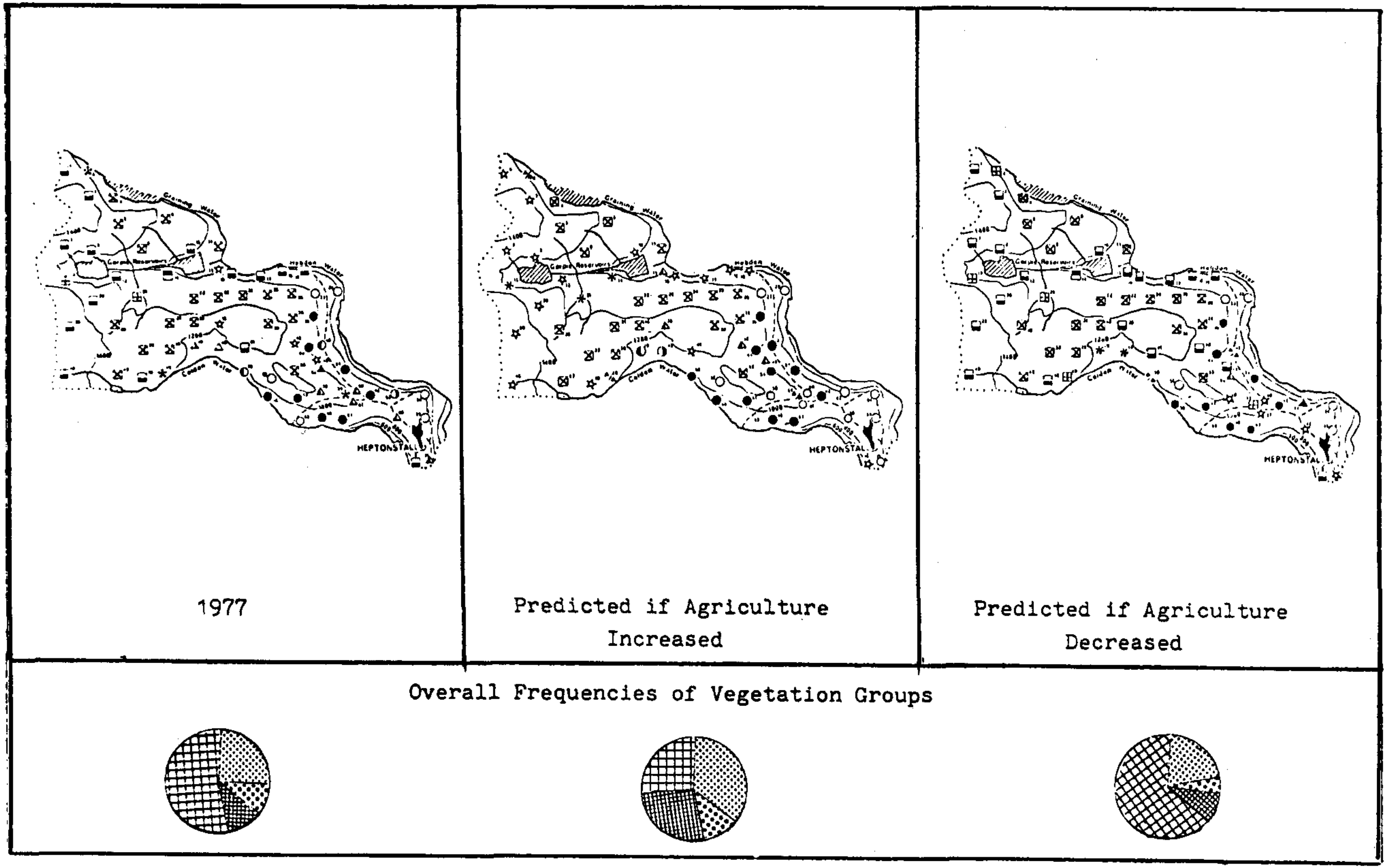


| Vegetation Group | Class | | % Main Sites in Vegetation Class 1 | 2 | 3 |
|---|---|---|---|---|---|
| Improved Pastures | 1 | Lolium/Holcus/Pteridium | 1 | 1 | - |
| | 2 | Lolium Grassland | 9 | 17 | 9 |
| | 3 | Lolium/Trifolium | 3 | 1 | - |
| | 4 | Herb rich Lolium Grassland | 12 | 16 | 12 |
| Rough Pastures | 5 | Agrostis/Juncus | 1 | - | - |
| | 6 | Festuca/Juncus | 1 | - | - |
| | 7 | Agrostis/Holcus | 1 | - | 1 |
| | 8 | Festuca/Agrostis | 7 | 6 | 1 |
| | 5/6 | Agrostis/Juncus or Festuca/Juncus | - | 5* | - |
| | 7/8 | Agrostis/Holcus or Festuca/Agrostis | - | - | 3* |
| Grassy Heaths | 14 | Festuca/Vaccinium | 6 | 23 | 7 |
| | 16 | Festuca/Nardus/Molinia | 5 | 4 | 2 |
| Shrubby Heaths | 9 | Calluna/Molinia/ Vaccinium | 1 | - | 1 |
| | 10 | Vaccinium/Calluna | 23 | - | 29 |
| | 11 | Nardus/Sphagnum/Calluna | 3 | - | 8 |
| | 12 | Eriophorum/Calluna | 27 | 27 | 27 |

1. Recorded Main Sites, 1977
2. Predicted Changes at Main Sites if Agriculture Increased, 10 + years.
3. Predicted Changes at Main Sites if Agriculture Decreased, 10 + years.

* Under a regime involving intensification of agriculture Class 16, Festuca/Nardus/Molinia, could move towards either Class 5, Agrostis/Juncus or the closely related Class 6, Festuca/Juncus. Similarly, with a reduction in the level of agricultural activity Class 3, Lolium/Trifolium could move towards Class 7, Agrostis/Holcus or Class 8, Festuca/Agrostis. These changes are indicated on the relevant columns of the histogram by the shaded areas.

FIGURE 5.7 LOCATION AND CLASSIFICATION OF VEGETATION MAIN SITES - HEPTONSTALL



## KEY TO FIGURE 5.7

| | | |
|---|---|---|
| **Group 1.** Improved Pastures | Class 1 : | Lolium/Holcus/Pteridium |
| | Class 2 : | Lolium |
| | Class 3 : | Lolium/Trifolium |
| | Class 4 : | Herb — rich Lolium |
| **Group 2.** Rough Pastures | Class 5 : | Agrostis/Juncus |
| | Class 6 : | Festuca/Juncus |
| | Class 7 : | Agrostis/Holcus |
| | Class 8 : | Festuca/Agrostis |
| **Group 3.** Grassy Heaths | Class 14: | Festuca/Vaccinium |
| | Class 15: | Festuca/Nardus/Vaccinium |
| | Class 16: | Festuca/Nardus/Molinia |
| **Group 4.** Shrubby Heaths | Class 9 : | Calluna/Molinia/Vaccinium |
| | Class 10: | Vaccinium/Calluna |
| | Class 11: | Nardus/Sphagnum/Calluna |
| | Class 12: | Eriophorum/Calluna |
| | Class 13: | Calluna |

## KEY TO FIGURES 5.7 AND 5.8

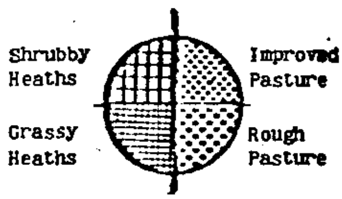
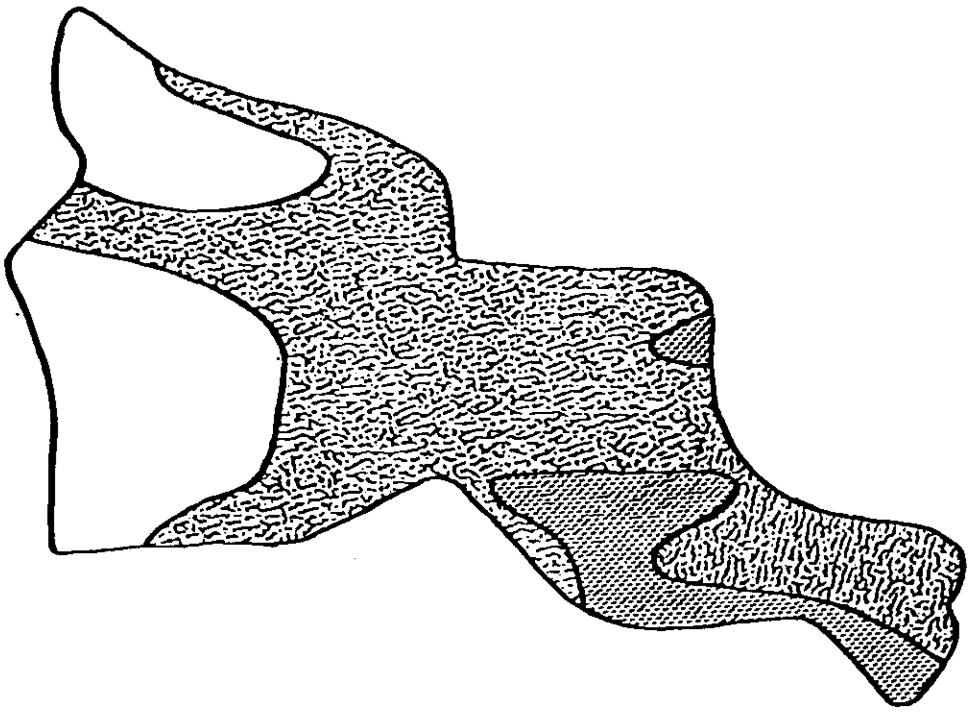


FIGURE 5.8 LAND GROUP-VEGETATION GROUP ASSOCIATIONS-HEPTONSTALL



VEGETATION GROUP FREQUENCIES AT SITES IN LAND GROUPS

PREDICTED CHANGES AT MAIN SITES

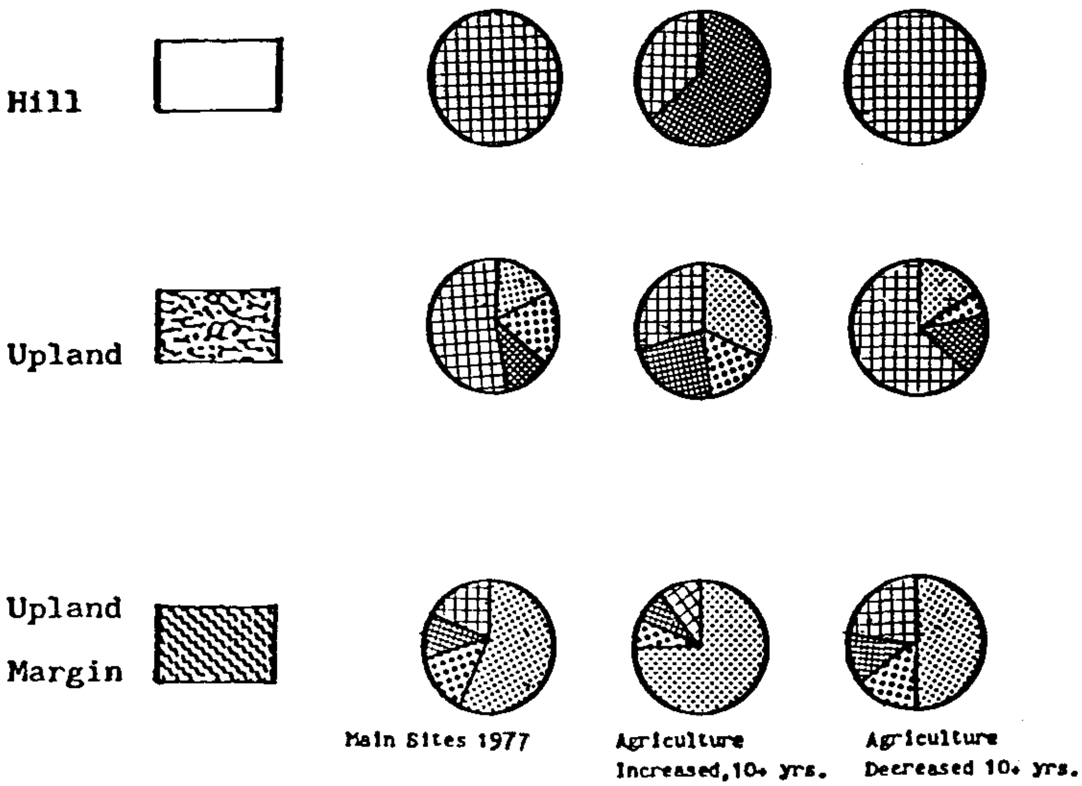
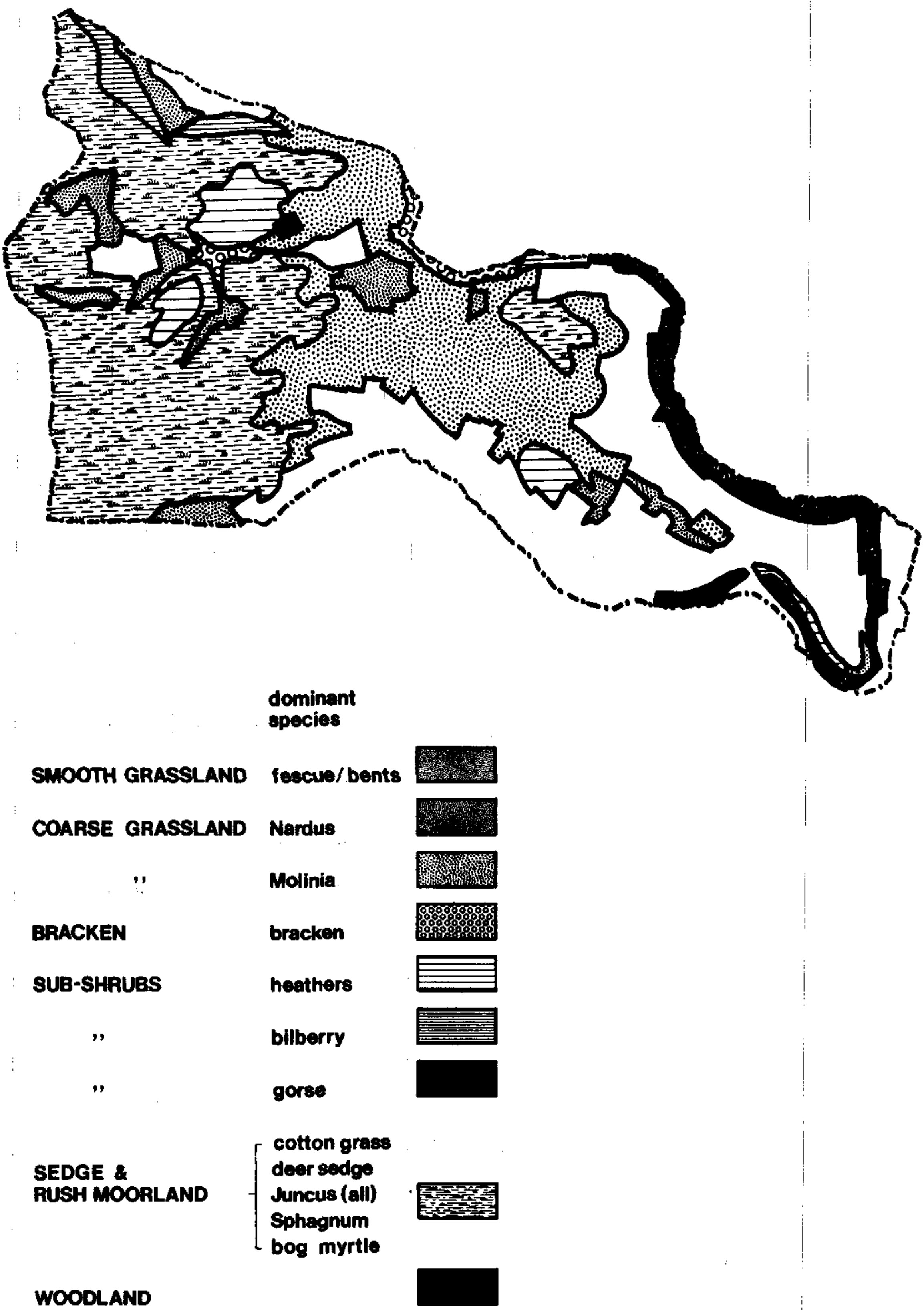
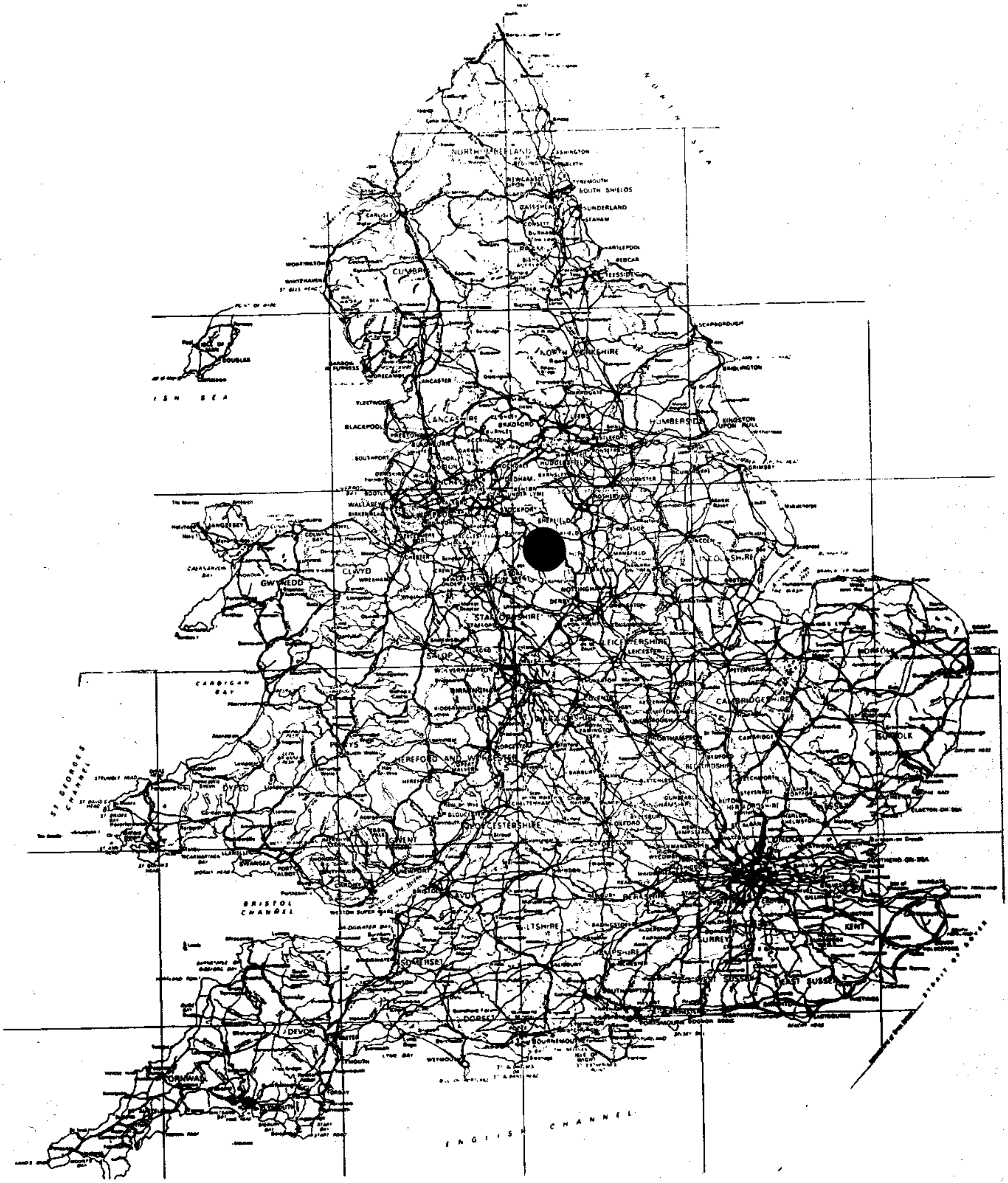


FIGURE 5.9 UPLAND LANDSCAPES STUDY VEGETATION MAP OF HEPTONSTALL



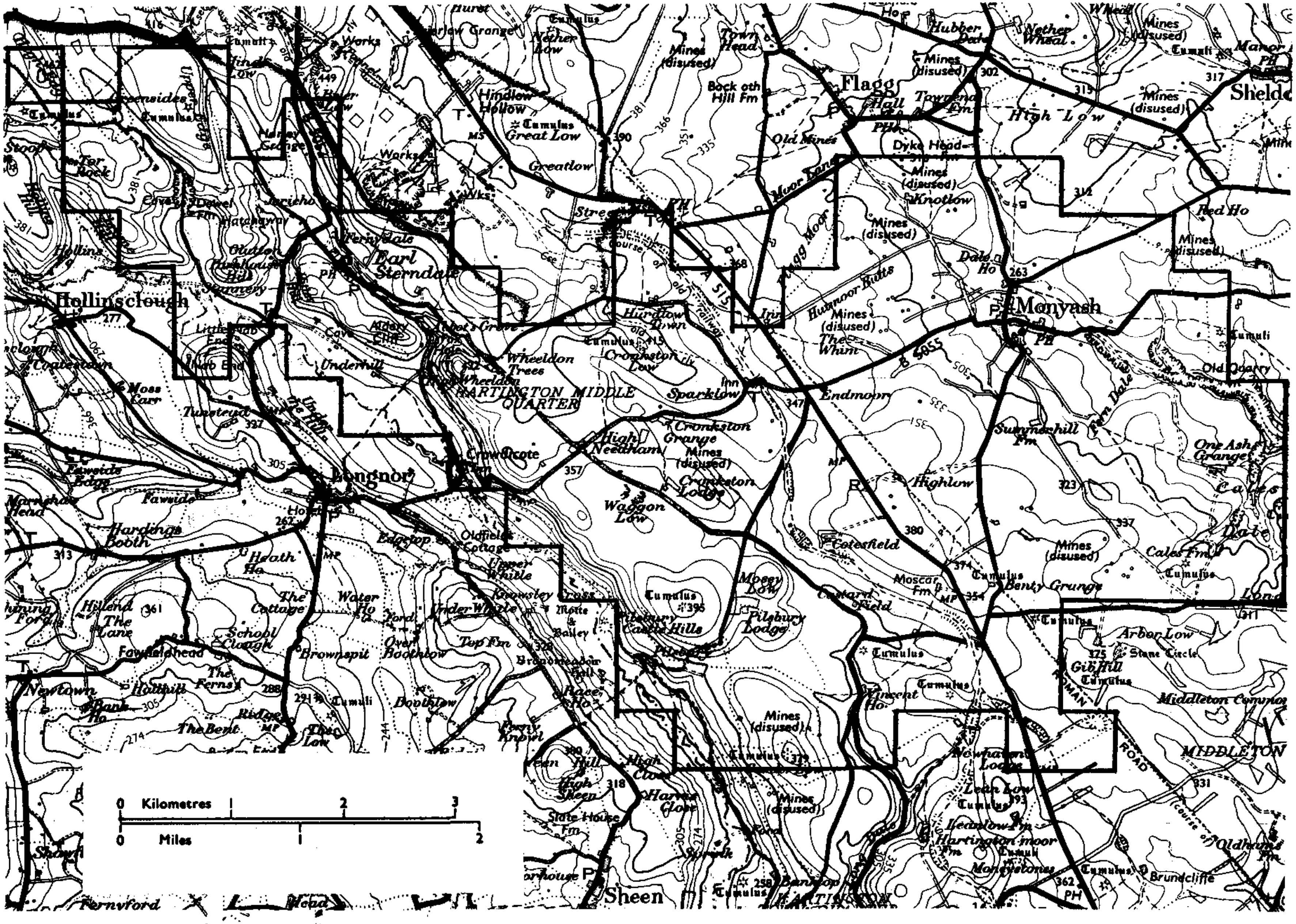

(Map by Geoffrey Sinclair, Environmental Information Services)

# MONYASH
# and
# HARTINGTON MIDDLE QUARTER



Farmland on upland plateau on the eastern fringe of Monyash village. Small fields enclosed by stone walls with scattered trees characterise this landscape, with improved pastures dominating the area.
(Photo by P.Ainsworth)

FIGURE 6.1   THE STUDY AREA OF MONYASH AND HARTINGTON MIDDLE QUARTER



## STUDY AREA 6: MONYASH AND HARTINGTON MIDDLE QUARTER, DERBYSHIRE

### PHYSICAL ENVIRONMENT

The combined parishes of Monyash and Hartington Middle Quarter (Figure 6-1) cover 36 $km^2$. They are situated in the Peak District region in what is known from its limestone rock as the 'White Peak', and they lie within the Peak District National Park. The main A515 road bisects the area, with Buxton to the north and Ashbourne to the south. Physiographically the area is of plateau character, dominated by altitudes between 244 and 427 m (800-1 400 ft). Gentle slopes ($<5^{o}$) are characteristic (Plate 1), but steep and very steep slopes are prominent in a limited part mainly along the western border near the course of the River Dove.

Climatically, in relation to the 12 study areas, Monyash is classifiable as moderately cold and dry (Part I, 2.32 and Figure 2-2), with mean daily temperatures for January and October estimated as 1.5 and 8.5$^{o}$C. The average annual number of days of snow lie is 30 and the annual average of daily sunshine hours 3.25. The eastern half lies in a moderate rainfall sector (1 001-1 200 mm, c. 40-48 in) while in the west rainfall is within the fairly high band (1 201-1 400 mm, c. 48-56 in pa). Smith (1976) gives the length of the growing season for the region that includes Monyash (and also Heptonstall), at an average altitude of 287 m, as 209 days (16 April-11 November).

Geologically the area is mapped as entirely consisting of Carboniferous Limestone Series rocks, in this area generally well bedded and only slightly impure limestones, mainly of the 'lagoonal' phase of deposition but including some reef limestones. A feature of jointed and bedded limestone is that surface water can percolate readily down through the joints in the limestone. In this part of the Peak District, sub-surface igneous rocks known to occur within the limestone sequence were important in causing such water to be directed so that it emerged at spring-lines in physiographically appropriate locations. Such springs of fresh water, more prominent in the area before modern extraction lowered the water table, were a key factor in the emergence of Monyash as an early settlement. Lathkill Dale, a characteristic Peak District limestone valley that commences its eastward course near Monyash village, is now dry in its upper part, the Lathkill stream emerging lower down the dale. The other impact of the non-exposed igneous rocks has been through their association with metal ores which penetrated weaknesses in the limestones and which have been worked widely in the Peak District, including the study area. No drift cover is mapped over the solid rocks here, though the soils are likely to have developed from material of other origins as well as from the insoluble residues remaining of the underlying limestone.

On the national soil map virtually the entire area is in a mapping unit dominated by Brown Earths, the exception being a narrow strip along the southwestern border along the River Dove which is in a unit dominated by Peaty Gleys, poorly drained moorland soils. In the national agricultural land classification, a sector around Monyash village is mapped as of quite high quality, in grade 3, though the altitude here would seem to be higher than generally accepted for this grade. Most of the area is classed as grade 4, and only a strip along the western border and a small area to the north of Earl Sterndale in the northwest is given as a complex of grade 4 with agriculturally poorer grade 5 land.

Topographically there is a dense road network, almost all the grid squares containing mapped roads, and the intensive agriculture that characterises the area is shown by the nearly universal occurrence of frequent field boundaries (Part I, Plate 10). Settlement, assessed by the presence of mapped buildings, is scattered widely through the whole area.

Land type distribution is shown in Figure 6-2. Upland plateau is the most frequent type, covering 56% of the area (Part I, Table 4-36), with subordinate upland, steep upland in the west, and some upland margin, again mainly in the west. Monyash is the only study area with no sector of hill land.

## LAND-USE HISTORY

There is abundant evidence of prehistoric Bronze Age settlement in the limestone country of the White Peak, for example the 'Tumulus' sites mapped in the south and the northwest of the study area (Figure 6-1). Later the Romans had a civil centre at Buxton and one of their roads to this is now followed by part of the southwestern boundary of Monyash parish. Settlements concerned with agriculture and mining became well established so that by the 8th century the first parish churches were built in the region. Lead mining was a major feature of the economy of the area through Roman, Saxon and medieval times, Monyash being an important mining and market centre. As a consequence 'Mines (disused)' vie with tumuli in their frequency on Figure 6-1.

Along with mining, stock rearing has been a mainstay of this region. Between the 12th and 16th centuries, monastic houses outside the district owned much land, for example that of One Ash Grange, near the eastern edge of Monyash parish, south of Lathkill Dale. Monyash village itself in this period would have been surrounded by open fields beyond which were more distant common lands where the mine workings were situated. The smaller strip-form walled fields near the village and the larger, squarer walled fields of later enclosure further from the village perpetuate this pattern (Part I, Plate 10). The later enclosure fields mainly resulted from an Enclosure Act of 1771.

This area falls within a region intensively studied by the Grassland Research Unit of the University of Sheffield (see for example Lloyd, Grime and Rorison 1971). Until the Enclosure Act large tracts of heather moorland persisted on the leached soils over much of the limestone plateau. Around this time, and following it, the reclamation of the surviving moorland was comprehensive and became permanent. Young (1770) remarked on the thoroughness with which reclamation was being pursued at the time of his tour.

Semi-natural grasslands in the White Peak are thus now almost entirely restricted to steep dale sides, small sites left by the lead mining industry which was at its height in the first half of the 18th century, or to places currently affected by limestone quarrying. According to Woollacott (1971), the intensification of farming and introduction of more economic but less agile breeds of sheep led to a decrease in grazing pressure on the steep dale side grasslands. This, together with a reduction in rabbit grazing since 1954, has in such situations encouraged the growth of taller grass and the spread of scrub. The consequent accumulation of dead plant material in turn led to an increase in grassland fires, usually in spring before seasonal growth has begun. Lloyd (1968 & 1972) has written of an inverse relationship between the occurrence of fire and grazing intensity. Usually started by carelessness, fires covering many hectares have been experienced in such dales as Lathkill. Their sporadic occurrence may play an important role in delaying takeover by scrub, thereby helping to maintain the rich variety of limestone grassland.

In recent times, agricultural statistics for the period 1900-1965 (Part I, Figures 4-4 to 4-6) show that the tillage area and sheep numbers in Monyash have fluctuated without any consistent trend, but there has been a considerable and steady increase in cattle numbers since 1930. Between 1878 and 1978, ULS (1979) calculate no significant change to have taken place in the extent of crops and grass (92.4 to 93%), and a slight fall to have affected the very small area of woodland (0.9 to 0.7%).

For a source from which to assess moorland, farmland, and moorland fringe distribution over the past 100 years, the first Ordnance Survey map of the study area, dates from 1876. From analysis of this and subsequent revisions, Figure 6-3 shows that only 100 ha, mostly in the northwest of Hartington Middle Quarter, can be identified as moorland core. The small area of moorland fringe (180 ha) includes 120 ha of reclaimed moorland, mainly around old lead workings. This limited extent of fringe is predominantly associated with the steep upland land type, with 52% of the fringe occurring in only 8% of the area. A further 32% of the moorland fringe is in the 14% of the area classified in the upland margin land type.

Mining is not active in the area now but limestone quarries and fluorspar workings nearby are important as local employers. Lathkill Dale just outside the study area is a National Nature Reserve, and the extension of the dale within Monyash is scheduled as a Site of Special Scientific Interest. Walking, particularly in Lathkill Dale, touring by car around a recommended motor route along by-ways, and through tourist traffic via the main road are the main impacts on Monyash of recreational use of the National Park.

VEGETATION

Species lists at 72 main sites were recorded in 1978 by the methods outlined in Chapter 3 of Part I of this report. Figure 6-4 shows the frequency of vegetation classes at these sites and Figure 6-5 includes the location of each site and its vegetation class in 1978.

Monyash is almost entirely pastoral (Plate 1 and Part I, Plate 21) and this is reflected in the monotony of the vegetation at the recorded sites. Improved pastures (Part I, 3.12), present at 85% of them, fall in 2 classes: <u>Lolium</u> grassland, class 2, (at 45% of sites) and herb-rich <u>Lolium</u> grassland, class 4 (at 40% of sites). The remaining 15% of the sites recorded supported 2 rough pasture classes (Part I, 3.14): <u>Agrostis</u>/<u>Holcus</u> grassland, class 7 (at 11% of sites) and <u>Festuca</u>/<u>Agrostis</u> grassland, class 8 (at 4% of sites). Woodland in Monyash (Part I, Table 3-4) is mainly lowland in character, the majority of the sampled woods being lowland basic woodlands (7 out of the 10 sites). Two were lowland acid woodlands and the remaining site was upland acid woodland.

Table 6-1 shows the association between vegetation classes at main sites in Monyash and the few land types present. In Figure 6-6 the relationship between land groups and vegetation groups is illustrated. There is no hill land. Improved pastures dominate all the land types that occur. Rough pastures occur at relatively few sites but are proportionately more frequent in land types other than upland plateau.

POTENTIAL VEGETATION CHANGE

Vegetation in Monyash has already been subjected to long established comprehensive modification for agriculture. With only 2 vegetation groups, represented by just 4 vegetation classes, recorded at main sites in 1978, this was the most uniform area of all those studied. Overwhelmingly the recorded sites were of just 2 improved pasture grassland classes. Various factors have combined to account for this. The early local mining economy and the later close proximity of Monyash to large industrial centres of population generated a demand for agricultural products. Relatively fertile soils over a favourable rock type, on land of gentle slopes and ease of improvement and cultivation, were natural features of advantage. The good communications brought about by the local mines and the adjacent towns also made their contribution. Although simple assumptions of agricultural and forestry potential in Part I (Table 5-19) suggest that forestry could be a potential land-use over about half the area, the level of local agriculture is such that there would be no transfer of land from it under any realistic circumstances.

The relatively few sites of rough pasture remaining in Monyash, which are Agrostis/Holcus grassland (class 7) and Agrostis/Festuca grassland (class 8), give the only significant remaining option for vegetation change under intensified or declining levels of agricultural management. ULS (1979) however classifies land occupied by the remaining semi-natural vegetation (in Monyash parish alone) as generally not improvable (mainly due to steep slopes) but of some grazing value. If agricultural effort was in fact turned to any less steep remnants then in part at least they might be able to be upgraded, in an agricultural sense, towards improved pasture classes 2 or 4 (Lolium grassland and herb-rich Lolium grassland) and thus rough pastures could disappear altogether. Under decreased management levels the trend would be for a slight diversification of vegetation with the possible ultimate re-emergence, if soil pH levels eventually fell sufficiently and a seed source for the heath species became available, of a grassy heath, probably Festuca/Vaccinium heath, class 14, replacing some rough pasture.

Figure 6-4 shows the frequencies of vegetation classes at main sites predicted under intensified or decreased levels of agricultural activity, and Figure 6-5 plots the predicted classes at each site. Such changes are predicted in accord with standard trends discussed in Part I, 5.74-5.77 and Figure 5.4 (summarised in Appendix 2) and do not take account of individual site land and management factors. With this reservation an intensification of agriculture to a moderate degree in Monyash could lead to the elimination of the last remnants of rough pastures and the total expansion of improved pastures from 85% of sites to occupy 100% of the recorded sites. The predicted outcome of a moderate decline in agricultural use would be for a small fall in the proportion of sites which are now rough pastures, allowing 4% of sites to change to a grassy heath. The long term stability of the agricultural use of this area is such that significant change in this direction is quite unlikely. The remnants of limestone grassland on steep sites are of an ecological interest that can be argued to be of greater importance (though not perhaps to their owners) than the small extent of improved pasture they could provide. The overall visual impact of even the maximum predicted changes on the landscape would be slight, with 14% of sites changing their vegetation group if agriculture was intensified and 4% changing if it declined.

The predicted frequency of vegetation groups in relation to land groups, sketched in Figure 6-6, shows that the low levels of change predicted are likely to be evenly spread between the 2 land groups present in Monyash.

The Upland Landscapes Study used only Monyash rather than the combined parishes as their study area. Its lack of semi-natural vegetation means that no ULS vegetation map was appropriate, although in effect virtually all the study area would be classed in the 'farmland' ULS unit, in accord with the recorded ITE sites being all pasture classes.

## CONCLUSION

Monyash is in the Peak District National Park and the policies of the Peak Park Joint Planning Board are directed towards encouraging the continuance and development of farming along established lines. This policy, coupled with the stated intention of farmers in Monyash (ULS 1979) to carry on with their present enterprises based mainly on dairy cattle without any major changes of management, suggests a stable future in Monyash and a low potential for vegetation change in the parish. The lack of present vegetational diversity in Monyash means that the potential for change is in any case very restricted. The landscape character of Monyash is controlled by its buildings and its field boundary pattern rather than by a varied vegetation, except very locally on dale sides.

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TABLE 6-1 CORRELATION OF VEGETATION CLASSES AND LAND TYPES - MONYASH

| Vegetation Group and Class | | Land Group and Type | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Hill | | | Upland | | | Upland Margin (6) |
| | | Steep Hill (1)* | Hill (3) | High Plateau (4) | Steep Upland (5) | Upland (7) | Upland Plateau (8) | |
| Improved Pastures | 1 | | | | | | | |
| | 2 | | | | 1 | 4 | 21 | 3 |
| | 3 | | | | | | | |
| | 4 | | | | 4 | 8 | 17 | 3 |
| Rough Pastures | 5 | | | | | | | |
| | 6 | | | | | | | |
| | 7 | | | | 2 | 4 | 2 | |
| | 8 | | | | | | 2 | 1 |
| Grassy Heaths | 14 | | | | | | | |
| | 15 | | | | | | | |
| | 16 | | | | | | | |
| Shrubby Heaths | 9 | | | | | | | |
| | 10 | | | | | | | |
| | 11 | | | | | | | |
| | 12 | | | | | | | |
| | 13 | | | | | | | |

As number of sites of each vegetation class located in each land type.
* Land type numbers as used on computer maps, Figure 6-2.

FIGURE 6.2 LAND TYPES - MONYASH

```
- 87
 -58 7
 -5---         8888
  777-78   8   888888
   87577-  88 88888888
   - 7-5-8858888777788
      87588-7888878878-
        5888888888888775
         588888888887-7
          5877877888888
           5-787888
           --787-88
            --57  88
```

UPLAND LAND GROUP

5 = Steep Upland

7 = Upland

8 = Upland Plateau

```
6 --
 6-- -
 6-666         ----
  ---6--    -   ------
   -----6   -- --------
   6 -6-6-------------
      -----6----------6
        ---------------
         ------------6-
          -------------
           -6------
           66---6--
            66--  --
```

UPLAND MARGIN LAND GROUP

6 = Upland Margin

FIGURE 6.3 MOORLAND CORE, FRINGE AND FARMLAND - MONYASH

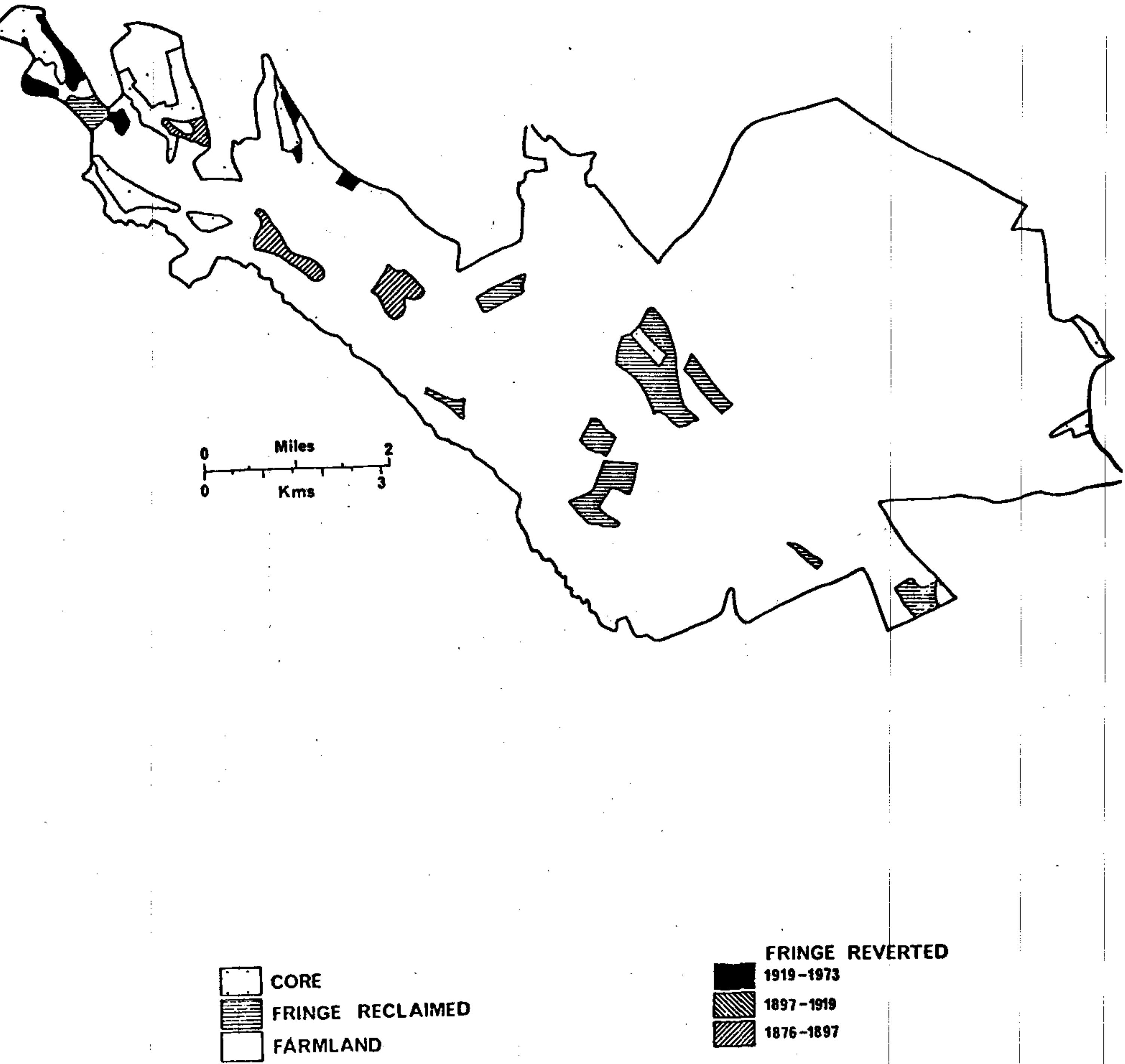
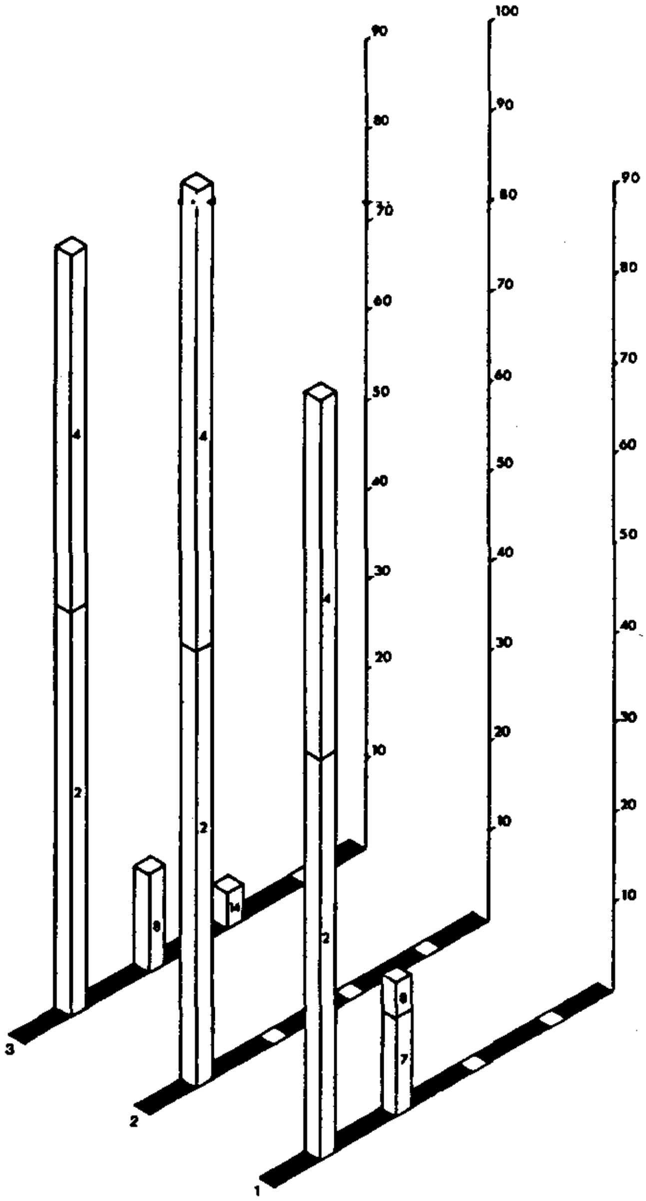


FIGURE 6.4 VEGETATION CLASS FREQUENCY AT MAIN SITES - MONYASH

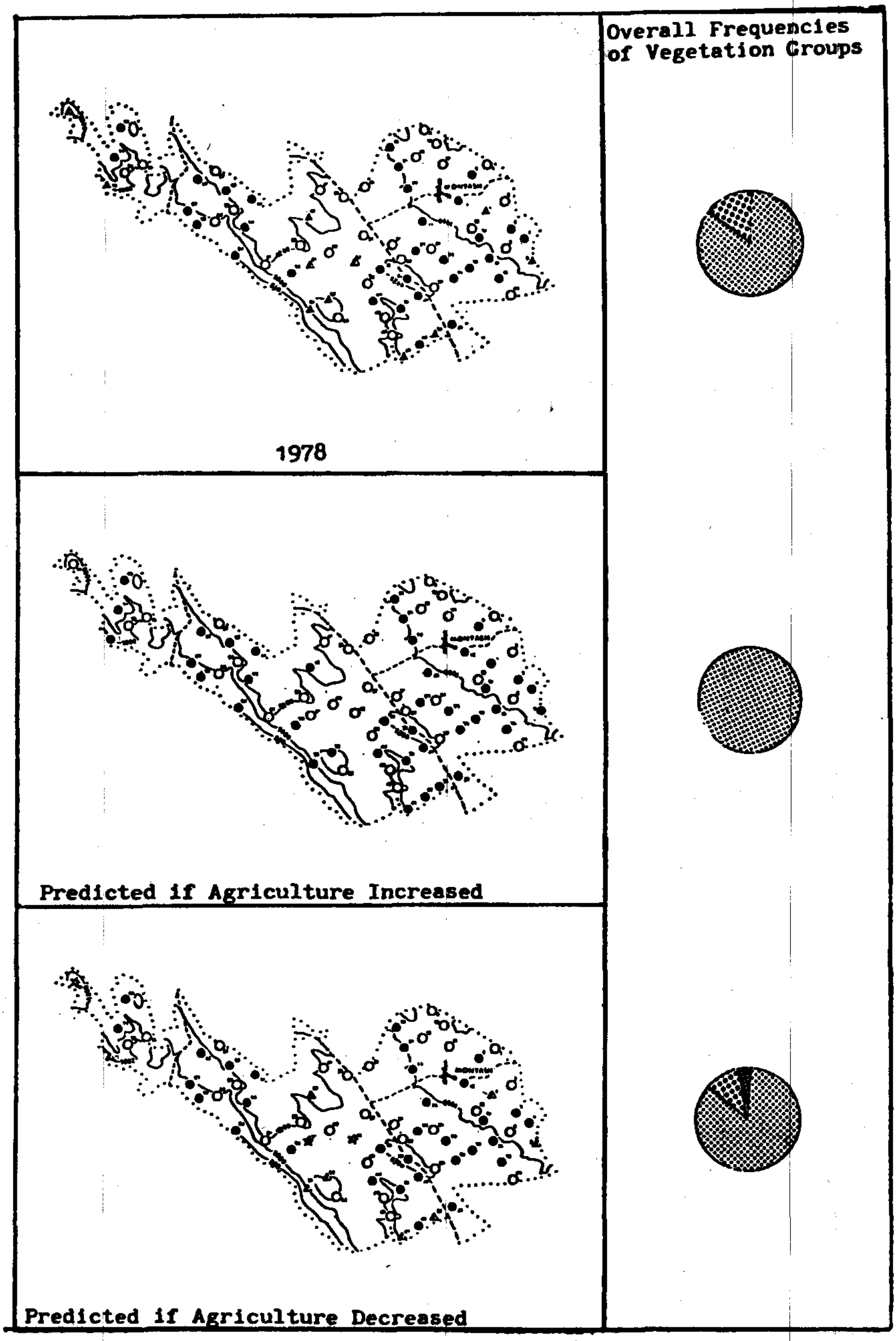



| Vegetation Group | Class | | % Main Sites in Vegetation Class 1 | 2 | 3 |
|---|---|---|---|---|---|
| Improved Pastures | 2 | Lolium Grassland | 45 | 49 | 45 |
| | 4 | Herb rich Lolium Grassland | 40 | 51 | 40 |
| Rough Pastures | 7 | Agrostis/Holcus | 11 | - | - |
| | 8 | Festuca/Agrostis | 4 | - | 11 |
| Grassy [illegible] | 14 | Festuca/Vaccinium | - | - | 4 |

1. Recorded Main Sites, 1978
2. Predicted Changes at Main Sites if Agriculture Increased, 10 + years.
3. Predicted Changes at Main Sites if Agriculture Decreased, 10 + years.

FIGURE 6.5 LOCATION AND CLASSIFICATION OF VEGETATION MAIN SITES

MONYASH



KEY TO FIGURE 6.5

| Group | Class | Vegetation |
|---|---|---|
| Group 1. Improved Pastures | Class 1 : | Lolium/Holcus/Pteridium |
| | Class 2 : | Lolium |
| | Class 3 : | Lolium/Trifolium |
| | Class 4 : | Herb — rich Lolium |
| Group 2. Rough Pastures | Class 5 : | Agrostis/Juncus |
| | Class 6 : | Festuca/Juncus |
| | Class 7 : | Agrostis/Holcus |
| | Class 8 : | Festuca/Agrostis |
| Group 3. Grassy Heaths | Class 14: | Festuca/Vaccinium |
| | Class 15: | Festuca/Nardus/Vaccinium |
| | Class 16: | Festuca/Nardus/Molinia |
| Group 4. Shrubby Heaths | Class 9 : | Calluna/Molinia/Vaccinium |
| | Class 10: | Vaccinium/Calluna |
| | Class 11: | Nardus/Sphagnum/Calluna |
| | Class 12: | Eriophorum/Calluna |
| | Class 13: | Calluna |

KEY TO FIGURES 6.5 AND 6.6

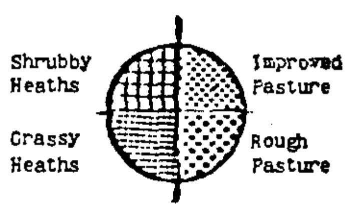
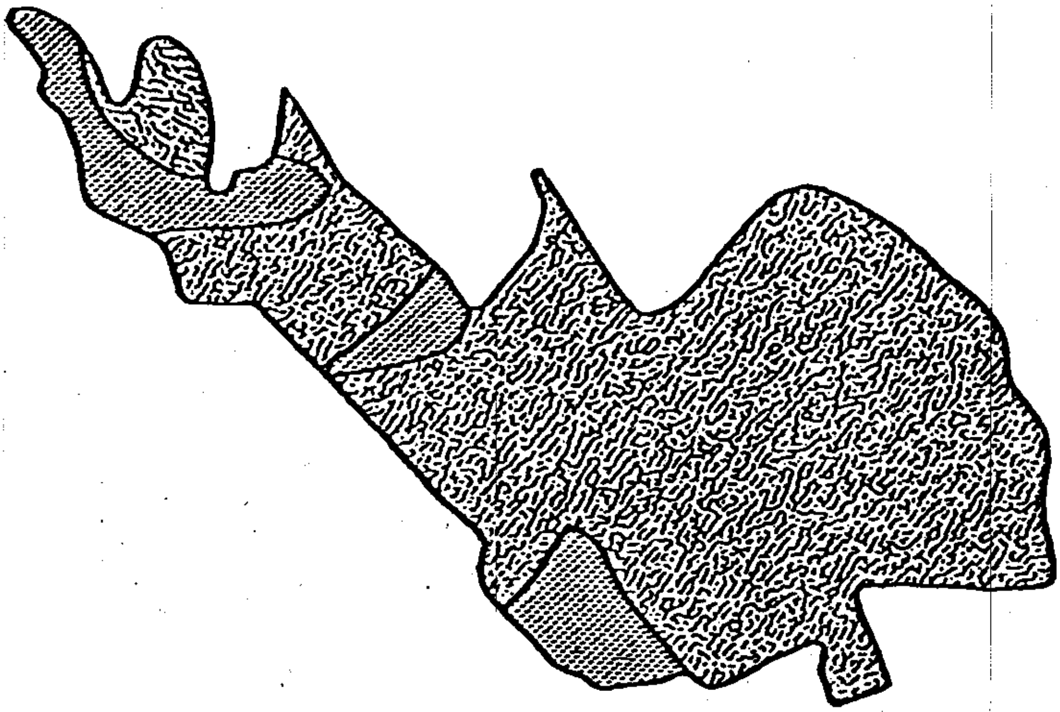
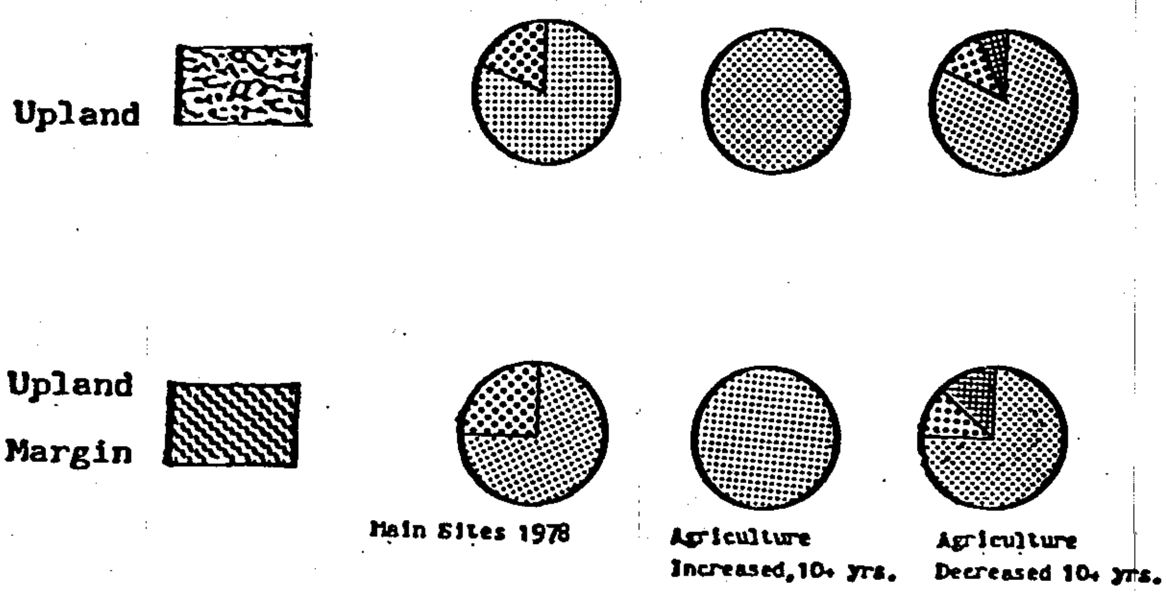


FIGURE 6.6 LAND GROUP-VEGETATION GROUP ASSOCIATIONS-MONYASH

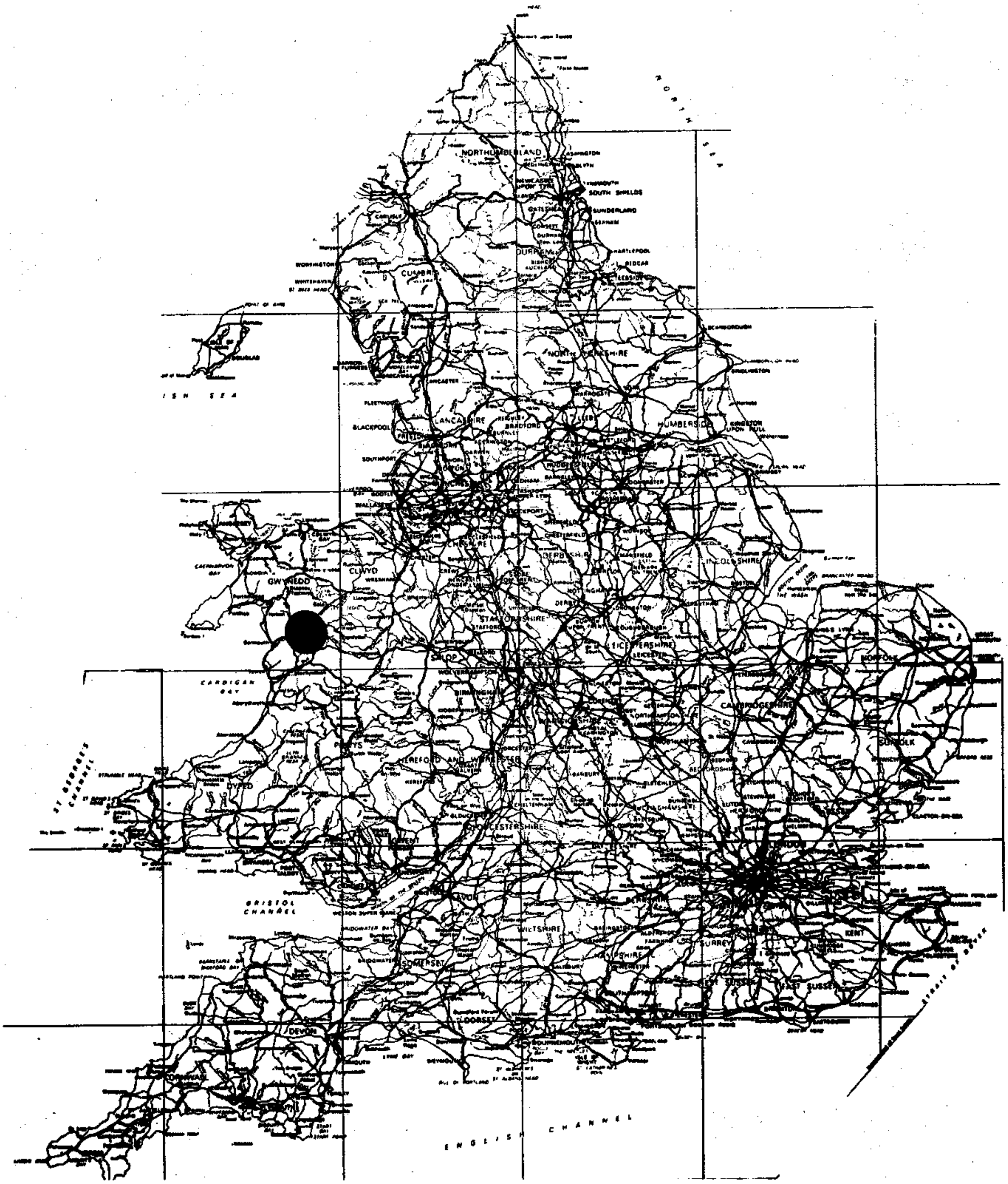


VEGETATION GROUP FREQUENCIES AT SITES IN LAND GROUPS

PREDICTED CHANGES AT MAIN SITES

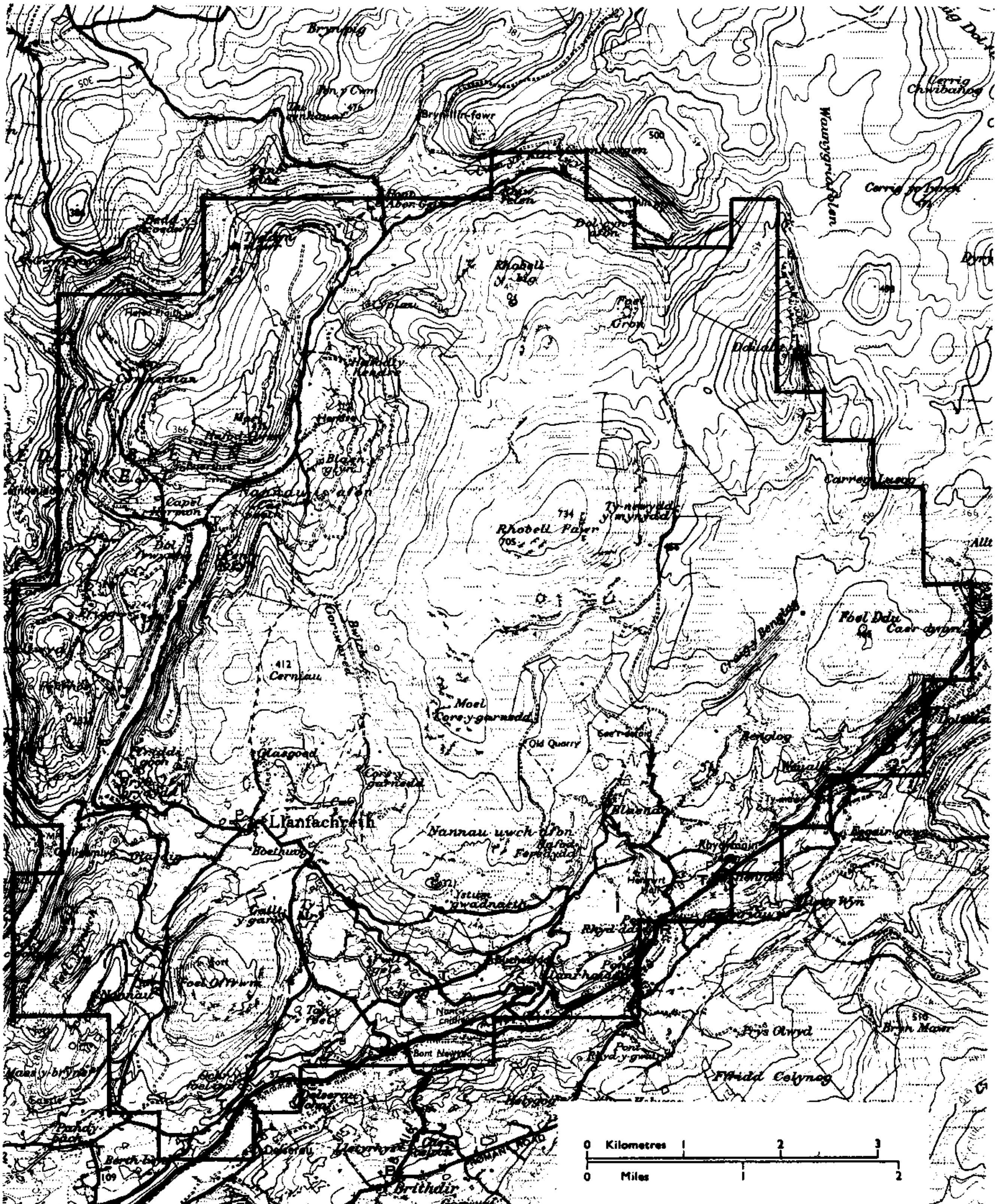


# LLANFACHRETH



Variety in the Llanfachreth landscape. Rough pasture with bracken is seen in the foreground, then improved pastures and wet rough pastures occur in the left mid-distance. Beyond the village of Llanfachreth there are woods and conifer plantations and, in the background, the heath vegetation of the hill sector rising towards Rhobell Fawr.
(Photo by D.F.Ball)

FIGURE 7.1 THE STUDY AREA OF LLANFACHRETH



# STUDY AREA 7: LLANFACHRETH, GWYNEDD

## PHYSICAL ENVIRONMENT

The study area of Llanfachreth, covering 72 km2 (Plate 1 and Figure 7-1), in the Snowdonia region, is situated just northeast of the town of Dolgelley in the southern part of the Snowdonia National Park. The southern boundary of Llanfachreth parish follows the River Wnion and the A494 road between Dolgelley and Bala (Part I, Plate 12), while the western and northern boundaries follow the River Mawddach. There is a wide altitude range (Figure 7-2). The southern and western boundaries are bordered by a belt of country dominated by altitudes below 244 m (800 ft), a significant part of which is below 122 m (400 ft). A central band lies mainly between 244 and 427 m (800-1 400 ft) while a substantial block in the northeast is dominated by land above 427 m (1 400 ft), reaching 734 m (2 410 ft) at the summit of Rhobell Fawr (Part I, Plates 11 and 12). Slopes are dominantly moderate (5-11°) over some 60% of the area, with steep and very steep slopes dominant over most of the remainder, especially in the central mountain block and flanking the valleys in the west.

In relation to the 12 study areas, Llanfachreth is classifiable as warm and wet (Part I, 2.32 and Table 2-4). The annual average of daily sunshine hours is 3.5 and the number of days of snow lie averages 20 (though there is a considerable range between shorter periods of snow lie on the lower ground and longer periods of snow lie on the mountains). January and October mean temperatures are 2.6 and 9.4°C but again the variation within the area will be high because of its altitude range (Part I, 2.31). Smith (1976) gives the length of the growing season as 225 days (11 April-22 November) for the region in which Llanfachreth is situated, at a height of 299 m. Figure 7-3 shows high rainfall (1 601-2 200 mm, c. 64-88 in pa) to occur over 75% of the area, with very high rainfall (2 201-2 400 mm, c. 88-96 in pa) over the high ground sector around and northeast of Rhobell Fawr.

Geologically the western half of the area and a small sector in the east are of Cambrian slaty and shaly sedimentary rocks. South of Llanfachreth village there are chemically similar but rather less hard mudstones and shales of Ordovician age. Moderately siliceous andesitic volcanic lavas of Ordovician age occupy the central sector around Rhobell Fawr while similar lavas, with volcanic ashes, are found in the east around Foel Ddu. The drift map shows boulder clay around the village of Llanfachreth and along the valley of the Wnion. Though not given on the geological drift map, peat cover is a feature of gentler slopes in the montane sector (Part I, 2.27). The national soil map places the southwestern half of the area, and a strip along the southeastern border, in a unit dominated by Brown Earths with associated moorland soils, Peaty Gleys and Peaty Podzols.

The agricultural land classification map grades land around Llanfachreth village and along the Wnion as grade 4, with the remainder, apart from the 'other uses' classification of forest areas, being grade 5. This area and Lynton are among test localities for a more detailed classification of hill land than is now available that is being developed by Research Officers of the Ministry of Agriculture's ADAS (Land Service) Resource Planning Group. Their results are not yet published, but ULS (1979) have applied a slight variation of their methodology to classify the land of the rough grazings in the study areas, as referred to in the sections on vegetation change in each area account.

A sharp physiographic distinction between the northeastern mountain sector and the remainder of the area that was noted above is sustained in the topographic features shown in the schematic maps of Figure 7-4. A dense network of minor roads, a widespread distribution of buildings, and a more intensive agriculture as shown by frequency of mapped field boundaries, all characterise the southern and western parts, while the northeast quarter is without roads, buildings or frequent field boundaries.

The distribution of land types in Llanfachreth is given in Figure 7-5. The northeastern sector falls in the hill land group. The steep hill land type is prominent around Rhobell Fawr, and the hill land type more frequent in the north. Steep upland is a feature in the east around Foel Ddu and along the western valleys, while upland margin dominates the southern half of the area and is also important in the western valleys.

## LAND-USE HISTORY

Settlement occurred from the earliest times in this climatically relatively favourable wooded western upland which has access to the sea but is sufficiently far inland from it for protection from hostile invaders. Permanent settlement dates at least as far back as the Iron Age, and the Romans used the valley of the Wnion for the route of a road westwards from Bala.

Thomas (1965) has emphasised inertia and continuity in the field and farm boundaries of the former county of Merionethshire, to the extent that 'one is constantly aware of looking at farmsteads that are usually at least 170 years old and at field boundaries that derive basically from the 16th century, if not earlier'. Cattle were the mainstay of the agrarian economy (Howell 1977) and, by Tudor times, a highly organised traffic in animals had evolved, so that, for example, the great summer fair at Eglwyswrw in Pembrokeshire attracted drovers from as far afield as Llanfachreth and the adjacent village of Llanelltyd, with centres like Dolgelley acting as 'local collecting points within the pastoral areas, lubricating the long distance movements' (Thomas op cit & 1967). The pastoral role of the uplands was conveyed by a commentator of 1610, who described the mountains of Merioneth as 'covered with fruitful flocks of sheep, besides cattle that therein do abundantly graze ... by reason of the unevenness of the soil and the rocks so near to the face of the earth, the plough cannot be drawn, nor corn prosper'.

The families of Nannau and their descendants the Vaughans have been vital to the fortunes of Llanfachreth since Cadwgan built a house at Nannau in the 11th century. The example in pastoral agriculture set by monasteries such as that of Cymmer near Dolgelley were followed by civil landowners. By the end of the 16th century, Hugh Nannau had become virtually the sole owner of Llanfachreth, with an estate that was divided into small farms run by family labour. Irregular and spasmodic extensions were made into the moorland from existing holdings, taking account of locally favourable physiographic and soil conditions. The survival of some tracts of woodland through medieval times is suggested by an action taken against Hugh Nannau in regard to his alleged removal of 30 000 oak trees on Penrhos Common in Llanfachreth between 1588 and 1603 (Nannau Manuscripts). The Vaughan Family came into the estate by marriage in 1775, and built the present mansion of Nannau in 1796. The ownership of the 2nd baronet, Sir Robert Williams Vaughan, from 1792 to 1843 was the peak of prosperity for Llanfachreth with estate management, roads and buildings all being carefully controlled and developed.

Thomas (1965) noted the absence until the late 18th century of detailed inventories of stock, information on land-use, or even farm maps for wide areas of Merionethshire. As is also the case with Ysbyty Ystwyth and Ystradgynlais and Glyntawe, it is not possible to construct a land-use map for this area from the Tithe Commutation Surveys of the 1840s. The survey of Llanfachreth only says that 12 136 acres of a total of 15 936 acres (c.4 900 of 6 450 ha) were meadow and pasture, and the remainder arable. Llanfachreth and Llanelltyd had been the subject of an Enclosure Act of 1809, implemented in 1821, which covered almost 6 100 ha

(15 000 acres). Morgan (1959) has drawn attention to the way in which the boundary of the common land tended to include all land over 305 m (1 000 ft) as well as the steeply sloping hillsides at lower levels. In contrast to the small scale and rather random shapes of post-medieval fields, the new enclosures were regular in layout and larger in size. Their main purpose was to create or redistribute proprietory rights, rather than to facilitate actual reclamation and cultivation of the waste. Profits from animal rearing, both cattle and later sheep, in some instances encouraged overgrazing. There were frequent complaints of commoners turning out livestock in the summer that had not been over-wintered on their farms, so that the regulation of stock numbers in the summer grazings was attempted from time to time. An agreement from as late as 1919 may have been representative of many in limiting the number of sheep that could be grazed on a sheepwalk shared by 3 holdings in Llanfachreth.

The presence of copper, lead and gold has been a historic factor in the economy of the Dolgelley area. Mining in and immediately adjacent to Llanfachreth became important in the 19th century. The most famous Welsh gold mine, Gwynfynydd, is on the western boundary of the area and other mines were operated under leases from the Nannau Estate. Gwynfynydd employed over 200 miners around 1890 but declined rapidly after this, to fail in the early years of this century. Now, as another alternative to agriculture, forestry is an important land-use occupying 30% of the study area (ULS 1979). Planting by the Forestry Commission started in 1922 and large areas of land have been sold or leased to the Commission since then.

Llanfachreth was surveyed by the Ordnance Survey first about 1887, with a revision as early as 1899. Thereafter, a 'provisional edition' was published in the 1950s, which incorporated additions made in 1949. Further large scale maps were published which indicated changes up to 1959 in the eastern and southern parts of the parish, and up to 1975 for the remainder of the area. Figure 7-6 drawn from analysis of these maps supplemented by air photographs shows that 3 225 ha comprise moorland core, and 1 860 ha moorland fringe. 1 630 ha of fringe have been afforested since 1919, and a further 30 ha represent moorland that has been reclaimed. 200 ha of improved land have reverted to moorland, mostly since 1945. The non-afforested fringe (78%) lies predominantly in the 44% of the area in the upland margin land type, with most of the remaining fringe in the steep upland land type.

The pattern of land-use between 1900 and 1965 as illustrated by Figures 4-4 to 4-6 in Part I of this report shows tillage to have fluctuated considerably through the period but to have fallen sharply and steadily since 1940, probably partly due to loss of agricultural land to forestry. Cattle numbers declined from a peak around 1940-1950 to their lowest level in the area over this time span. Sheep numbers were notably high in 1900 but then remained at similar average levels between 1910 and 1965. ULS (1979) calculate that the area of crops and grass has fallen between 1887 and 1978 from 22 to 17% of the area and that woodland (including plantation forestry) has expanded from 13 to 33%.

## VEGETATION

Vegetation was recorded at 72 main sites in 1978, using the methods described in Chapter 3 of Part I of this report. Llanfachreth is one of only 2 study areas in which all 16 vegetation classes were represented at recorded main sites (Ystradgynlais is the other). The frequency of the vegetation classes in 1978 is given in Figure 7-7, and the locations and classification of the main sites are shown in Figure 7-8. A north-central sector with shrubby and grassy heath sites is bordered on the south and west by rough pasture sites in association with more grassy heaths and a relatively small amount of improved pasture. The western side of the parish is largely afforested, forming part of the Forestry Commission forest of Coed-y-Brenin (Part I, Plate 11). There are also further blocks of forest in the northeastern corner of the study area, explaining apparently unsampled sectors on the maps of Figure 7-8.

Improved pastures occur at only 11% of the recorded sites in Llanfachreth. Rough pastures occupy 28% of the recorded sites, with class 7, Agrostis/Holcus grassland the most frequent. Plate 24 in Part I illustrates a close up of rough pasture class 5, Agrostis/Juncus grassland, from this area. Grassy heaths occur at 30% of recorded sites, the most frequently recorded class being class 16, Festuca/Nardus/Molinia heath (at 22% of sites). Shrubby heaths are similarly prominent, occurring at 31% of sites, half of which have Nardus/Sphagnum/Calluna heath, class 11.

Surviving semi-natural woodland, (much has been lost to plantation forestry), is particularly concentrated in the southern part of the parish. Among 15 woodland sites examined 11 are classifiable as upland acid woodlands, 2 are lowland acid woodlands and 2 lowland basic woodlands (Part I, Table 3-4).

Table 7-1 gives the association between vegetation classes at main sites and the land types in which these sites are situated, while Figure 7-9 sketches the frequency of vegetation groups related to land groups. All but one of the improved pasture sites are in the upland margin sector. Rough pastures fall mainly within the upland margin or steep upland land types. Grassy heath sites are found mostly in the steep upland but also in the steep hill and upland margin land types. Shrubby heaths are particularly concentrated in the steep hill and hill land types. The variety of vegetation in the upland margin land type is notable, with 13 of the 16 vegetation classes represented.

## POTENTIAL VEGETATION CHANGE

Viewed from a vantage point the impression Llanfachreth gives is of a mosaic of vegetation units, with forestry, woods, improved and unimproved pastures on lower ground, and forestry extending into unimproved moor and mountain at higher altitude (Plate 1). The development of forestry has been the greatest single recent change in Llanfachreth, with afforestation of the western sector by the Forestry Commission on land bought or leased from the Nannau Estate. The parish is wholly within the Snowdonia National Park but forestry was well established here before the Park was set up and the Park authorities have a benign attitude towards it in this part of Snowdonia, recognising the economic and social importance of an integrated agriculture-forestry policy. If arguments of the national need for greatly increased timber production are accepted they must imply that forestry expansion here cannot be ruled out. If this were to happen then the pressure for much of the major direct change would be on the land at present under agricultural use and this would inevitably mean loss of vegetation diversity. A simple assessment of land with forestry potential discussed in Part I (5.95-5.100) assesses that of Llanfachreth as about equal to its present forest area. This is because the assumptions give priority to agriculture in more favourable land types. Clearly forestry expansion in the area, on these assumptions, could only be substantially at the expense of land which also has agricultural potential. The Upland Landscapes Study report (1979) suggests that maintenance of local employment to sustain the social situation as it is at present requires forestry expansion as a matter of necessity.

Omitting from consideration this real possibility of substantial direct change, the potential for mainly gradual vegetation change in Llanfachreth may be considered in relation to the present vegetation classes recorded and the general principles discussed in Part I (5.74-5.78 and Figure 5-4), the trends of which are summarised in Appendix 2. In the ULS (1979) report on this area, they have calculated that about 75% of rough grazings are unimprovable though mostly these have some grazing value and a further 16% have potential improvement limited by physiographic constraints. These estimates are based on application of the criteria for detailed hill land classification that have been developed by the Agricultural Development and Advisory Service (ADAS) Resource Planning Group.

The most frequent vegetation classes at the sampled sites were: in the improved pastures, Lolium/Holcus/Pteridium grassland, (class 1); in the rough pastures, Agrostis/Holcus grassland, (class 7); in the grassy heaths, Festuca/Nardus/Molinia heath, (class 16); and in the shrubby heaths, Nardus/Sphagnum/Calluna heath, (class 11). Class 1 could change towards Lolium grassland on agricultural intensification or to Agrostis/Holcus grassland on agricultural decline; Agrostis/Holcus grassland could change to herb-rich Lolium grassland on intensification or Festuca/Agrostis grassland on agricultural decline; the class 16 grassy heath in this area could alternatively change to Agrostis/Juncus grassland under heavier use or to Nardus/Sphagnum/Calluna heath following a declining agricultural use; the class 11 shrubby heath could be modified to Festuca/Nardus/Molinia grassy heath with more intensive grazing, or remain unchanged if agricultural use declined.

Figure 7-8 includes maps showing the changes which might be expected at recorded sites on ecological grounds as a result of moderate levels of agricultural intensification or decline. The differences which these predicted changes would produce in the frequency of vegetation classes at the recorded main sites are included in Figure 7-7. Individual site factors of environment or management are not taken into account in these generalised predictions. With this proviso, from the general principles of change as uniformly applied to all sites of a particular present vegetation class in all study areas it is estimated that intensification of agriculture could lead to a substantial increase in the proportions of sites supporting improved pastures (11-39%). Rough pastures would show a small increase (28-30%) and grassy heaths a small decrease (from 30% of sites to 27%). Shrubby heaths would decrease substantially (from 31% of sites now to 4%). The predicted increase in improved pastures would particularly involve expansion of the classes of higher agricultural quality in the group, herb-rich Lolium grassland, class 4, and Lolium grassland, class 2. Though such changes are theoretically possible, ULS (1979) have recorded that only 7 out of 37 farmers are entirely dependent on agricultural income and that only 10 farms are assessed as viable when run on a full time basis. ULS considers prospects for the future of the present pattern of farming as 'not particularly bright'.

In predictions following a declining agriculture, improved pastures would fall from 11 to 4% of sites, rough pastures from 28 to 20% of sites and grassy heaths from 30 to 15% of sites. The number of sites with shrubby heath vegetation could double (from 31% now to 61%). In considering the overall impact of these predicted changes of vegetation class on the landscape, agricultural intensification involves a change in vegetation group at 88% of the recorded main sites whilst agricultural decline would cause a change in vegetation group at 53% of sites.

The sketch of associations between vegetation and land groups given in Figure 7-9 shows upland and upland margin to be susceptible to considerable change between alternatives of prominent improved pastures and a dominance of heaths. The impact of change on the hill land group is likely to be less, though increased agricultural grazing pressure could supplant most shrubby heaths with grassy heaths.

Figure 7-10 reproduces the Upland Landscapes Study vegetation map of Llanfachreth (ULS 1979), which has mapping units based on assessment of cover of dominant species. Table 7-2 compares the ITE vegetation class at main sites and additional sites recorded in 1979 (Part I, 5.66-5.67) with the ULS mapping units in which the sites are located. As was the case with Bransdale, 'farmland' in this area apparently includes a wide variety of vegetation classes, just over 20% of them heath classes. 'Bracken' as a unit also includes a wide range of the vegetation classes in which bracken can occur as a conspicuous species. Table 5-3 shows the frequency of vegetation classes that could occur at main sites which fall in each mapping unit. The visual character of the vegetation in most mapping units could change substantially under the results of these predictions.

## CONCLUSION

Llanfachreth is the study area with the longest forestry tradition and the highest proportional impact of forestry as a land-use, an employer and a visual factor in the landscape. If forestry does not expand then it is said that employment locally will be affected. At present many small farms, the majority of them part time, permit a wide range of vegetation classes to persist in the upland margin sector. A more clear cut split between forestry planting in new locations and amalgamated, more intensively farmed land elsewhere could substantially reduce the vegetation variety which is a prominent landscape feature of Llanfachreth. Gradual change also could affect a very high proportion of the recorded sites. The potential for change is thus great. All depends on Estate, Forestry Commission and National Park policies and attitudes to a stabilized or increased forestry enterprise and the consequent effect this can have on farm structures and economies. Only the highest ground in the northeast is reasonably resistant, from its environment and altitude, to substantial change, and, as another influence for stability, this montane sector is not one of easy access and hence has little recreational pressure.

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TABLE 7-1 CORRELATION OF VEGETATION CLASSES AND LAND TYPES - LLANFACHRETH

| Vegetation Group and Class | | Land Group and Type: Hill — Steep Hill (1)* | Hill — Hill (3) | Hill — High Plateau (4) | Upland — Steep Upland (5) | Upland — Upland (7) | Upland — Upland Plateau (8) | Upland Margin (6) |
|---|---|---|---|---|---|---|---|---|
| Improved Pastures | 1 | | | | | | 1 | 2 |
| | 2 | | | | | | | 1 |
| | 3 | | | | | | | 1 |
| | 4 | | | | | | | 2 |
| Rough Pastures | 5 | | | | | | | 3 |
| | 6 | 1 | | | | | | 1 |
| | 7 | | | | 4 | | | 5 |
| | 8 | | | | 1 | | | 6 |
| Grassy Heaths | 14 | 1 | | | 3 | | | 1 |
| | 15 | | | | | | | 1 |
| | 16 | 5 | | | 7 | | | 4 |
| Shrubby Heaths | 9 | 1 | | | | | | |
| | 10 | 1 | | | | | | |
| | 11 | 4 | 4 | | 1 | | | 2 |
| | 12 | 1 | 2 | | | | | |
| | 13 | 1 | 2 | | 1 | | | 2 |

As number of sites of each vegetation class located in each land type.
* Land type numbers as used on computer maps, Figure 7-5.

TABLE 7-2 CORRELATION OF ULS VEGETATION MAPPING UNITS AND ITE VEGETATION CLASSES - LLANFACHRETH

| ULS Mapping Unit | Number of ITE Sites in Area of ULS Unit | ITE Vegetation Class | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Improved Pastures | | | | Rough Pastures | | | | Grassy Heaths | | | Shrubby Heaths | | | | |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 14 | 15 | 16 | 9 | 10 | 11 | 12 | 13 |
| Smooth Grassland | 9 | | | | | | | | 2 | | | 3 | 1 | 1 | 1 | | 1 |
| Coarse Grassland/*Nardus* | 11 | | | | | | | | | 1 | | 2 | | | 5 | | 3 |
| Coarse Grassland/*Molinia* | 12 | | | | | | 2 | | | | | 9 | | | 1 | | |
| Bracken | 16 | 1 | | | | 1 | 2 | 2 | 1 | 4 | 1 | 2 | | | | | 2 |
| Sub-shrubs/Heathers | 7 | | | | | | | | | 1 | | 2 | | | 3 | 1 | |
| Sub-shrubs/Bilberry | 2 | | | | | | | | | 1 | | | | | | 1 | |
| Sub-shrubs/Gorse | | | | | | | | | | | | | | | | | |
| Sedge & Rush Moorland | 3 | | | | | | | 1 | | | | | | | 1 | 1 | |
| Farmland | 28 | 3 | 1 | 1 | 2 | 2 | 1 | 8 | 4 | | 1 | 4 | | | | | 1 |

As number of recorded sites in each ITE vegetation class that are located in each ULS unit

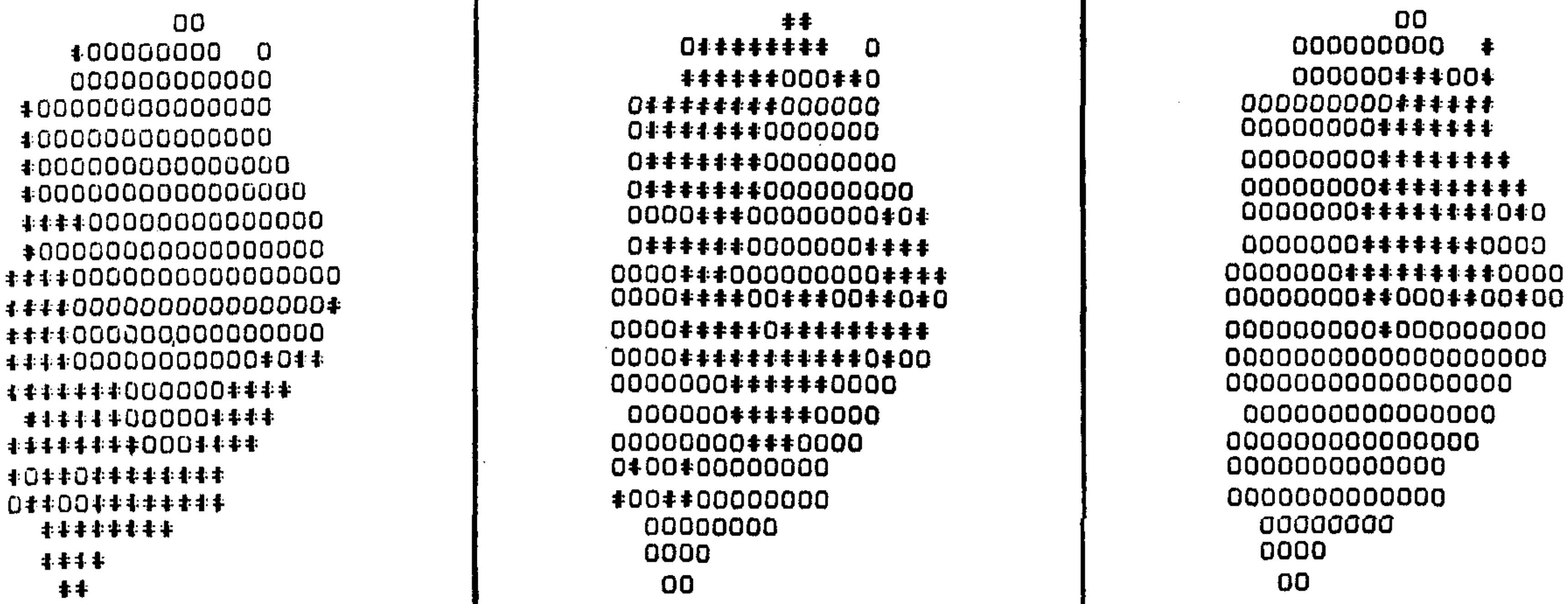
TABLE 7-3 PREDICTIONS OF CHANGE IN THE BALANCE OF VEGETATION GROUPS AT SITES LOCATED IN ULS MAPPING UNITS - LLANFACHRETH

| ULS Mapping Unit | ITE Vegetation Groups | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Improved Pastures | | | Rough Pastures | | | Grassy Heaths | | | Shrubby Heaths | | |
| | A | B | C | A | B | C | A | B | C | A | B | C |
| Smooth Grassland | | 2 | | 2 | 3 | | 3 | 4 | 2 | 4 | | 7 |
| Coarse Grassland/*Nardus* | | | | | 3 | | 3 | 8 | | 8 | | 11 |
| Coarse Grassland/*Molinia* | | 2 | | 2 | 9 | | 9 | 1 | 2 | 1 | | 10 |
| Bracken | 1 | 7 | | 6 | 7 | 3 | 7 | 2 | 4 | 2 | | 9 |
| Sub-shrubs/Heathers | | | | | 3 | | 3 | 3 | | 4 | 1 | 7 |
| Sub-shrubs/Bilberry | | | | | 1 | | 1 | | | 1 | 1 | 2 |
| Sub-shrubs/Gorse | | | | | | | | | | | | |
| Sedge & Rush Moorland | | 1 | | 1 | | 1 | | 1 | | 2 | 1 | 2 |
| Farmland | 7 | 22 | 3 | 15 | 5 | 12 | 5 | 1 | 7 | 1 | | 6 |

As number of recorded sites falling in each ITE vegetation group that are located in each ULS unit

A - situation as recorded
B - predicted balance of vegetation if agricultural use increased, 10+ yrs
C - predicted balance of vegetation if agricultural use decreased, 10+ yrs

FIGURE 7.2 ALTITUDE SECTORS - LLANFACHRETH

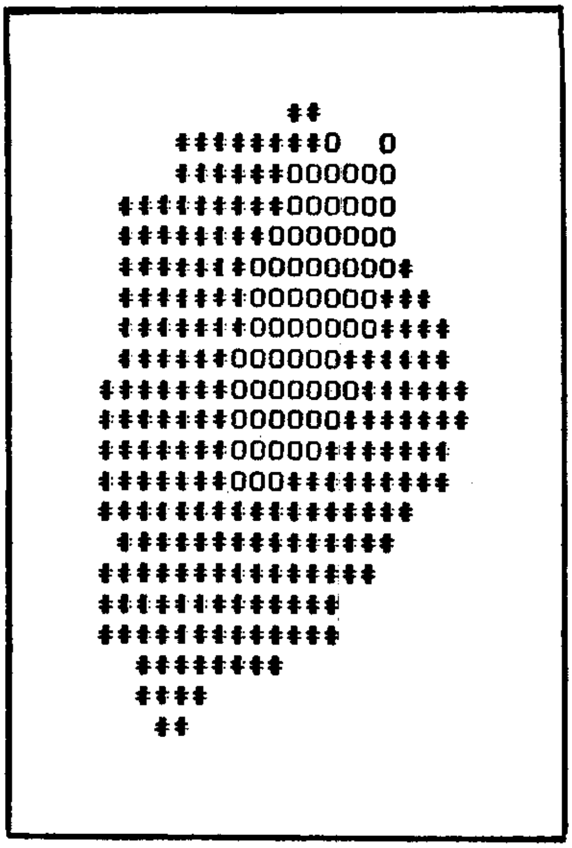


\+ , Dominantly Altitudes < 244m(800ft)

\+ Dominantly Altitudes 244-427m(800-1400ft)

\+ Dominantly Altitudes > 427m(1400ft)

FIGURE 7.3 RAINFALL SECTORS - LLANFACHRETH



\# High Rainfall (1601-2200mm,64-88in pa)

0 Very High Rainfall (2201-3000mm,88-120in pa)

FIGURE 7.4 TOPOGRAPHIC CHARACTERISTICS - LLANFACHRETH

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#0#############
####0########
0###0########
  ########
  ####
   ##
```

\# Roads Present

```
          ##
    #00##000#   0
    #00#00000000
 #0#000#00000000
 0#000##00000000
 #000##0000000000
 0#####00000000000
 0#####000000#00000
 #0##0#000000000000
0##0000000000000000#
0###000000000000000#
##0000000000#00#000
00##0###00#########
0###############0
 ######00#0#####
#0#############
#0##0###0####
00#00########
  #0######
  ####
   ##
```

\# Buildings Present

```
          00
    #00####0#  0
    #00##0000000
 0##00##00000000
 00000###0000000
 #0##0###00000000
 ####0##0000000000
 0#0###000000000000
 000#0#000000000000
0#0000#0000000000000
0##0000##0000#00000#
0#00##0#00#0#0##000
000######000#####0#
00##############0
 ##0############
0#######0######
00#0#########
00000########
  0#0#####
  #0##
   ##
```

\# Frequent Field Boundaries
Score > 10, on scale 0-25

FIGURE 7.5 LAND TYPES – LLANFACHRETH

```
          --
    ---------  1
    ------131111
 --------33333111
 ---1---33333311
 --31----13333311
 --------1111113334
 --------11111-1333-
 -------111111433---
-------111111133-11-
---------11---111-31-
---------1133--------
---------11---------
-------------------
 ---------------
---------------
-------------
----1--------
  --------
  ----
   --
```

HILL LAND GROUP

1 = Steep Hill

3 = Hill

4 = High Plateau

```
          55
    -55--55-5   -
    555--5------
 -5555----------
 -55------------
 -5-----5--------
 5--55-5----------
 5-----5-----5----5
 -55-5----------555
5--5555---------5--5
5---5555--555---5---
--55555---------5-555
55--5-----5------5-
-------------------
 --8---55--------
-5--------------
-5--5---------
5--5----------
  -5------
  ----
   --
```

UPLAND LAND GROUP

5 = Steep Upland

7 = Upland

8 = Upland Plateau

```
          --
    6--66--6-   -
    ---66-------
 6----66--------
 6---666--------
 6---666---------
 -66--6-----------
 -66666------------
 6--6-6------------
-66------------------
-666-----------------6
66-----6----66-6---
--66-666---666666-6
6666666666666666
 66-666--6666666
6-6666666666666
6-66-66666666
-66--66666666
  6-666666
  6666
   66
```

UPLAND MARGIN LAND GROUP

6 = Upland Margin

FIGURE 7.6 MOORLAND CORE, FRINGE AND FARMLAND - LLANFACHRETH

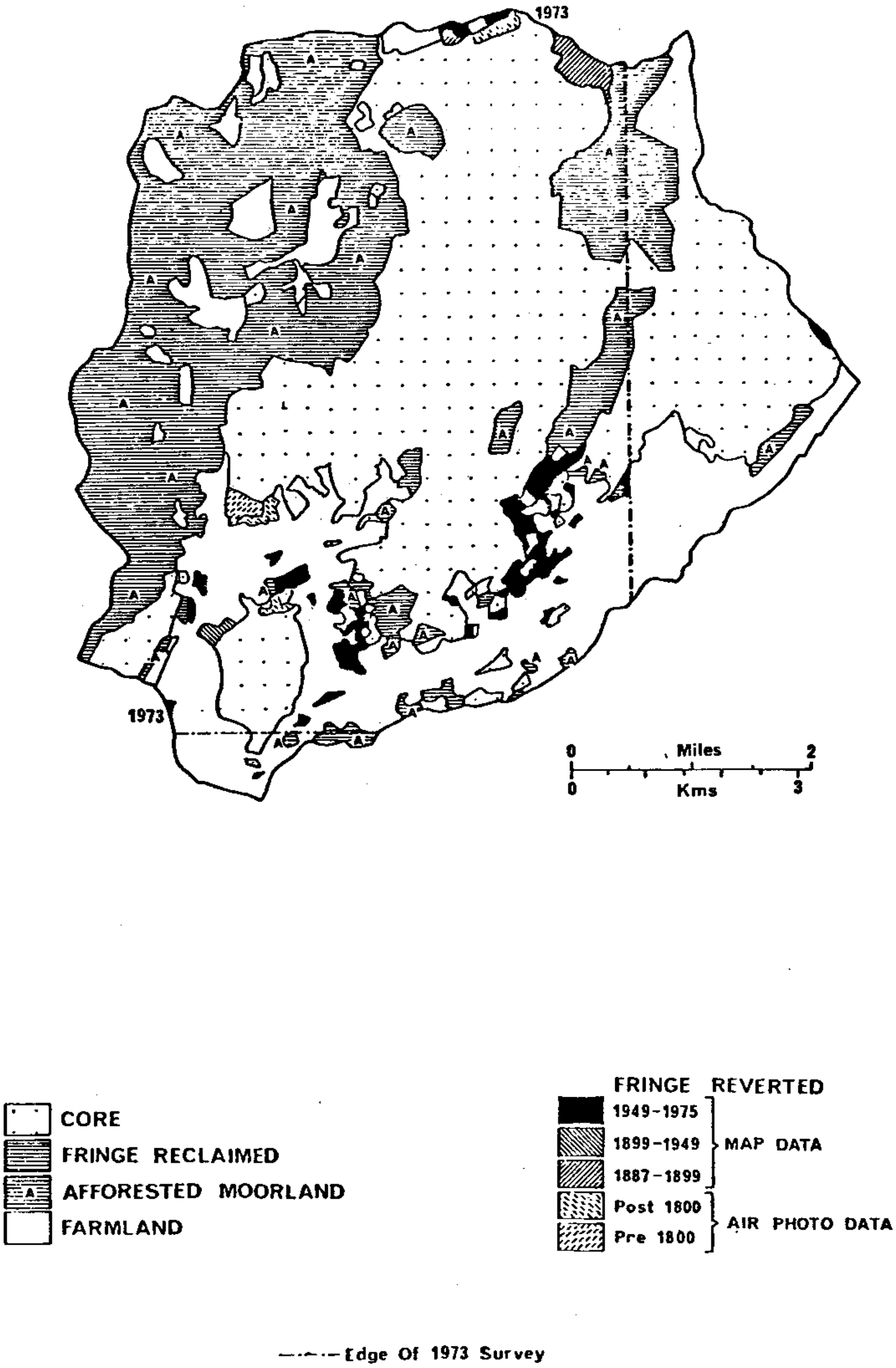
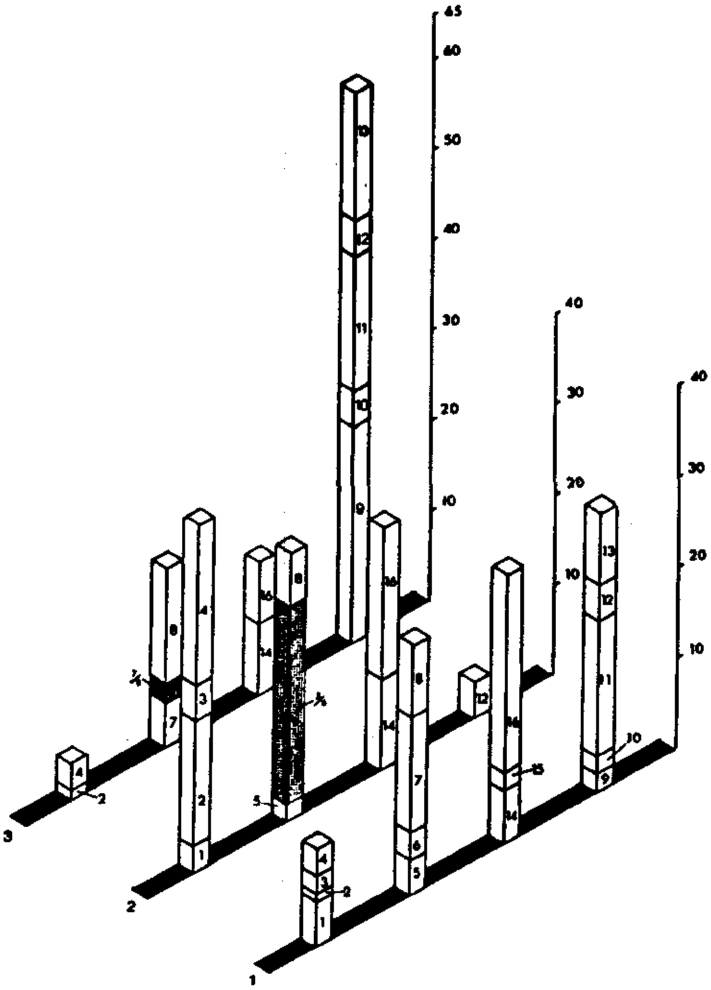


FIGURE 7.7 VEGETATION CLASS FREQUENCY AT MAIN SITES - LLANFACHRETH




| Vegetation Group | Class | | % Main Sites in Vegetation Class 1 | 2 | 3 |
|---|---|---|---|---|---|
| Improved Pastures | 1 | Lolium/Holcus/Pteridium | 5 | 3 | - |
| | 2 | Lolium Grassland | 1 | 14 | 1 |
| | 3 | Lolium/Trifolium | 2 | 4 | - |
| | 4 | Herb rich Lolium Grassland | 3 | 16 | 3 |
| Rough Pastures | 5 | Agrostis/Juncus | 4 | 2 | - |
| | 6 | Festuca/Juncus | 3 | - | - |
| | 7 | Agrostis/Holcus | 13 | - | 5 |
| | 8 | Festuca/Agrostis | 8 | 6 | 13 |
| | 5/6 | Agrostis/Juncus or Festuca/Juncus | - | 22* | - |
| | 7/8 | Agrostis/Holcus or Festuca/Agrostis | - | - | 2* |
| Grassy Heaths | 14 | Festuca/Vaccinium | 6 | 10 | 8 |
| | 15 | Festuca/Nardus/Vaccinium | 2 | - | - |
| | 16 | Festuca/Nardus/Molinia | 22 | 17 | 7 |
| Shrubby Heaths | 9 | Calluna/Molinia/Vaccinium | 2 | - | 24 |
| | 10 | Vaccinium/Calluna | 2 | - | 4 |
| | 11 | Nardus/Sphagnum/Calluna | 15 | - | 15 |
| | 12 | Eriophorum/Calluna | 4 | 4 | 4 |
| | 13 | Calluna | 8 | - | 14 |

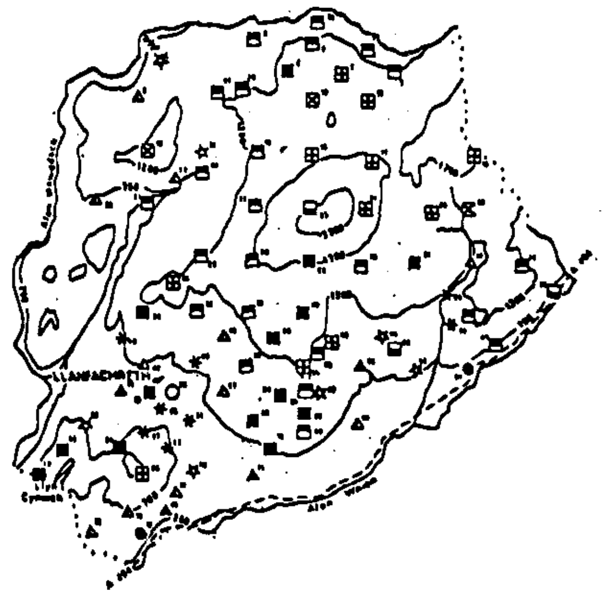
1. Recorded Main Sites, 1978.
2. Predicted Changes at Main Sites if Agriculture Increased, 10 + years.
3. Predicted Changes at Main Sites if Agriculture Decreased, 10 + years.

* Under a regime involving intensification of agriculture Class 16, Festuca/Nardus/Molinia, could move towards either Class 5, Agrostis/Juncus, or the closely related Class 6, Festuca/Juncus. Similarly, with a reduction in the level of agricultural activity, Class 3, Lolium/Trifolium could move towards Class 7, Agrostis/Holcus or Class 8, Festuca/Agrostis. These changes are indicated on the relevant histograms by the shaded areas.

FIGURE 7.8 LOCATION AND CLASSIFICATION OF VEGETATION MAIN SITES - LLANFACHRETH

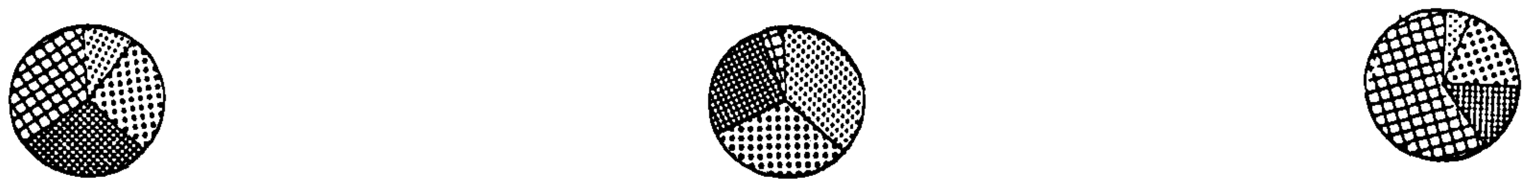
1978

Predicted if Agriculture Increased



Predicted if Agriculture Decreased

Overall Frequencies of Vegetation Groups



KEY TO FIGURE 7.8

| | | |
|---|---|---|
| Group 1. Improved Pastures | Class 1 : | Lolium/Holcus/Pteridium |
| | Class 2 : | Lolium |
| | Class 3 : | Lolium/Trifolium |
| | Class 4 : | Herb — rich Lolium |
| Group 2. Rough Pastures | Class 5 : | Agrostis/Juncus |
| | Class 6 : | Festuca/Juncus |
| | Class 7 : | Agrostis/Holcus |
| | Class 8 : | Festuca/Agrostis |
| Group 3. Grassy Heaths | Class 14: | Festuca/Vaccinium |
| | Class 15: | Festuca/Nardus/Vaccinium |
| | Class 16: | Festuca/Nardus/Molinia |
| Group 4. Shrubby Heaths | Class 9 : | Calluna/Molinia/Vaccinium |
| | Class 10: | Vaccinium/Calluna |
| | Class 11: | Nardus/Sphagnum/Calluna |
| | Class 12: | Eriophorum/Calluna |
| | Class 13: | Calluna |

KEY TO FIGURES 7.8 AND 7.9

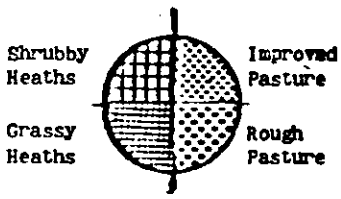
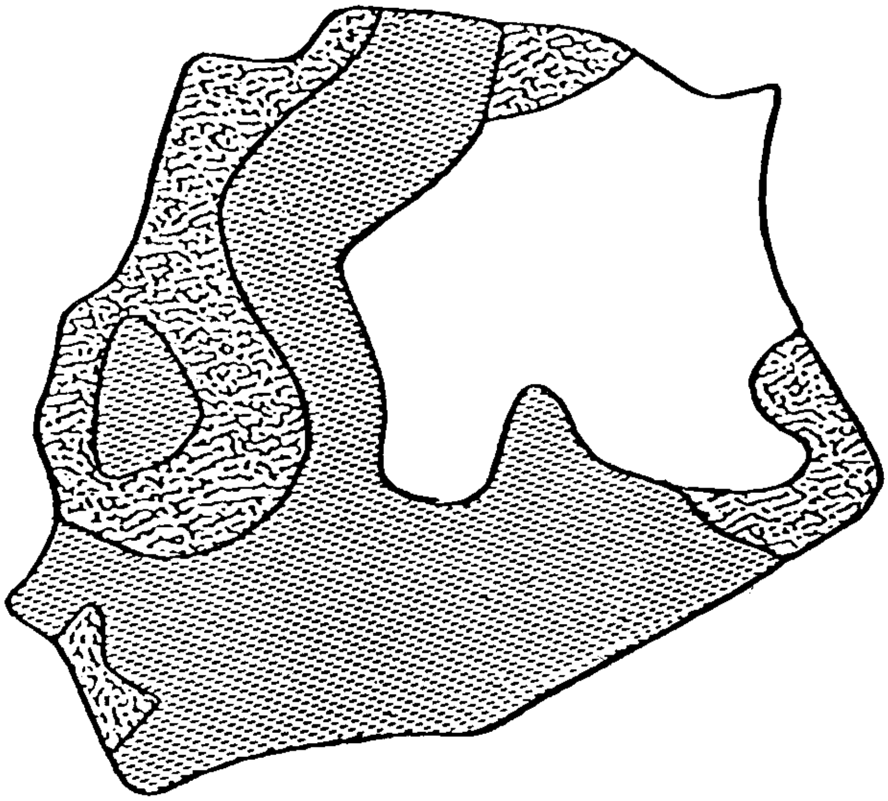


FIGURE 7.9 LAND GROUP-VEGETATION GROUP ASSOCIATIONS-LLANFACHRETH



**VEGETATION GROUP FREQUENCIES AT SITES IN LAND GROUPS**

**PREDICTED CHANGES AT MAIN SITES**

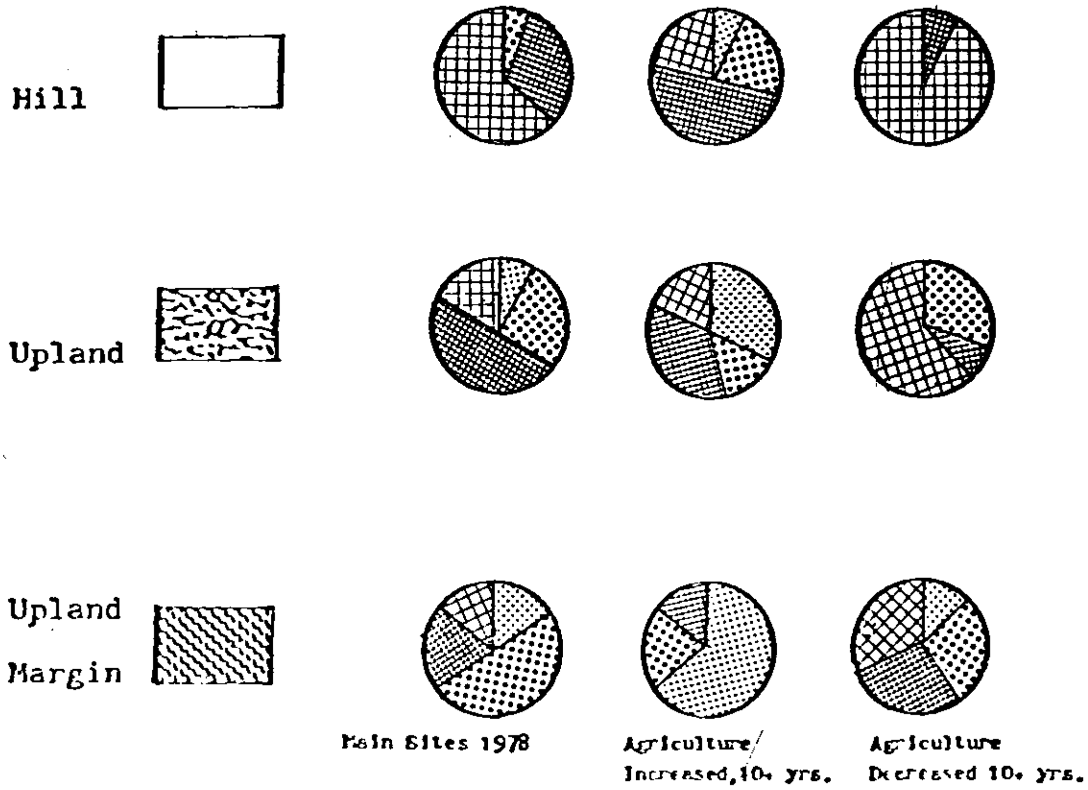
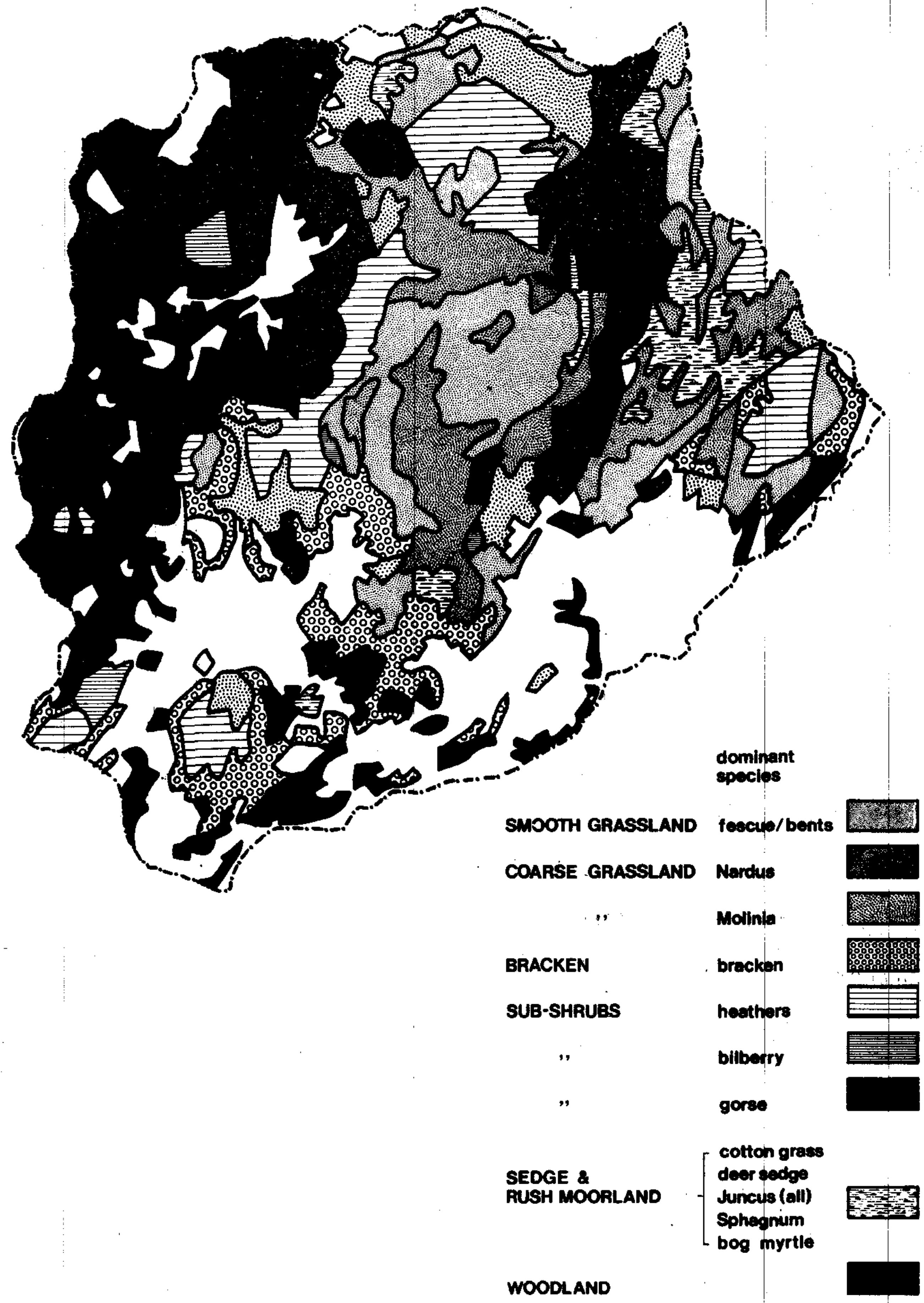
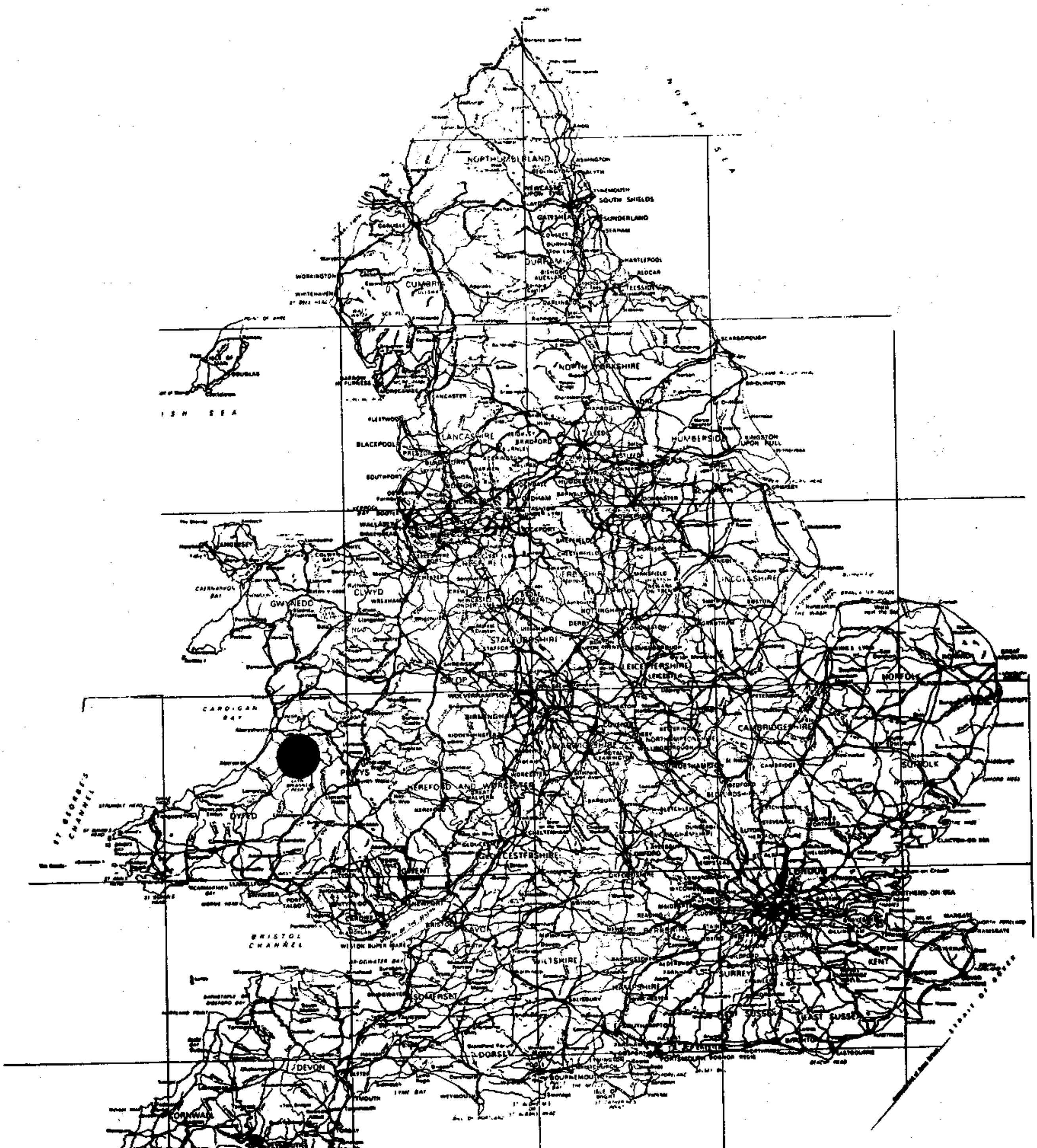


FIGURE 7.10 UPLAND LANDSCAPES STUDY VEGETATION MAP OF LLANFACHRETH



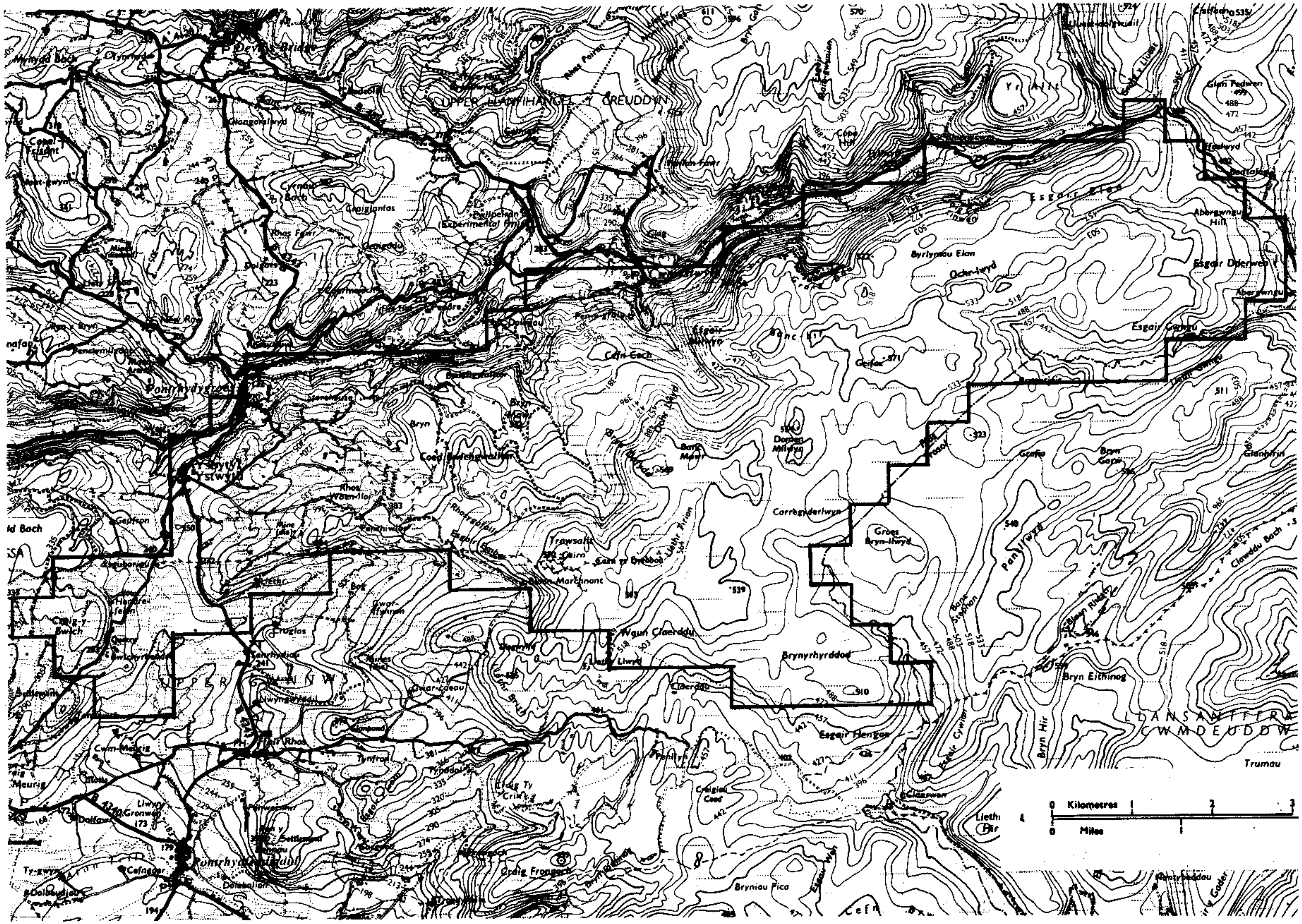

(Map by Geoffrey Sinclair, Environmental Information Services)

# YSBYTY YSTWYTH



The plate shows the north western corner of the study area on the edge of the village, looking north eastwards along the valley of the Afon Ystwyth. On the valley sides plantations contrast with fairly extensive deciduous woodland. These give way to moorland on the hill tops in the distance The foreground fields are rough and improved pastures.
(Photo by P.Ainsworth)

FIGURE 8.1 THE STUDY AREA OF YSBYTY YSTWYTH



# STUDY AREA 8: YSBYTY YSTWYTH, DYFED

## PHYSICAL ENVIRONMENT

The study area of Ysbyty Ystwyth (Figure 8-1) is situated in the west of the Cambrian Mountains region, about 18 km southeast of the mid-Wales coastal town of Aberystwyth. It covers 53 $km^2$, occupying an elongated wedge running from the village of Ysbyty Ystwyth eastwards up to and just across the watershed that runs approximately north-south through the centre of Wales. Thus it is drained in part westwards by tributaries of the River Ystwyth (Plate 1), and in part eastwards by streams such as the Elan which eventually feed the Mid-Wales reservoir system (Part I, Plate 13). The northern boundary of the area follows the River Ystwyth as it flows past the old mines of Cwmystwyth.

High ground with altitudes above 426 m (1 400 ft) dominates the eastern half of the area (Part I, Plate 13). Moderate altitudes (244-427 m, 801-1 400 ft) are dominant in the west, and there is some ground below 244 m along the course of the Ystwyth (Figure 8-2). Slopes are mainly moderate (5-11°) over most of the area but steep and very steep slopes are important in the north in a band along the southern side of the Ystwyth valley (Plate 1), while gentle slopes are dominant in the southeastern tip of the area and in a band along its southern edge (Figure 8-3).

Climatically, relative to the range covered by the 12 study areas Ysbyty Ystwyth can be classified as cold and wet (Part I, 2.32). Mean temperatures for January and October are estimated as 1.8 and 8.8°C, the annual average of daily sunshine hours is 3.25, and 20 days are given as the average with snow lying. There is of course considerable variation in these quantities between the village locality and the eastern hills (see Part I, 2.31 for temperature considerations). In the west, around the village, rainfall is fairly high (1 201-1 600 mm, c. 48-64 in pa) while over the hills stretching to the east it is high (1 601-2 200 mm, c. 64-88 in pa).

Geologically, the area consists entirely of siltstones and slaty shales with subordinate sandstones of Lower Silurian (Llandovery) age. The early geological maps show it as drift free, but much of the hill sector actually has peat cover, many of the steeper slopes have scree and periglacial head deposits mantling them, and some glacial drifts must occur in valleys and depressions. On the national soil map the western half of the study area is mapped in a unit dominated by Brown Earths with subordinate Brown Podzolic Soils and Gleys. A narrow band in the centre of the study area around Llyn Fyrddon is mapped as dominated by Peaty Podzols in association with Peaty Gleys, Brown Podzlic Soils, Rankers and Peat. The eastern quarter of the area is shown as dominated by Peat with subordinate Peaty Gleys and Peaty Podzols.

On the agricultural land classification map a small area adjoining the Ysbyty Ystwyth-Pontrhydfendigaid road is mapped as grade 4. Otherwise the study area is all mapped as grade 5, apart from 'other uses' covering the forest plantation of Coed Bwlchgwallter.

Topographic features are illustrated in the schematic maps of Figure 8-4. Roads and buildings are concentrated in the west or follow the course of the Ystwyth. The limited extent in relatively intensive agricultural use is shown by the sector with frequent field boundaries.

The physiographic and topographic distinctions between an eastern part and the remainder of the area are reflected in the distribution of land types. Figure 8-5 shows the widespread hill land group to be concentrated in the east (Part I, Plate 13), with hill and high plateau land types most prominent. The upland land group, principally the steep upland land type, flanks this hill sector along the northwest margin. Upland and upland plateau occupies the southeastern corner, while upland margin occurs around the village and scattered along the Ystwyth Valley.

## LAND-USE HISTORY

Ysbyty Ystwyth through history, and probably prehistory also, has been a centre for metal mining. It has also supported a pastoral economy that depends on stock movements between lower ground in winter and high moorland grazings in summer, a system traditionally introduced to the area in the 12th century by the Cistercian monks of Strata Florida to the south. The persistence of this pastoral economy is illustrated by the kind of references made to the local manorial court during the 18th century. These mention the need to repair 'the mountain fence', presumably to stop livestock straying and to prevent people not entitled to common rights from turning their cattle, sheep and horses onto the commons. One of the most serious difficulties was preventing the construction by squatters of 'new houses and ditches'. A surveyor for the Crosswood Estate of some 17 000 ha (42 000 acres) described in 1814 how over 100 houses had been built by encroachment and recounted how 'a great many of the sheep walks on this Estate' had been rendered useless because of this 'worst description of people, the very scum of this and other counties'! In many cases, the scale of squatting reflected the lack of interest taken by landowners and commoners in the higher ground. This is borne out by the surveyor's remark that 'the persons that were appointed to show me the estates were very often at a loss to point out the boundaries and in many parts of the sheep walks I could not find any person who could distinguish the boundary from that of other properties' (Crosswood Deeds, manuscript).

Turning back to mining, it was only because landowners had again begun to appreciate the potential value of the minerals under their estates after an Act of 1693 gave them, rather than the Crown, the right to profit from mines on their land, that they began to take a greater interest in curbing the activities of trespassers. In opposition to this aim, employment in the mines encouraged more people to come to the area. In some cases squatters were evicted but more usually the threat of eviction was used to persuade them to become tenants paying an annual rent. This brought mutual benefit. It gave the landowner greater income and assured him of labour for the metal mines that were being extensively exploited, and it was accepted by the squatters as it regularised their position in a locality that could provide work. Settlement was thus greater than the agricultural resource justified and was only sustained by employment in mining. This was at a peak in the latter part of the 19th century when in 1871 Ysbyty Ystwyth reached its highest recorded population (941). From this time, the prosperity of the mines declined. Because this also coincided with a national fall in the profitability of upland farming as cheaper world food supplies became available, the population inevitably dropped. In 1931 it was 402 and by the 1971 census it was 227 compared to the 941 peak in the 19th century. No mines have operated in recent years, but there is a working roadstone quarry in the western corner of the parish.

In the later 18th and early 19th centuries, Ysbyty Ystwyth was on the fashionable tourist itinerary. This resulted from the construction by Thomas Johnes of a mansion at Hafod just north of the Ystwyth. The landscaped Hafod Estate, which extended south of the river within the study area, provided 'romantic' walks and vistas, with planted and architectural features. Landowners in the area were criticised in the early 19th century for neglecting woodlands but Johnes planted substantially, mainly north of the Ystwyth. Deciduous woodlands planted by Johnes have largely been cleared during the 20th century wars and the remnants are now almost obscured by conifer plantations such as that of Coed Bwlchgwallter (Plate 1 and Part I, Plate 30). The agricultural improvements carried out by Johnes also made the estate of public interest but the financial burden of the whole activity was too great and it did not survive Johnes' death. Now the area is not a major recreational magnet.

The Tithe Commutation Survey of 1841, when the then parish of Ysbyty Ystwyth was estimated to cover 2 244 ha (5 544 acres), recorded 1 215 ha (3 000 acres) of common, 810 ha (2 000 acres) of meadow and pasture, and 160 ha (400 acres) of arable producing barley, potatoes and oats (Public Record Office). During the 20th century, tillage area and cattle numbers have fallen, while sheep numbers, though fluctutating, have remained of a similar order between 1900 and 1965 (Part I, Figures 4-4 to 4-6). ULS (1979) calculate a fall of crops and grass from 15% of the area in 1886 to 13% in 1978, with an increase in woodland (including plantations) from 4 to 8% between the same years.

Mapping carried out by the Ordnance Survey first in 1886 was later revised in 1901, 1948 and, for part of the parish, in 1964. From these revisions, supported by air photographs, Figure 8-6 identified moorland core as extending over 3 800 ha, with a moorland fringe of 568 ha that includes 320 ha of moorland that have been afforested since the mid-1950s. The non-afforested fringe occurs mostly in the upland margin and steep upland land types (37 and 31% of the fringe fall respectively into land types which occupy 16 and 17% of the total area), the remainder being in the upland and upland plateau land.

## VEGETATION

The vegetation at 75 main sites was recorded in 1978. Figure 8-7 includes the frequency then of vegetation classes at main sites, and Figure 8-8 gives their location and vegetation class.

More than half (53%) of the sites examined were shrubby heaths and a further 30% grassy heaths. This strong moorland element in the vegetation characterises central and eastern sectors. East of a line approximately from Dologau in the north to Blaen-Marchnant in the south, the central moorland sites are dominated by shrubby heaths of classes 11, Nardus/Sphagnum/Calluna heath (present at 23% of the main sites), and 12, Eriophorum/Calluna heath (at 26% of sites) (see Part I, Plate 42). It is of interest that this study area was the only one in which evidence of burning as a management tool was not noted at recorded heath sites. If this is a persistent management characteristic it should have an impact on the character and possibly the survival of the shrubby heaths. Peripheral to these shrubby heaths is a zone in which the recorded sites are dominated by grassy heath vegetation, with sites of Festuca/Nardus/Molina heath, class 16, prominent south of Llyn Fyrddon (12% of sites). In the west around Ysbyty Ystwyth this class, with Festuca/Vaccinium heath, class 14 (at 18% of the recorded sites), is associated particularly with rough pasture of class 8, Festuca/Agrostis grassland (Part I, Plate 30). The apparent gap without recorded sites in the north central part of the area on Figure 8-7 is due to the Forestry Commission plantation of Coed Bwlchgwallter, planted, as previously noted, over the landscaped grounds of Hafod, the 18th century mansion later destroyed by fire. Only along the northern boundary following the Ystwyth (Plate 1), and around the village, are improved and rough pastures, particularly the latter, prominent at the recorded sites.

Woodland at 10 sites recorded also in 1978, concentrated along the Ystwyth and in the west, consists of 6 sites classified as upland acid woodlands and 4 as lowland acid woodlands (Part I, Table 3-4).

Table 8-1 shows the relationship of vegetation classes at main sites with the land types in which they are situated, while Figure 8-9 sketches the frequency of vegetation groups in land groups, using a map of land groups simplified from Figure 8-5. Upland margin sites were all pastures; upland sites had mainly rough pastures and heaths, while hill sites were dominantly shrubby heaths.

## POTENTIAL VEGETATION CHANGE

Land-uses other than agriculture have major impacts on the present and future of this area. The largest landowner is the Welsh Water Authority, concerned with maintenance of the catchment of its reservoirs to the east. A possible extension of these reservoirs could involve loss of farmland, accompanied by some balancing hill land improvement (ULS 1979). The status of common lands is being disputed. Forestry is an important employer in the region and could be expanded locally from the existing major plantation. Simplified assessments of forestry potential (Part I, 5.95-5.100), which retain more favourable land in agriculture and assume that commercial planting could not extend above 427 m (1 400 ft), give 25% of the area as potential forestry land, compared to the 8% of present forest (ULS 1979). The conservation aim to maintain a substantial area of little modified and relatively undisturbed moorland is another influence on the future. The Nature Conservancy Council wishes to see the present fairly low-intensity type of agriculture continue in the interests of wild life conservation. It is not possible to predict confidently the outcome of interactions between these major interests.

So far as agriculture is concerned, expansion of effort in the presently farmed area seems unlikely as the farming structure is based on small fragmented units, with many farmers having other sources than agriculture for part of their income (ULS 1979). On the moorland, changes could be minimal or noticeable depending on resolution of the disputes over common land, and the intentions of the Water Authority. ULS application of the ADAS (Ministry of Agriculture) criteria for hill land classification that are now being developed shows 75% of the rough grazing to be generally not improvable, though rather more than half of this has 'some grazing value'. Only 15% of the present rough grazing is assessed as 'improvable' without site limitation.

Although land holding factors could thus lead to either stability or major change, it is possible to put these options aside and to consider potential changes of vegetation in this area in the standard way that was been applied to all areas in this study. Figure 8-8 shows predicted changes of vegetation class that could occur at the recorded main sites, based on application of the general principles of gradual change following agricultural intensification or decline set out in Part I (5.74-5.78 and Figure 5-4) and summarised in <u>Appendix 2</u>. The frequencies of vegetation classes that could result from such changes are included in Figure 8-7.

It has been noted previously that the most prominent vegetation classes are shrubby heaths of class 11 (<u>Nardus</u>/<u>Sphagnum</u>/<u>Calluna</u> heath) and class 12 (<u>Eriophorum</u>/<u>Calluna</u> heath), with grassy heath classes 14, <u>Festuca</u>/<u>Vaccinium</u> heath, and 16, <u>Festuca</u>/<u>Nardus</u>/<u>Molinia</u> heath. The standard predictions for change are that intensified agriculture could cause these grassy heaths to change to rough pastures and shrubby heath class 11 to move towards grassy heath class 16. Shrubby heath class 12 is unlikely to change significantly. If agriculture declined the grassy heaths could move towards shrubby heaths but initially at least to rather drier classes (classes 13 or 9, <u>Calluna</u> heath or <u>Calluna</u>/<u>Molinia</u>/<u>Vaccinium</u> heath) than the wet boggy moorland classes which are now the most common shrubby heaths.

The overall impact of the predicted changes is that agricultural intensification could involve increases in improved pastures (from 6 to 17% of sites) and of rough pastures (from 11 to 30% of sites) while shrubby heaths would fall from 53 to 26% of sites. From predictions of change following agricultural decline, there would be a substantial increase in shrubby heaths (to 83% of recorded sites) with falls in other vegetation groups. 68% of sites could change their vegetation group on agricultural intensification and 45% on agricultural decline.

The relationship between the predicted balances of vegetation groups and the land groups in Ysbyty Ystwyth is included in Figure 8-9. Change would be most obvious in the upland group, with pastures becoming more prominent than heaths after agricultural intensification, or almost disappearing with agricultural decline. In the upland margin group, heaths would replace rough pastures at about a third of the sites under the agricultural decline predictions.

Figure 8-10 reproduces the vegetation map prepared in the Upland Landscapes Study (1979). It is possible to correlate ITE vegetation classes at main sites (including the additional sites recorded in 1979, see Part I, 5.66-5.67) with the ULS mapping units in which they are situated (Table 8-2). Appendix 3 discusses the overall correlation for 11 study areas. Most ULS map units in this area include a range of grassy and shrubby heaths. The most widespread, 'sedge and rush moorland', includes mainly sites of 2 shrubby heath classes. 'Farmland' appears to contain a wide range of vegetation classes, around 35% of the sites in this unit being classified as heaths. Table 8-3 sets out the proportions in which ITE classes could occur at main sites in each ULS mapping unit if the standardised courses of vegetation change discussed above occurred in this area. The 'coarse grassland/Molinia' unit is one which could show the relatively largest swings between pastures and heaths.

CONCLUSION

Ysbyty Ystwyth has opposed interests acting towards stability or change. Conservation interests wish to sustain the present low tempo agriculture and retain the open moorland, while present farm structure and farmers' attitudes also tend to main the status quo. Forestry however could expand if the common land issue and water catchment needs were resolved. Water requirements might, by drowning some land and encouraging the upgrading of other moorland in compensation, affect the vegetation of the moorland markedly. If conservation interests prevail, then change as a result of impetus from agricultural activity alone is unlikely to be great. At present, Ysbyty Ystwyth has the third largest proportion of shrubby heath sites of any study area (after Lunedale and Heptonstall) and it is clearly ecologically important as having one of the least disturbed moorland sectors among the study parishes. The potential for forestry expansion is considerable and might lead, by compromise, to intensified agriculture in the west based on fewer larger farm units. Forestry or water developments then could bring about substantial vegetation change but on balance, probably the present situation may survive largely unchanged, at least in the short term.

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TABLE 8-1 CORRELATION OF VEGETATION CLASSES AND LAND TYPES - YSBYTY YSTWYTH

| Vegetation Group and Class | | Land Group and Type | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Hill | | | Upland | | | Upland Margin (6) |
| | | Steep Hill (1)* | Hill (3) | High Plateau (4) | Steep Upland (5) | Upland (7) | Upland Plateau (8) | |
| Improved Pastures | 1 | | | | | | | 1 |
| | 2 | | | | | | | 1 |
| | 3 | | | | | | 1 | 1 |
| | 4 | | | | | | | |
| Rough Pastures | 5 | | | | | | | |
| | 6 | | | | | 1 | | |
| | 7 | | | | | | | 2 |
| | 8 | | | | 3 | 1 | | 3 |
| Grassy Heaths | 14 | 2 | 4 | 2 | 4 | 1 | | |
| | 15 | | | | | | | |
| | 16 | | 3 | 3 | 3 | | | |
| Shrubby Heaths | 9 | 1 | | | | | | |
| | 10 | 1 | | | 1 | | | |
| | 11 | 3 | 8 | 3 | 1 | 1 | 1 | |
| | 12 | 1 | 12 | 6 | | | | |
| | 13 | | | | | | | |

As number of sites of each vegetation class located in each land type.
* Land type numbers as used on computer maps, Figure 8-5.

TABLE 8-2 CORRELATION OF ULS VEGETATION MAPPING UNITS AND ITE VEGETATION CLASSES - YSBYTY YSTWYTH

| ULS Mapping Unit | Number of ITE Sites in Area of ULS Unit | ITE Vegetation Class: Improved Pastures | | | | Rough Pastures | | | | Grassy Heaths | | | Shrubby Heaths | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 14 | 15 | 16 | 9 | 10 | 11 | 12 | 13 |
| Smooth Grassland | 7 | | 1 | 1 | | | | | 1 | 2 | | | | | 1 | | 1 |
| Coarse Grassland/*Nardus* | 4 | | | | | | | | | 1 | | 3 | | | | | |
| Coarse Grassland/*Molinia* | 25 | | | 2 | | | | | 2 | 6 | | 3 | | 2 | 6 | 4 | |
| Bracken | 2 | | | | | | | | | 2 | | | | | | | |
| Sub-shrubs/Heathers | 2 | | | | | | | | | | | 1 | | | 1 | | |
| Sub-shrubs/Bilberry | 3 | | | | | | | | | 1 | | | | | 1 | 1 | |
| Sub-shrubs/Gorse | 4 | | | | | | | 2 | | 1 | | | | | | 1 | |
| Sedge & Rush Moorland | 27 | | | | | | | | | 2 | | 3 | | 1 | 8 | 13 | |
| Farmland | 14 | | | 1 | | 1 | | 2 | 5 | 1 | | 3 | | | | | 1 |

As number of recorded sites in each ITE vegetation class that are located in each ULS unit

TABLE 8-3 PREDICTIONS OF CHANGE IN THE BALANCE OF VEGETATION GROUPS AT SITES LOCATED IN ULS MAPPING UNITS - YSBYTY YSTWYTH

| ULS Mapping Unit | ITE Vegetation Groups | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Improved Pastures | | | Rough Pastures | | | Grassy Heaths | | | Shrubby Heaths | | |
| | A | B | C | A | B | C | A | B | C | A | B | C |
| Smooth Grassland | 2 | 3 | 1 | 1 | 2 | 1 | 2 | 2 | 1 | 2 | | 4 |
| Coarse Grassland/*Nardus* | | | | | 4 | | 4 | | | | | 4 |
| Coarse Grassland/*Molinia* | 2 | 4 | | 2 | 9 | 2 | 9 | 8 | 2 | 12 | 4 | 21 |
| Bracken | | | | | 2 | | 2 | | | | | 2 |
| Sub-shrubs/Heathers | | 1 | | | 1 | | 1 | | | 1 | | 2 |
| Sub-shrubs/Bilberry | | | | | 1 | | 1 | 1 | | 2 | 1 | 3 |
| Sub-shrubs/Gorse | | 2 | | 2 | 1 | 2 | 1 | | | 1 | 1 | 2 |
| Sedge & Rush Moorland | | | | | 5 | | 5 | 9 | | 22 | 13 | 27 |
| Farmland | 1 | 9 | | 8 | 4 | 3 | 4 | | 6 | 1 | 1 | 5 |

As number of recorded sites falling in each ITE vegetation group that are located in each ULS unit

A - situation as recorded

B - predicted balance of vegetation if agricultural use increased, 10+ yrs

C - predicted balance of vegetation if agricultural use decreased, 10+ yrs

FIGURE 8.2 ALTITUDE SECTORS - YSBYTY YSTWYTH

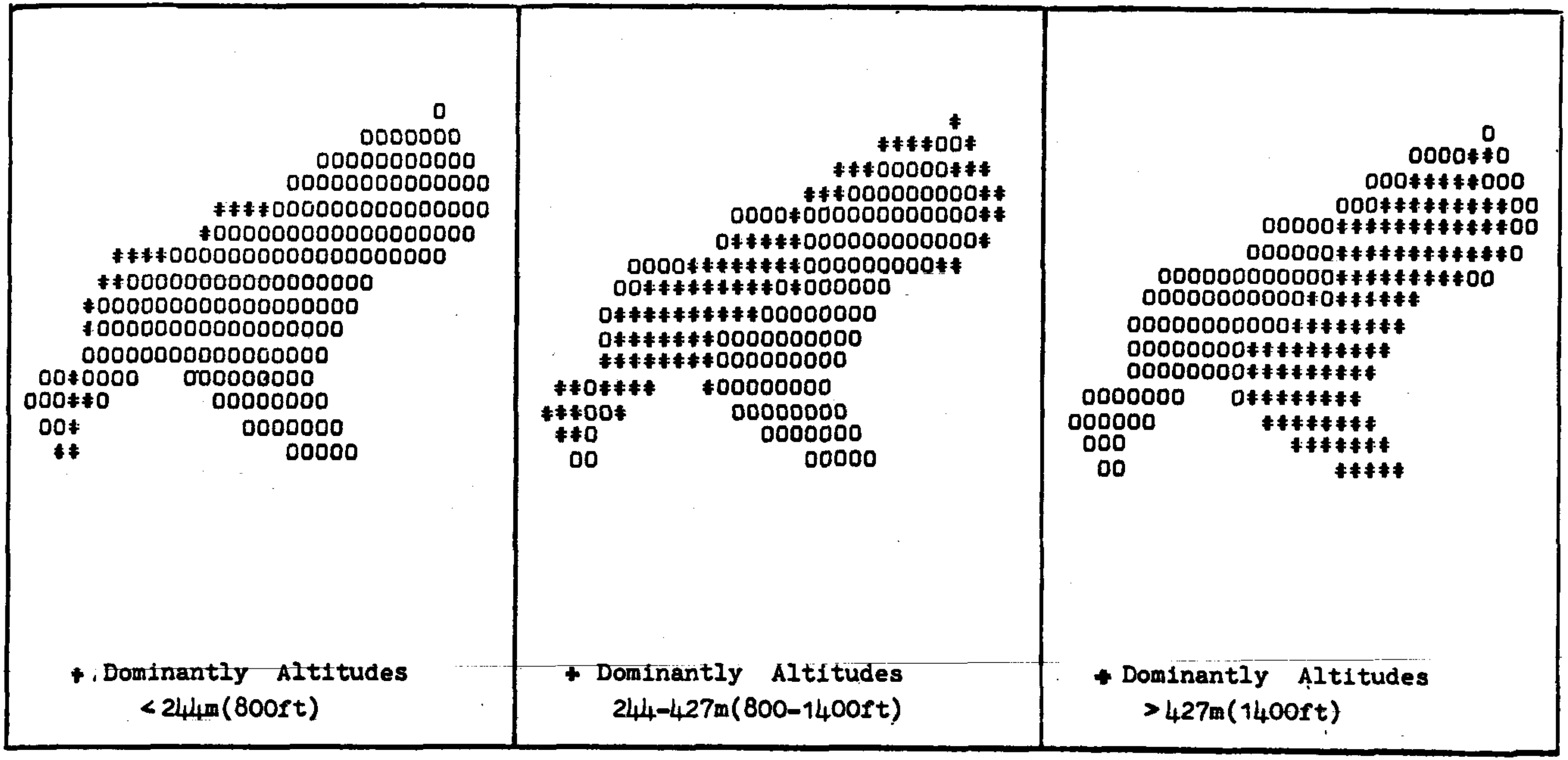


FIGURE 8.3 SLOPE SECTORS - YSBYTY YSTWYTH

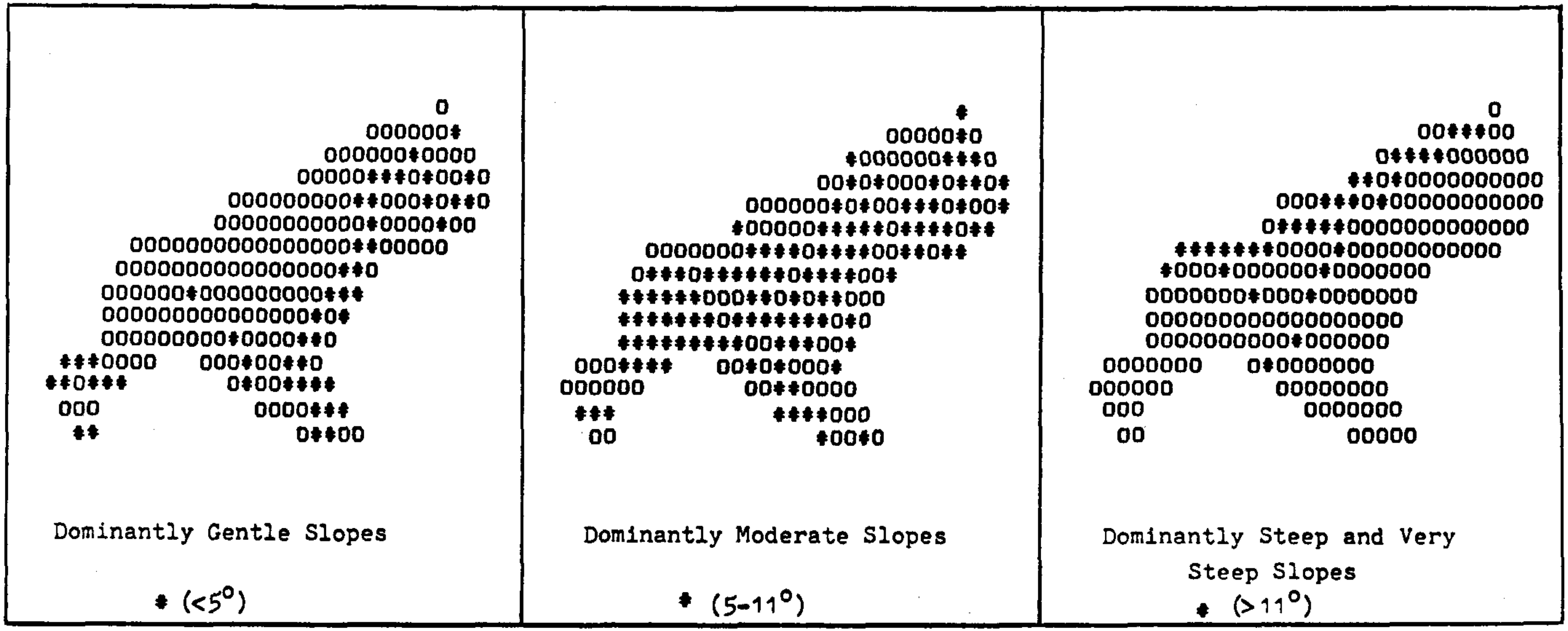


FIGURE 8.4 TOPOGRAPHIC CHARACTERISTICS - YSBYTY YSTWYTH

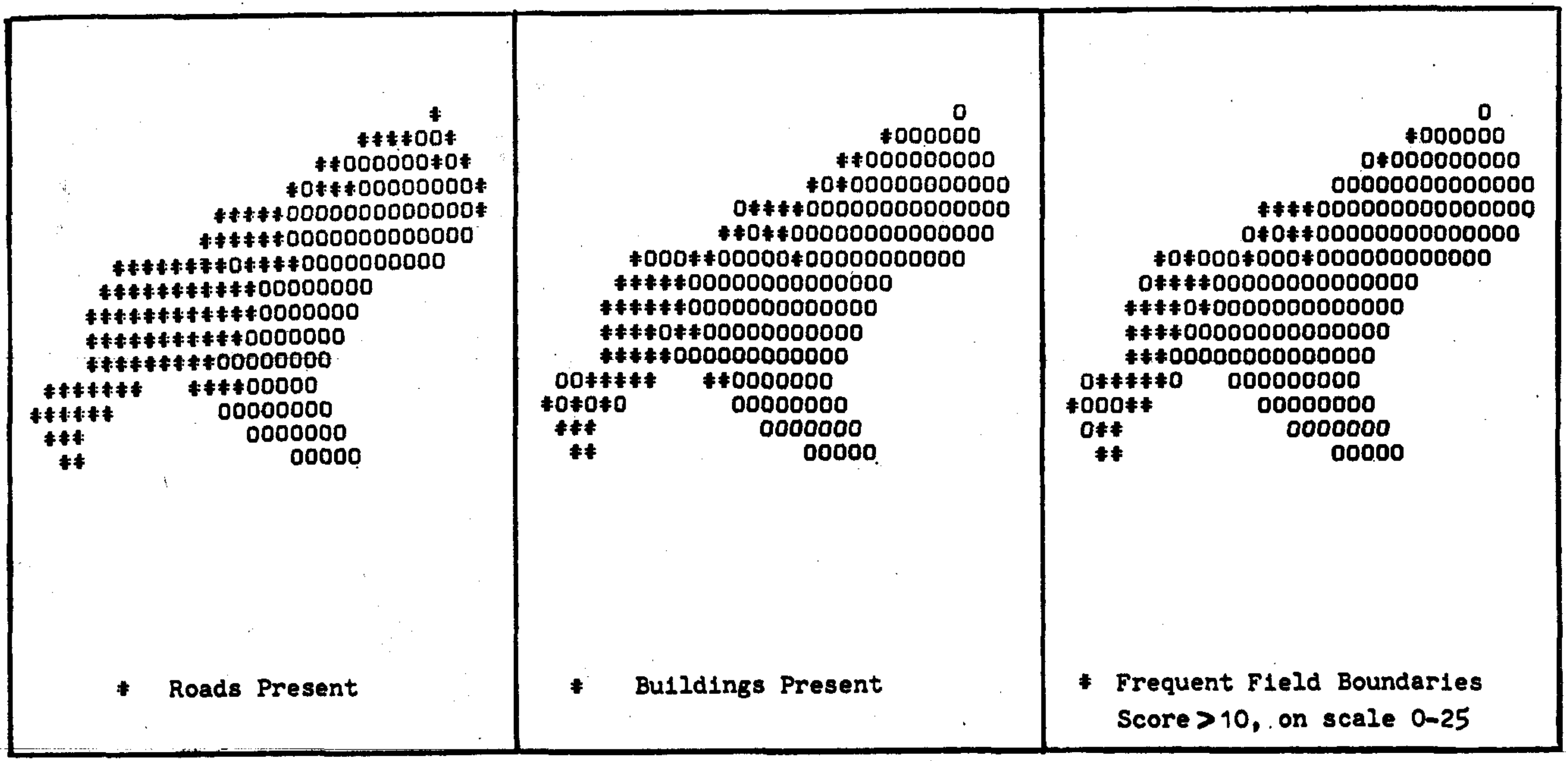


FIGURE 8.5 LAND TYPES – YSBYTY YSTWYTH

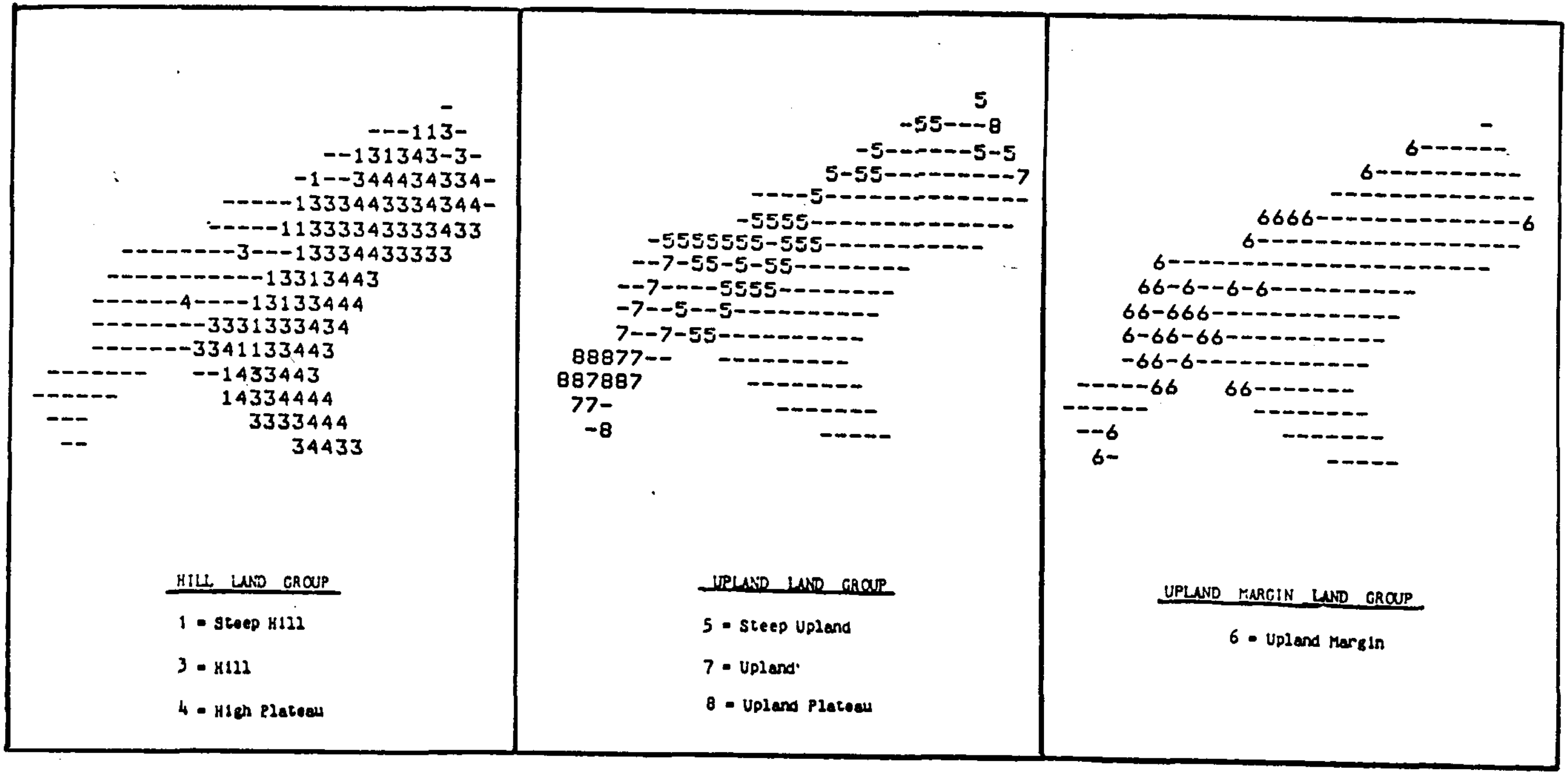
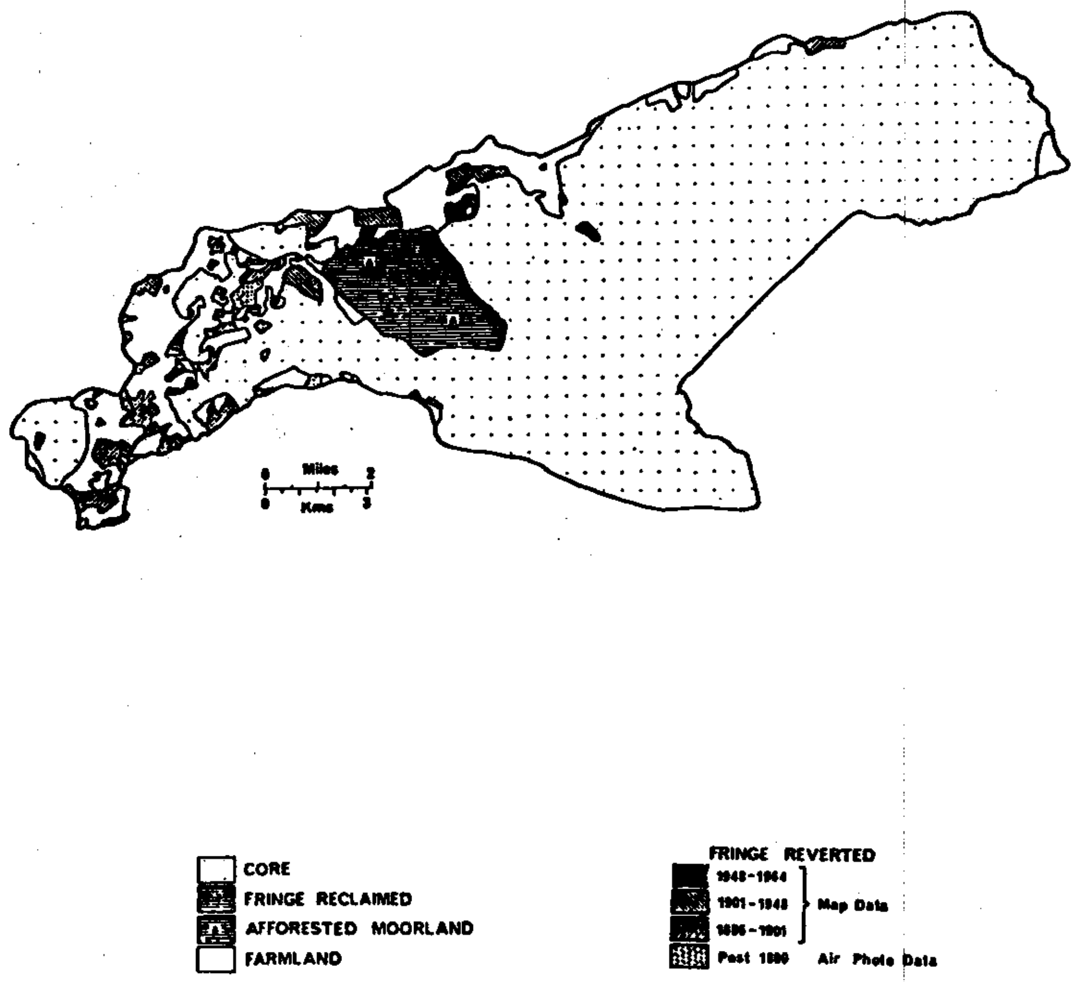
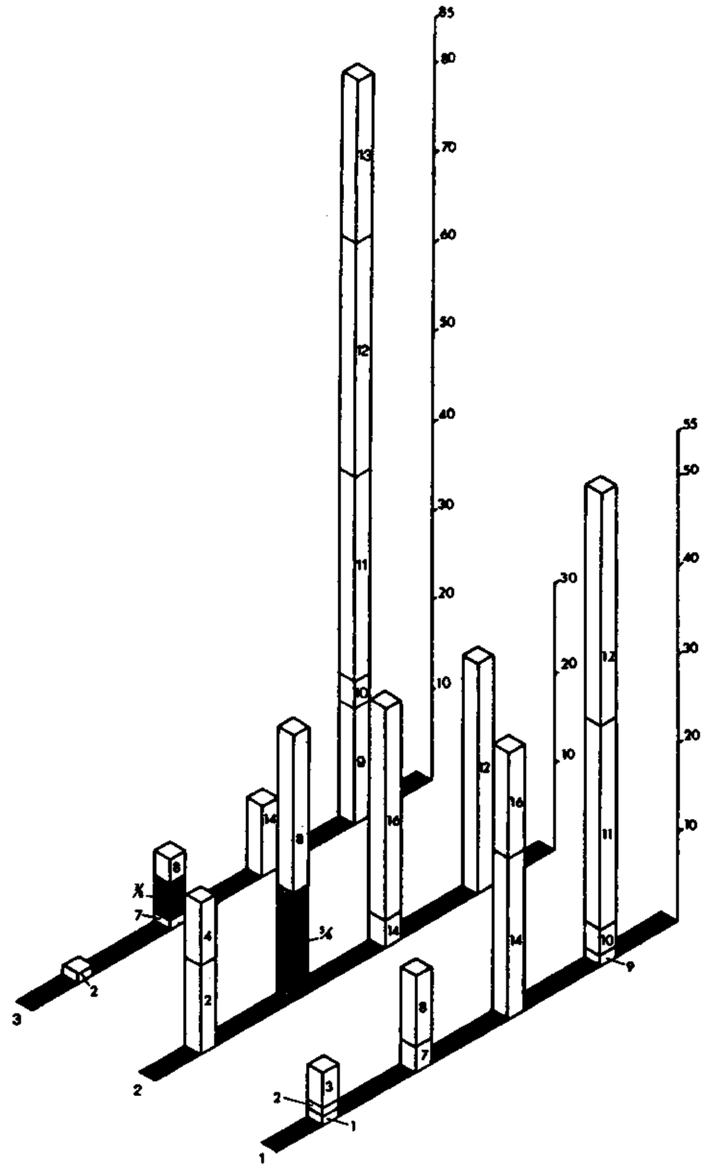


FIGURE 8.6 MOORLAND CORE, FRINGE AND FARMLAND - YSBYTY YSTWYTH



# FIGURE 8.7 VEGETATION CLASS FREQUENCY AT MAIN SITES - YSBYTY YSTWYTH



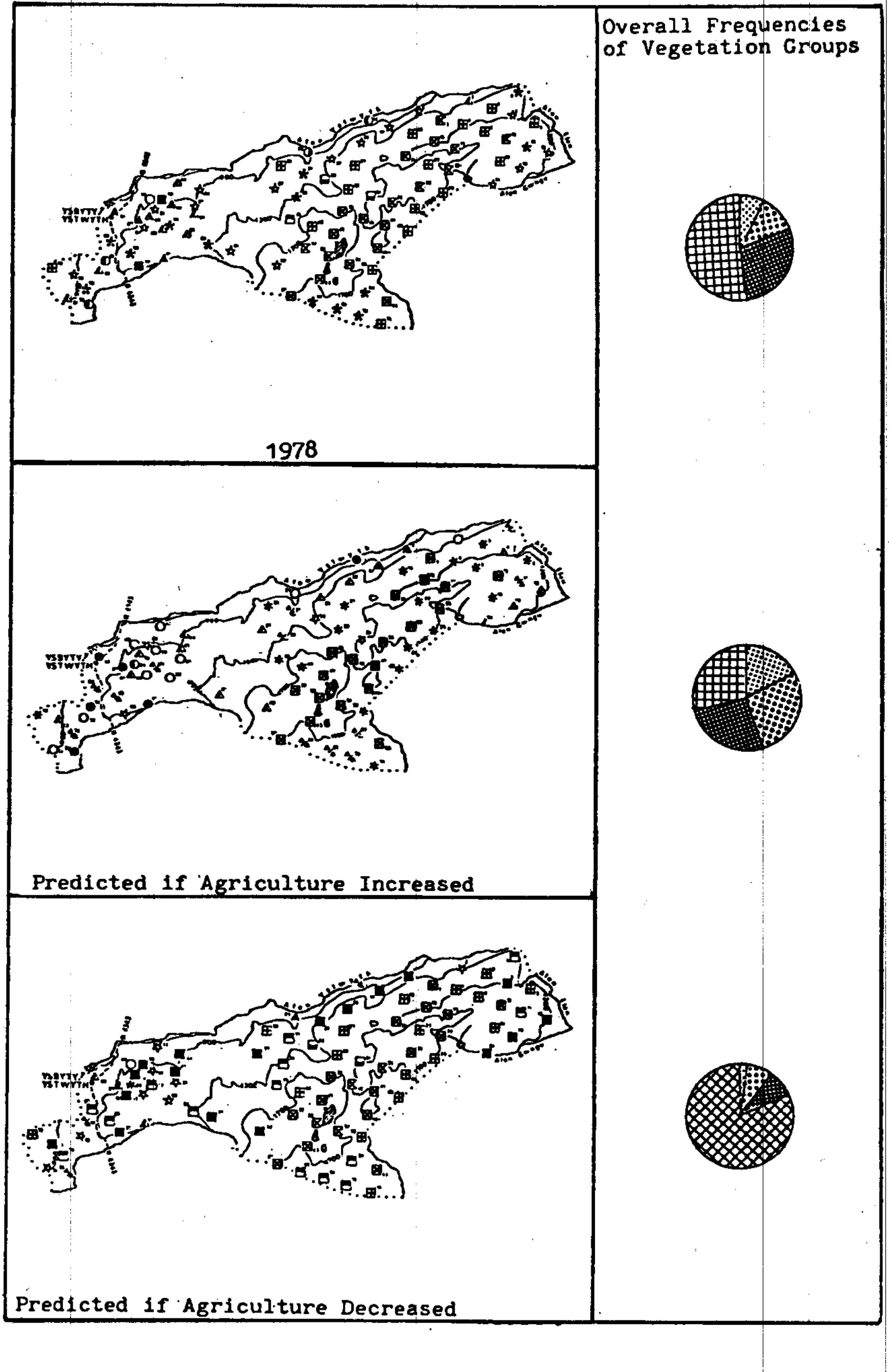

| Vegetation Group | Class | | % Main Sites in Vegetation Class 1 | 2 | 3 |
|---|---|---|---|---|---|
| Improved | 1 | Lolium/Holcus/Pteridium | 1 | - | - |
| Pastures | 2 | Lolium Grassland | 1 | 10 | 1 |
| | 3 | Lolium/Trifolium | 4 | - | - |
| | 4 | Herb rich Lolium Grassland | - | 7 | - |
| Rough | 7 | Agrostis/Holcus | 3 | - | 1 |
| Pastures | 8 | Festuca/Agrostis | 8 | 18 | 3 |
| | 5/6 | Agrostis/Juncus or Festuca/Juncus | - | 12* | - |
| | 7/8 | Agrostis/Holcus or Festuca/Agrostis | - | - | 4* |
| Grassy | 14 | Festuca/Vaccinium | 18 | 3 | 8 |
| Heaths | 16 | Festuca/Nardus/Molinia | 12 | 24 | - |
| Shrubby | 9 | Calluna/Molinia/Vaccinium | 1 | - | 13 |
| Heaths | 10 | Vaccinium/Calluna | 3 | - | 3 |
| | 11 | Nardus/Sphagnum/Calluna | 23 | - | 23 |
| | 12 | Eriophorum/Calluna | 26 | 26 | 26 |
| | 13 | Calluna | - | - | 18 |

1. Recorded Main Sites, 1978.
2. Predicted Changes at Main Sites if Agriculture Increased, 10 + years.
3. Predicted Changes at Main Sites if Agriculture Decreased, 10 + years.

* Under a regime involving intensification of agriculture Class 16, Festuca/Nardus/Molinia, could move towards either Class 5, Agrostis/Juncus or Class 6, Festuca/Juncus which is closely related to it. Similarly, with a reduction in the level of agricultural activity, Class 3, Lolium/Trifolium could move towards Class 7, Agrostis/Holcus or Class 8, Festuca/Agrostis. These changes are indicated on the histograms by the shaded areas.

FIGURE 8.8 LOCATION AND CLASSIFICATION OF VEGETATION MAIN SITES

YSBYTY YSTWYTH



KEY TO FIGURE 8.8

| | | |
|---|---|---|
| Group 1. Improved Pastures | Class 1 : | Lolium/Holcus/Pteridium |
| | Class 2 : | Lolium |
| | Class 3 : | Lolium/Trifolium |
| | Class 4 : | Herb — rich Lolium |
| Group 2. Rough Pastures | Class 5 : | Agrostis/Juncus |
| | Class 6 : | Festuca/Juncus |
| | Class 7 : | Agrostis/Holcus |
| | Class 8 : | Festuca/Agrostis |
| Group 3. Grassy Heaths | Class 14: | Festuca/Vaccinium |
| | Class 15: | Festuca/Nardus/Vaccinium |
| | Class 16: | Festuca/Nardus/Molinia |
| Group 4. Shrubby Heaths | Class 9 : | Calluna/Molinia/Vaccinium |
| | Class 10: | Vaccinium/Calluna |
| | Class 11: | Nardus/Sphagnum/Calluna |
| | Class 12: | Eriophorum/Calluna |
| | Class 13: | Calluna |

KEY TO FIGURES 8.8 AND 8.9

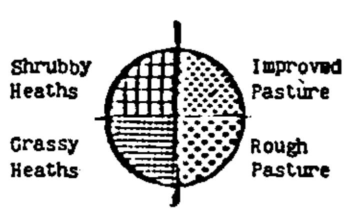
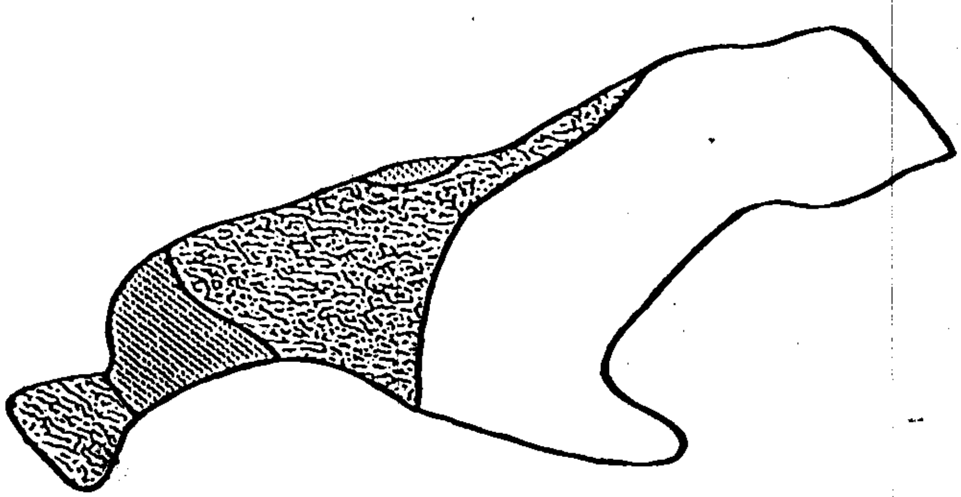


FIGURE 8.9 LAND GROUP-VEGETATION GROUP ASSOCIATIONS-YSBYTY YSTWYTH



VEGETATION GROUP FREQUENCIES AT SITES IN LAND GROUPS

PREDICTED CHANGES AT MAIN SITES

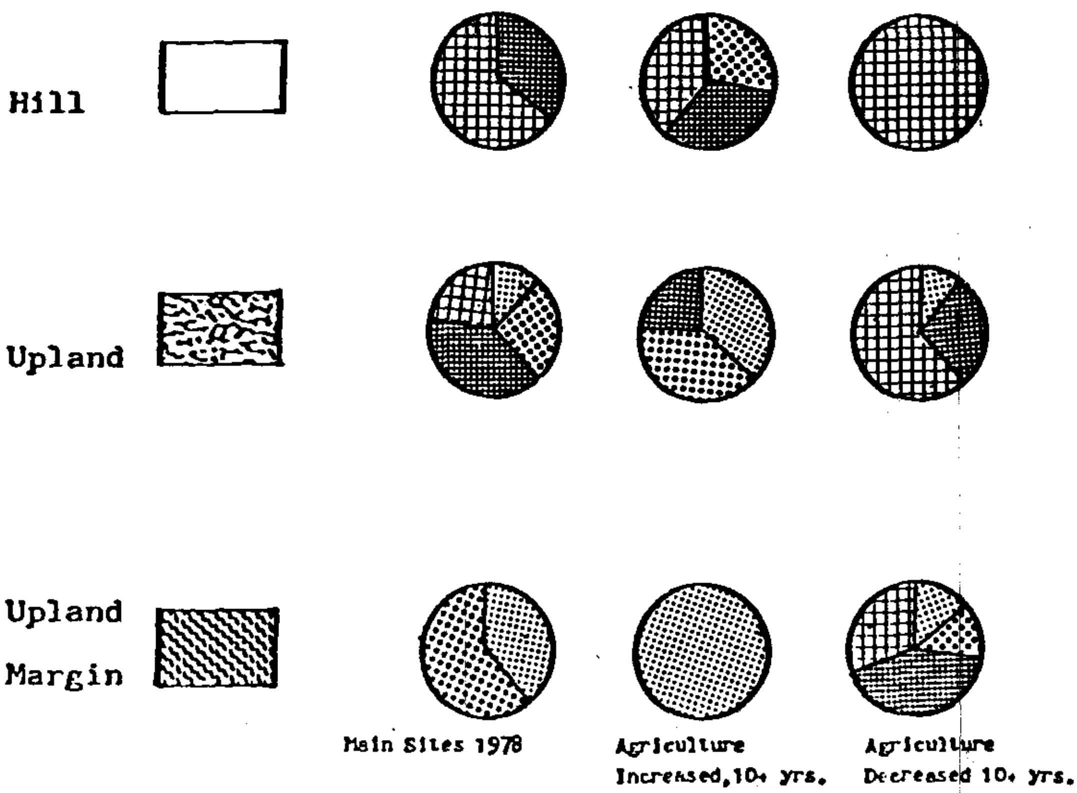
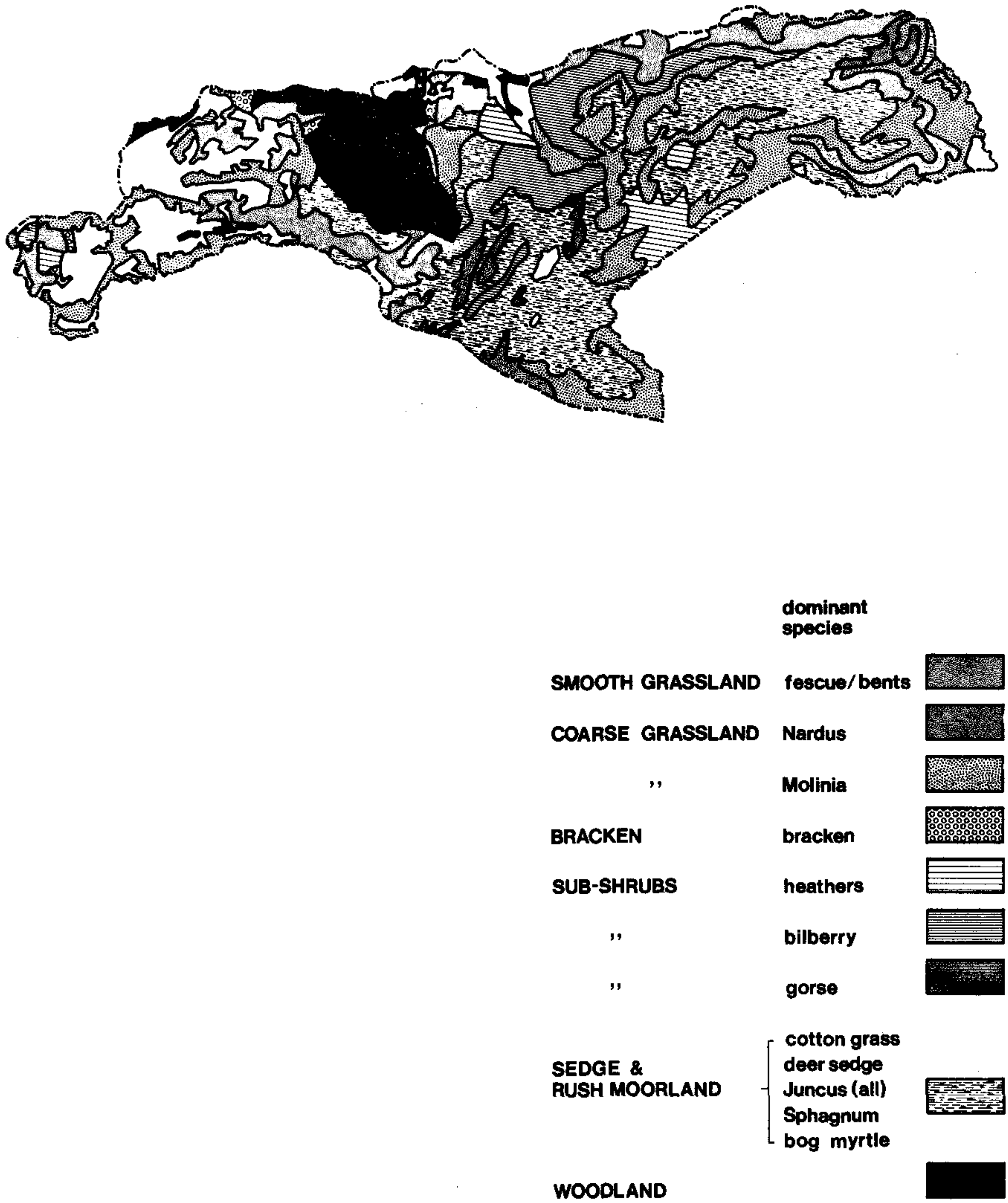
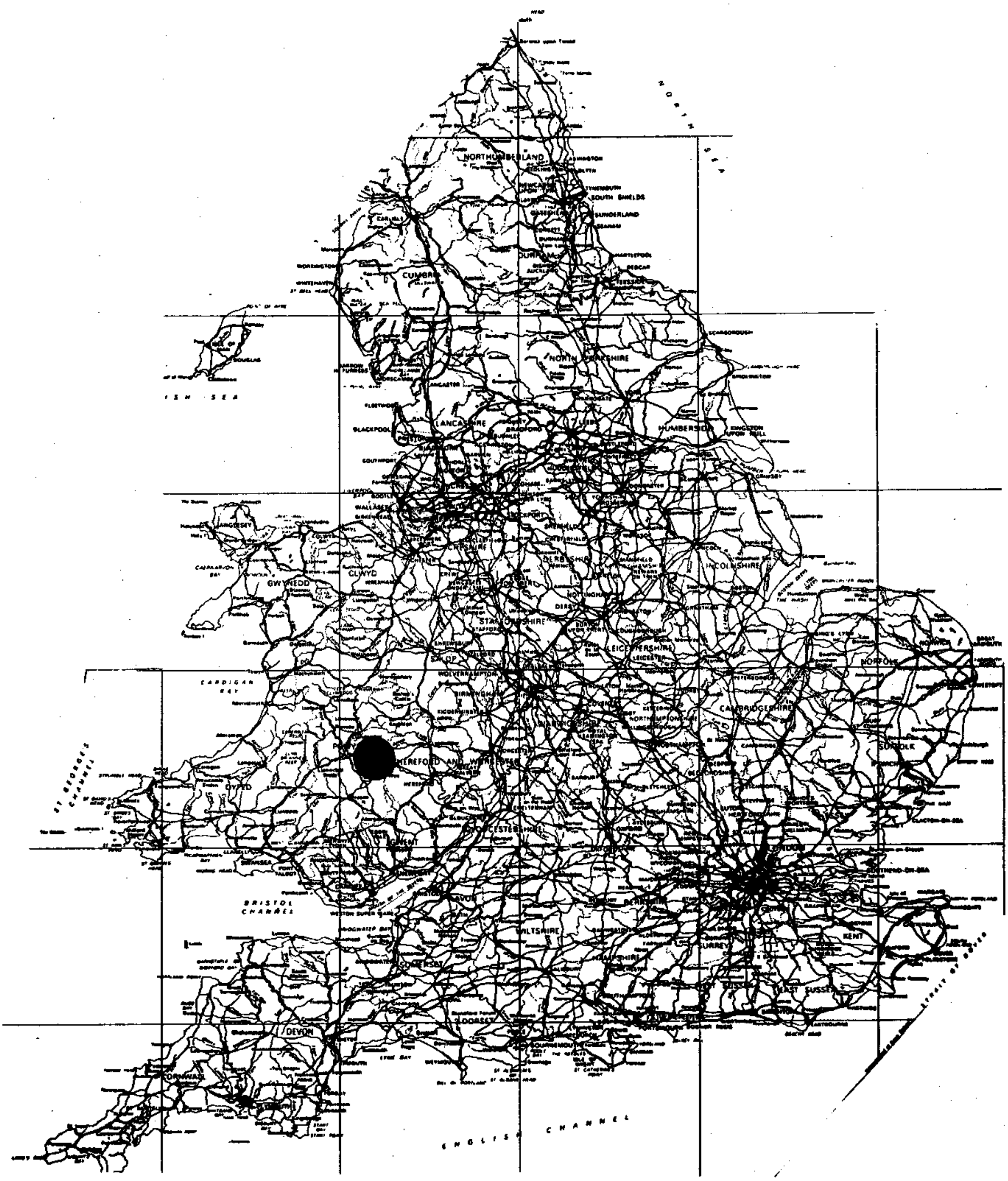


FIGURE 8.10 UPLAND LANDSCAPES STUDY VEGETATION MAP OF YSBYTY YSTWYTH




(Map by Geoffrey Sinclair, Environmental Information Services)

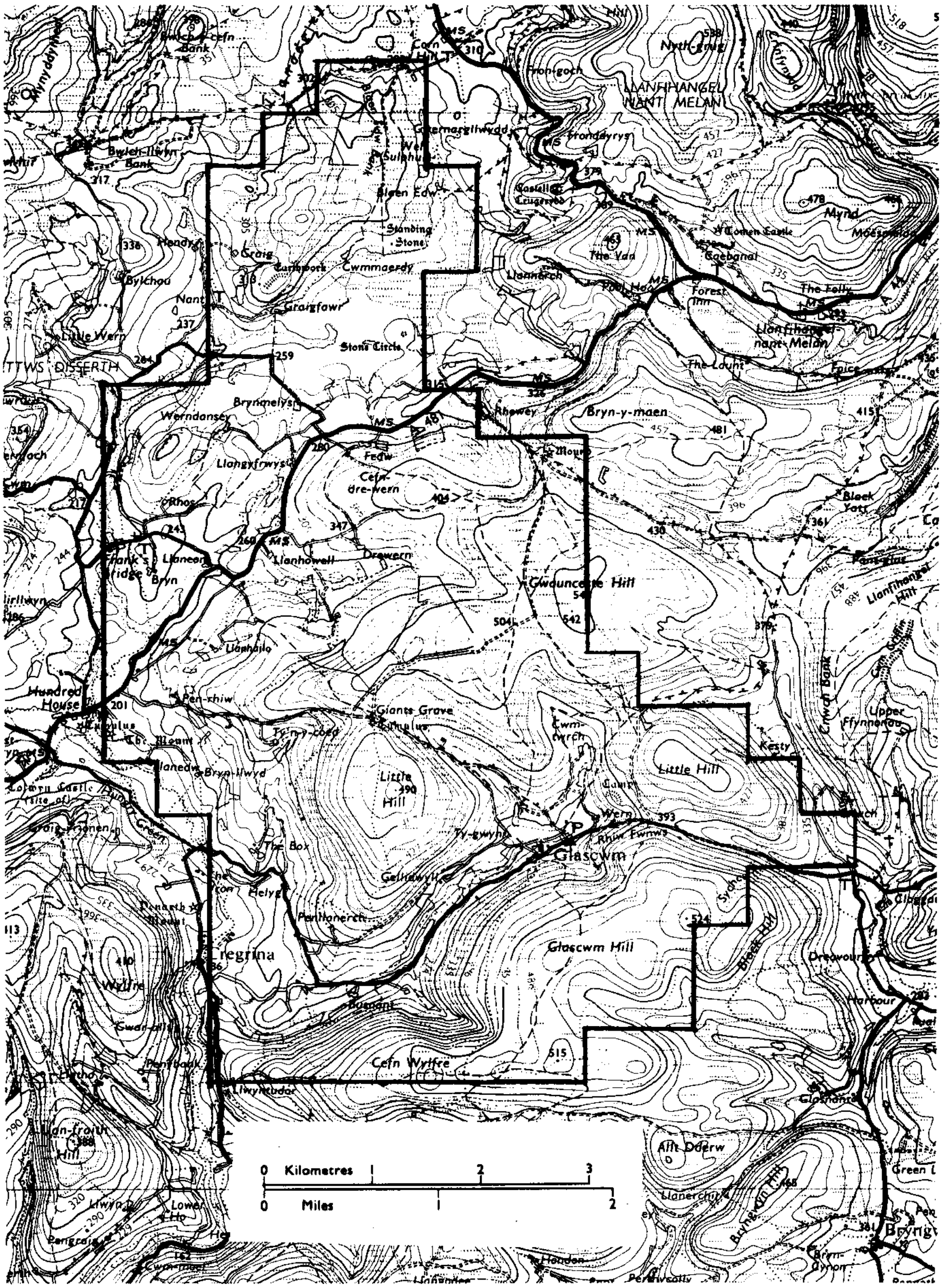
# GLASCWM


NORTHUMBERLAND
SOUTH SHIELDS
SUNDERLAND
CUMBRIA
NORTH YORKSHIRE
LANCASHIRE
BLACKPOOL
HUMBERSIDE
GWYNEDD
CLWYD
DERBYSHIRE
LINCOLNSHIRE
STAFFORDSHIRE
NORFOLK
CAMBRIDGESHIRE
SUFFOLK
HEREFORD AND WORCESTER
DYFED
GWENT
GLOUCESTERSHIRE
CLACTON-ON-SEA
BRISTOL CHANNEL
WILTSHIRE
KENT
SURREY
EAST SUSSEX
DORSET
DEVON
CORNWALL
ENGLISH CHANNEL
CARDIGAN BAY

GLASCWM - PLATE 1

View in the northern sector of the study area showing extensive grassland improvement in the foreground and on the distant hills, with fingers of rough pastures, mainly on wetter lower ground in the mid-distance. The foreground vegetation is improved pasture of class 3, *Lolium*/*Trifolium* grassland.
(Photo by P.Ainsworth)

FIGURE 9.1 THE STUDY AREA OF GLASCWM



# STUDY AREA 9: GLASCWM, POWYS

## PHYSICAL ENVIRONMENT

The study area of Glascwm (Figure 9-1), covering approximately 37 $km^2$, is situated in the Radnor-Clun Forests region about 8 km east of Builth Wells. Altitudes between 244 and 427 m (800-1 400 ft) dominate most of the area, with lower ground dominant along the Edw River in the west, and land over 427 m prominent on the hills in the east (Figure 9-2). Moderate slopes (5-10°) are characteristic of much of the area (Figure 9-3 and Plate 1) but steep and very steep slopes are frequent around Drewern and following the valley of the Clas Brook to Glascwm village, while gentle slopes are prominent from Franks Bridge to Cwmmaerdy.

Climatically, in relation to other upland areas in this study, Glascwm can be described as relatively warm and dry (Part I, 2.32). January and October mean temperatures are estimated as 2.2 and 9.2°C, the annual average of daily sunshine hours is 3.25, and the average number of days with snow lying is 20. Rainfall is fairly high (1 201-1 600 mm, c. 48-64 in pa) over the higher ground in the east, and moderate (1 001-1 200 mm, c. 40-48 in pa) on the lower ground in the west (Figure 9-4). The growing season for grass in the district containing Glascwm, at an average altitude of 309 m, is estimated by Smith (1976) as 229 days (8 April-23 November).

Geologically, Glascwm consists virtually entirely of Silurian non-calcareous shaly sedimentary rocks, typical of the most widespread soil parent materials in Wales. In the northwest around Graig and Blaen Edw a few narrow outcrops of igneous rocks (rhyolitic ash and dolerites) are shown on the early geological maps, but no recent detailed survey that confirms their presence has been located. No glacial drift is mapped, but shallow drifts and head deposits are certainly present on the lower ground and footslopes. On the national soil map Glascwm lies mainly in a mapping unit dominated by freely drained Brown Earths, with associated Gleys and Brown Podzolic Soils. There is a small sector on Glascwm Hill mapped as dominated by Peaty Podzols.

The agricultural land classification maps reflect the combination of a climate that is relatively favourable for an upland area, and soils that are predominantly freely drained mineral soils of reasonable agricultural potential. About half the study area, mainly in a zone approximately 2 km wide along its western boundary, together with an area around the hamlet of Glascwm itself, is classified as grade 4 land (Plate 1 and Part I, Plate 14). The remainder, comprising the higher parts such as Glascwm Hill, the 2 "Little Hills" in the east, and Blaen Edw in the northeast, is classed as grade 5.

Topographically (Figure 9-5), there is a quite intensive pattern of small roads throughout most of the area, which is crossed by the A481 main road between Builth Wells and New Radnor. There is a closely related settlement and farming intensity pattern, with buildings and frequent field boundaries concentrated in the lower ground of the west and following the Clas Brook valley.

The distribution of land types (Part I, 4.11-4.20) is shown in Figure 9-6. All 7 land types are represented but the upland land group is most widespread, occupying half the area. Hill land is present in the east and southeast around Glascwm and Gwaunceste Hills, while upland margin is mainly concentrated in the western third of the area.

## LAND-USE HISTORY

The Welsh borderland in which Glascwm is situated is a region which has maintained a relative stability of land-use till recent times (Sylvester 1969). As in other upland areas, early settlement utilised the higher ground but, by the Iron Age and the Roman period, pastoral agriculture had predominantly moved lower. Glascwm, although never becoming a settlement of any size, has an early history as a church. This possibly extends as far back as the 6th century and the church was certainly mentioned in the 12th century. Pastoral farming, from scattered farmsteads, remained the main agricultural effort through the centuries. Writers on local agriculture during the last 200 years or so emphasised the scope offered by the natural environment of Glascwm for arable expansion and pasture improvement. Malkin (1804) described how 'the mountains of Radnorshire are for the most part low and broad-crowned, so that they might be convertible to purposes of husbandry, if there was not already a larger proportion of ground in tillage than the confined knowledge and deficient activity of the natives can turn to a lucrative account'. The 'impoverished and hungry' appearance of the farms he considered to reflect not so much the marginal nature of the land for farming but the 'slovenly management, local prejudices and indolent habits' of the occupants! Redford (1940), reporting the 1st Land Utilization Survey carried out in the area in 1932, noted that the land-use of Radnorshire had undergone 'no major change for hundreds of years'. The farming pattern then included limited cropping for farm use and a concentration on sheep utilising the hill grazings on common land, with some rearing of cattle for fattening on the better lands of Herefordshire and

Shropshire. Glascwm Hill and Red Hill just south of the parish boundary at this time were described as being covered by 'considerable areas of Molinia and Nardus pasture surrounded by an extensive belt of heather'. The lower slopes were occupied largely by fescue and bracken. Very few farmers attempted to plough all the available land on their holdings. Only the 3 or 4 most accessible fields with the most favourable aspect were used to grow cereals, clover and roots in rotation.

The strictures on the capacity of early 19th century farmers and the problems of those between 1918 and 1939 have not continued to apply to present day farming. The considerable changes which have occurred since 1945 are mentioned when discussing the vegetation of the main sites recorded in the area. These changes have particularly emphasised pasture improvement in the sectors already in relatively intensive agricultural use.

A series of maps follows extension of intensive agricultural use into the moorland core over the past 150 years. Figure 9-7 shows the land-use pattern as mapped in the Tithe Commutation Survey of 1837 (Public Record Office) and Figure 9-8 the closely comparable distribution of rough pasture and intensively farmed land as it existed at the 1st Land Utilization Survey in 1932. The Ordnance Survey prepared their first large scale map of the area in 1887, with revisions in 1902 1948 and 1965. Figure 9-9 which plots moorland core, moorland fringe, and farmland as identified from different map and air photo sources (Part I, 4.47), up to 1965 shows again the relatively stable pattern which had persisted, with only small areas of fringe as land had changed between farm and moor. After 1965 the rate of agricultural improvement or afforestation of the moorland core has accelerated, the situation in 1978 being shown in Figure 9-10.

Farmland that has been continuously in intensive use over the period approximately post-1800 occupies 53% of the area, moorland core 35%, and moorland fringe 12% (444 ha). The moorland fringe mainly consists of land reclaimed for agriculture (accounting for 8% of the total area) with some reclaimed for afforestation (2%), and a further 2% which has changed from intensive agricultural use to moorland rough grazing over the period (the figures for these changes are given in Table 4-6 in Part I). 50% of the fringe falls in the upland plateau, 20% in the upland margin and 16% in the steep upland land types, which comprise 14, 27 and 25% of the area as a whole, showing a relative favouring of the upland plateau land for recent change.

Agricultural statistics from 1900-1965 (Part I, Figures 4-4 to 4-6) show a steep, steady rise in tillage since 1940 and increases also in sheep and to a lesser extent cattle, though cattle in 1965 were still only at about a level reached temporarily in 1910. Calculations by ULS (1980) give an increase in the area of crops and grass between 1887 and 1976 from 46 to 57% of the area. Glascwm thus remains primarily agricultural, but under a regime which is more intensive and prosperous than at any previous period. Recent afforestation in the area consists of a few small plantations, but there is a negligible impact of other upland land-use interests, such as water supply, recreation or conservation.

## VEGETATION

In Glascwm the vegetation was recorded in 1977 at 71 main sites and 11 woodland sites, as described in Part I, Chapter 3. The percentage of main sites in each vegetation class in 1977 are included in Figure 9-11, while individual site locations and their vegetation classes are shown in Figure 9-12. Improved pastures account for 49% of all recorded sites and rough pastures occupy a further 23%. Lolium/Trifolium and herb-rich Lolium improved pastures, classes 3 and 4, are most prominent (42% jointly) while Agrostis/Holcus and Festuca/Agrostis rough pastures, classes 7 and 8, (jointly 17% of recorded sites) are also frequent. The moorland element is thus muted in Glascwm, the grassy and shrubby heath groups combined accounting for only 28% of sites. Only Lynton and Monyash have smaller proportions of heath classes at their recorded sites.

Most of the moorland vegetation sites are associated with common land in the east and southeast of the parish (the location of common land in Glascwm is shown in Part I, Figure 4-2). Festuca/Vaccinium grassy heath, class 14 (12%), and Vaccinium/Calluna shrubby heath, class 10 (13%), are present in roughly equal proportions (Part I, Plates 31 and 44). Festuca/Vaccinium heath sites are concentrated round the more westerly of the 2 hills that are both referred to by the Ordnance Survey as 'Little Hill', in the southeast corner. Vaccinium/Calluna heath sites occur in a band running across the southern end of the parish and to the northeast between the western Little Hill and Gwaunceste Hill. A less extensive locality with grassy heath sites, mainly Festuca/Vaccinium heath, is present in the north (see eg Part I, Plate 14).

Small semi-natural woodlands are scattered throughout the parish. These fall into the lowland basic woodland (5 recorded sites) and upland acid woodland (6 recorded sites) categories (Part I, Table 3-4). Only 3 of the woodlands visited in Glascwm showed evidence of regeneration, proportionately the lowest recorded in the whole study apart from in Shap which had no woodland regeneration. Poor regeneration as a result of grazing pressure is clearly critical to the continued survival of these remnant woods. Of the forestry plantations, the largest are near Llyn-y-waun in the centre of the parish and near Llanweir Pool in the north.

Table 9-1 shows the association between vegetation classes at main sites in the study area and the land types in which they are situated, and Figure 9-13 includes a schematic illustration of the association between land groups and vegetation groups using a sketch of land group distribution based on Figure 9-6. Hill land contains virtually all the recorded sites of shrubby heaths. Upland, while containing some grassy heath sites, has mainly improved and rough pastures, while sites in the upland margin are predominantly improved pastures.

POTENTIAL VEGETATION CHANGE

Glascwm is notable for its present high frequency of improved pastures, half the main sites recorded being in this group. As shown in Figure 9-11, and noted above, herb-rich Lolium and Lolium/Trifolium grasslands are the most important classes, accounting for 42% of the recorded main sites. The scale of abrupt improvements which have taken place and are still proceeding in this area is such that gradual vegetation change is likely to be a minor part of the picture of future landscape change. It is unlikely that any agricultural decline would lead to substantial reversion of the improved pastures, though theoretically if this did happen some could change through Festuca/Agrostis, class 8, rough pastures towards Festuca/Vaccinium, class 14, grassy heaths, from which they were probably initially developed. In this area, scrub woodland would be likely to interrupt such a succession, in the absence of grazing. Declining grazing pressure could expand shrubby heaths at sites that are now grassy heaths.

The assumptions applied in Part I (5.95-5.100) to estimate potential forestry land in the study areas give an estimate that potentially forestry could occupy 35% compared to its present 4% of the area. This would involve a fall of 15% in the land in agriculture (Part I, Table 5-19). In an area which is favourable for agriculture and in which agriculture is expanding, this assumed forestry potential is unlikely to be realised under any foreseeable conditions.

Considering gradual change through further agricultural intensification, it is probable that improvement schemes will mainly be at the expense of the comparatively plentiful rough pastures, upgrading agriculturally the Agrostis/Holcus, class 7, and Festuca/Agrostis, class 8 grasslands. In so far as intensification modifies the existing heath vegetation it is likely to affect first the remnants of grassy heaths in the north. If grazing pressures increase on the shrubby heath common grazings on the hills in the southeast, then Vaccinium/Calluna, class 10 shrubby heath would move through Festuca/Vaccinium, class 14 grassy heath towards Festuca/Agrostis, class 8 rough pasture.

ULS (1979) in their application of the hill land classification scheme being developed by ADAS have noted that of the present rough grazings some 50% are 'improvable', 17% have some limitations to improvement and 33% are 'not improvable' though of this latter, 75% have 'some grazing value'. These calculations are another indication of the potential in Glascwm for further change.

The overall estimated changes in the balance of vegetation classes at recorded sites are given in Figure 9-11 and the predicted situations at individual main sites are shown in Figure 9-12. These predictions of the results of agricultural intensification or decline are based on a standard application to all sites of the general ecological trends of change discussed in Part I (5.74-5.78 and Figure 5.4) They are therefore generalised probabilities rather than confident assessments at each individual site of the likely response to specific site and managment conditions.

With this reservation, the prediction is that increased intensity of agricultural use in this area would lead to an estimated increase in recorded sites with improved pastures from 49 to 72% and a decrease of sites with rough pastures from 23 to 13%. Grassy heaths would remain unchanged in their frequency, though not their location, and shrubby heaths would disappear. The prediction for a declining agriculture situation shows a halving (49 to 25%) of improved pastures at recorded sites, with increases in the remaining 3 vegetation groups, although that for grassy heaths would be negligible. Shrubby heaths would double, from 14% of sites in 1977 to an estimated 28%. Calculating the proportion of recorded main sites estimated as liable to change their vegetation group under the general hypotheses of agricultural expansion or contraction leading to gradual vegetation change, 51% would change if agriculture intensified, while 54% of sites would change if agriculture declined (Part I, Table 5-17).

Figure 9-13 includes the predicted change in the balance of vegetation groups in each land group. In the hill land, shrubby heaths would disappear if agriculture intensified, or would expand by about half their present number of sites if agriculture decreased. In both cases the vegetation range would become less varied than it is now. The upland sector would also become vegetationally less varied if agriculture increased, while the upland margin sector would be likely to become virtually entirely improved pastures. In a situation of declining agriculture there would be more vegetation diversity introduced into the upland margin sector.

A reduction of the Upland Landscapes Study vegetation map of Glascwm is included here as Figure 9-14. Table 9-2 shows the correlation between ITE vegetation classes at the recorded main sites (including additional sites recorded in 1979, see Part I, 5.66-5.67) and ULS mapping units in which the sites fall. 'Farmland' is the dominant ULS unit and this in turn has most ITE sites situated in it, only about 9% of these being heath classes. Of the remainder, about 65% are improved pastures, and the rest rough pastures. The prominent heath classes at ITE sites are grassy heath class 14, Festuca/Vaccinium heath and shrubby heath class 10, Vaccinium/Calluna heath. The first of these falls mainly in the ULS 'coarse grass/Molinia', 'bracken', and 'sub-shrubs/heathers' units, while the latter's sites occur in the 'sub-shrubs/heathers' and 'sub-shrubs/bilberry' units. Table 9-3 shows the way in which the proportions of vegetation classes at ITE sites in each mapping unit would change as a consequence of the predictions made from standard assumptions following agricultural intensification or decline. The small areas of 'coarse grassland' and 'bracken' could show the largest overall contrasts from being entirely pastures, through a mixture of pasture and heath classes, to being entirely heaths, while the 'farmland' would become notably more diversified if agriculture declined, as heaths expanded at the expense of rough pastures, and rough pastures at the expense of improved pastures.

## CONCLUSION

Glascwm is an upland area in which agriculture is definitely the main land-use, with little conflict with other major users. Its climate, soil and physiography are relatively generally favourable to agriculture. Improvement of present pastures will be a main course of agricultural intensification. Additionally reclamation of the limited most favourable areas of remaining heaths will continue. The probable sequence of change would be to rough pastures and eventually where possible to improved pastures on the lower altitude heaths free of common land constraints. Only limited sectors of heath vegetation are likely to persist on the highest ground of the least favourable shallow soils and, even there, grassy heaths will take over as grazing pressures are intensified. The attitudes of farmers as expressed both to ULS and during the ITE fieldwork all emphasised intentions to continue grassland improvement schemes as far as economically possible. In such circumstances, major forestry expansion is unlikely and there are negligible recreational or conservation interests active in the area to exert counteracting pressures against agricultural intensification. Expansion of improved pastures and a decline of the heaths can be expected to continue to simplify the vegetation range in the Glascwm landscape.

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TABLE 9-1 CORRELATION OF VEGETATION CLASSES AND LAND TYPES - GLASCWM

| Vegetation Group and Class | | Land Group and Type: Hill | | | Upland | | | |
|---|---|---|---|---|---|---|---|---|
| | | Steep Hill (1)* | Hill (3) | High Plateau (4) | Steep Upland (5) | Upland (7) | Upland Plateau (8) | Upland Margin (6) |
| Improved Pastures | 1 | | | | | 1 | 1 | 2 |
| | 2 | | | | | 1 | | |
| | 3 | | | 1 | 3 | | 4 | 5 |
| | 4 | | | | 3 | 4 | | 10 |
| Rough Pastures | 5 | | | | | 1 | | 1 |
| | 6 | | | | | | 2 | |
| | 7 | | | | 1 | 1 | 1 | 2 |
| | 8 | 1 | | 1 | 3 | | | 2 |
| Grassy Heaths | 14 | 3 | | | 4 | | 2 | |
| | 15 | | | | 1 | | | |
| | 16 | | | | | 1 | | |
| Shrubby Heaths | 9 | | | | | | | |
| | 10 | 3 | 4 | 1 | 1 | | | |
| | 11 | | | | | | | |
| | 12 | | | | | | | |
| | 13 | | | | | | | |

As number of sites of each vegetation class located in each land type.
* Land type numbers as used on computer maps, Figure 9-6.

TABLE 9-2 CORRELATION OF ULS VEGETATION MAPPING UNITS AND ITE VEGETATION CLASSES - GLASCWM

| ULS Mapping Unit | Number of ITE Sites in Area of ULS Unit | ITE Vegetation Class | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Improved Pastures | | | | Rough Pastures | | | | Grassy Heaths | | | Shrubby Heaths | | | | |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 14 | 15 | 16 | 9 | 10 | 11 | 12 | 13 |
| Smooth Grassland | 1 | | | | | | | 1 | | | | | | | | | |
| Coarse Grassland/*Nardus* | | | | | | | | | | | | | | | | | |
| Coarse Grassland/*Molinia* | 3 | | | | | | | | | 2 | | 1 | | | | | |
| Bracken | 4 | | | | | | | 1 | | 3 | | | | | | | |
| Sub-shrubs/Heathers | 6 | | | | | | | | | 2 | | | | 4 | | | |
| Sub-shrubs/Bilberry | 6 | | | | | | | | | 1 | 1 | | | 4 | | | |
| Sub-shrubs/Gorse | | | | | | | | | | | | | | | | | |
| Sedge & Rush Moorland | | | | | | | | | | | | | | | | | |
| Farmland | 65 | 6 | 1 | 18 | 17 | 3 | 2 | 3 | 9 | 3 | | | 1 | 2 | | | |

As number of recorded sites in each ITE vegetation class that are located in each ULS unit

TABLE 9-3 PREDICTIONS OF CHANGE IN THE BALANCE OF VEGETATION GROUPS AT SITES LOCATED IN ULS MAPPING UNITS - GLASCWM

| ULS Mapping Unit | ITE Vegetation Groups | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Improved Pastures | | | Rough Pastures | | | Grassy Heaths | | | Shrubby Heaths | | |
| | A | B | C | A | B | C | A | B | C | A | B | C |
| Smooth Grassland | | 1 | | 1 | | 1 | | | | | | |
| Coarse Grassland/*Nardus* | | | | | | | | | | | | |
| Coarse Grassland/*Molinia* | | | | | 3 | | 3 | | | | | 3 |
| Bracken | | 1 | | 1 | 3 | | 3 | | 1 | | | 3 |
| Sub-shrubs/Heathers | | | | | 2 | | 2 | 4 | | 4 | | 6 |
| Sub-shrubs/Bilberry | | | | | 2 | | 2 | 4 | | 4 | | 6 |
| Sub-shrubs/Gorse | | | | | | | | | | | | |
| Sedge & Rush Moorland | | | | | | | | | | | | |
| Farmland | 42 | 59 | 18 | 17 | 3 | 27 | 3 | 3 | 14 | 3 | | 6 |

As number of recorded sites falling in each ITE vegetation group that are located in each ULS unit

A - situation as recorded
B - predicted balance of vegetation if agricultural use increased, 10+ yrs
C - predicted balance of vegetation if agricultural use decreased, 10+ yrs

FIGURE 9.2 ALTITUDE SECTORS - GLASCWM

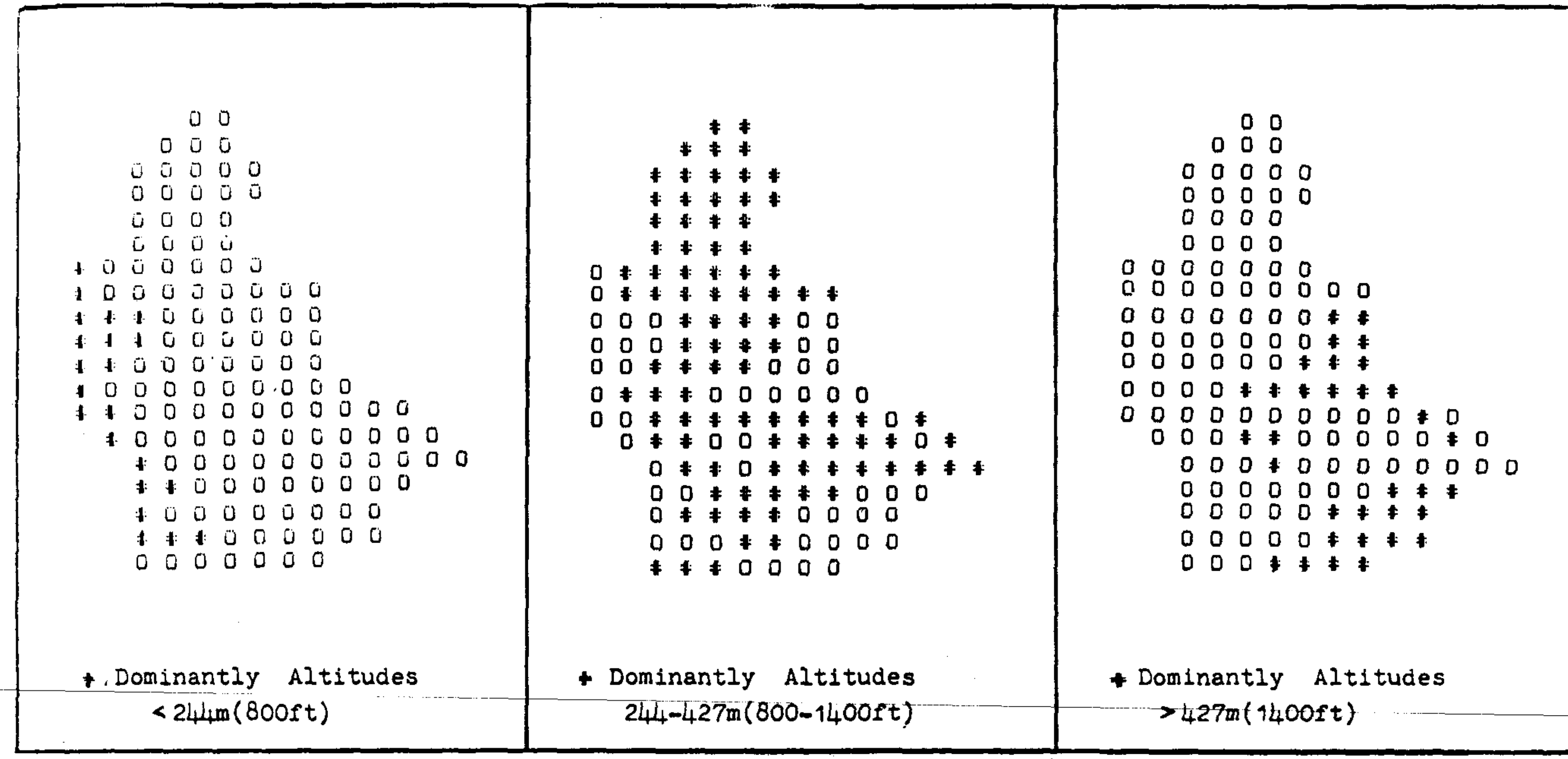


FIGURE 9.3 SLOPE SECTORS - GLASCWM

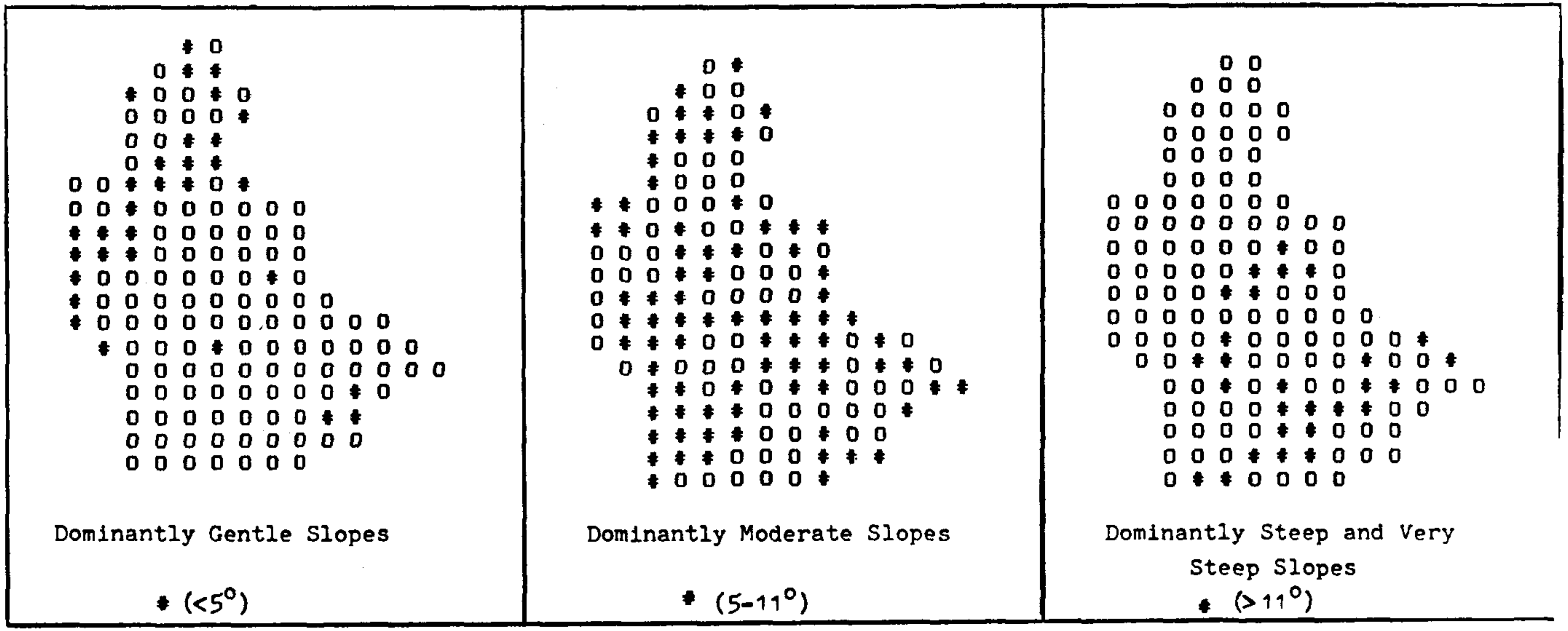
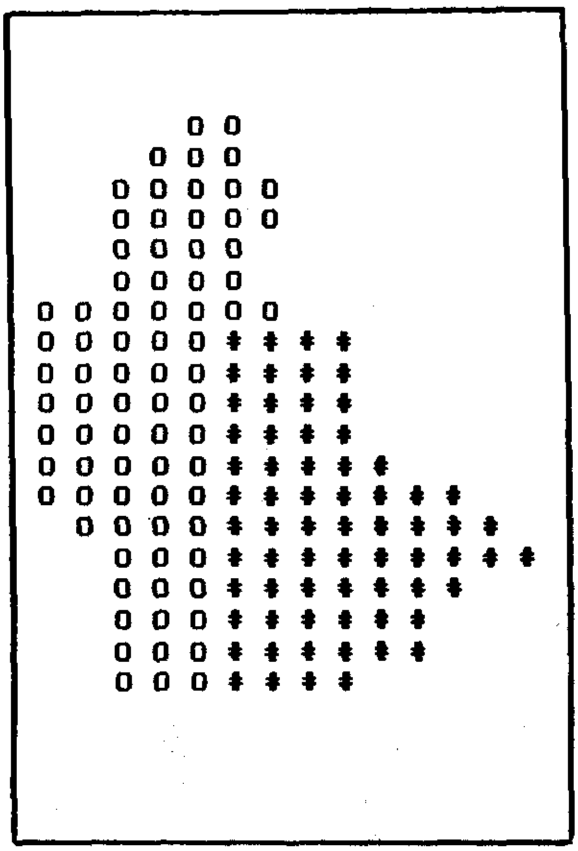


FIGURE 9.4 RAINFALL SECTORS - GLASCWM



0 Moderate Rainfall (1001-1200mm,40-48in pa)

‡ Fairly High Rainfall (1201-1600mm,48-64in pa)

FIGURE 9.5 TOPOGRAPHIC CHARACTERISTICS - GLASCWM

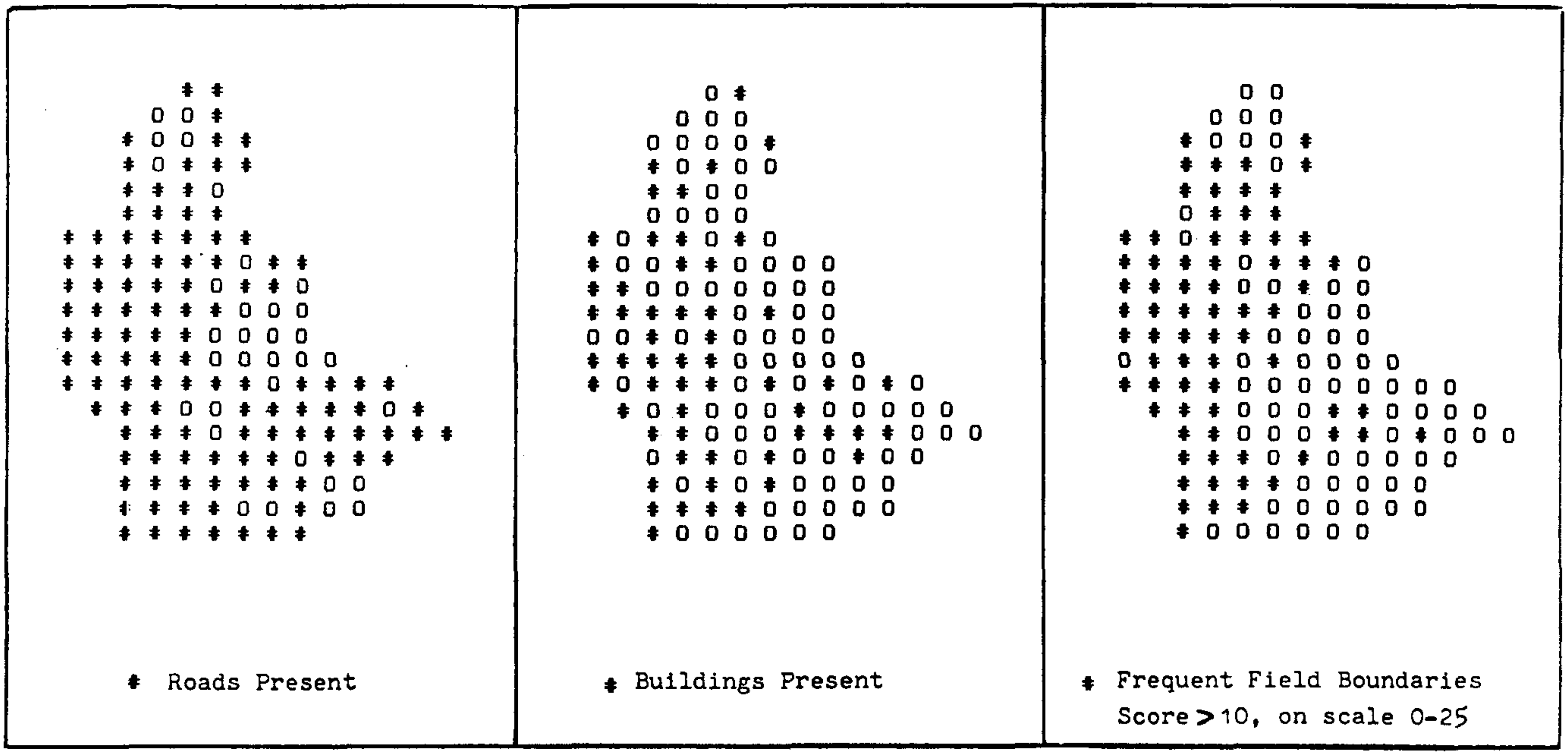


FIGURE 9.6 LAND TYPES – GLASCWM

```
        - -
      - 4 -
    - - - - -
    - - - - -
    - - - -
    - - - -
- - - - - - -
- - - - - - - - -
- - - - - - - - 1
- - - - - - - 1 3
- - - - - 1 3 4 3
- - - - - 3 3 1 1 1
- - - - - - - 1 - - - -
  - - - 1 4 - - - - - 3 -
    - - 1 1 - - - - - - - -
    - - - - - - 1 - 4 1
    - - - - - 1 3 4 4
    - - - - - 1 3 3 3
    - - 1 1 1 1 3
```

HILL LAND GROUP

1 = Steep Hill

3 = Hill

4 = High Plateau

```
        8 7
      8 - 8
    8 5 5 8 -
    - 7 - - 8
    7 - 8 8
    7 8 8 8
- 7 8 8 8 - 8
- - 8 7 5 5 5 7 5
- - - - 5 5 5 5 -
- 8 - - 7 7 5 - -
8 - - 7 5 - - - -
8 5 - 5 - - - - - -
8 - - 7 5 5 5 - 7 5 - 5
  - 7 5 - - 5 - - 5 5 - 5
    - - - - 5 - - 5 5 5 7 7
    - - - 5 5 5 - 5 - -
    - 7 - - 5 - - - -
    - - - 5 5 - - - -
    - 5 - - - - -
```

UPLAND LAND GROUP

5 = Steep Upland

7 = Upland

8 = Upland Plateau

```
        - -
      - - -
    - - - - 6
    6 - 6 6 -
    - 6 - -
    - - - -
6 - - - - 6 -
6 6 - - - - - - -
6 6 6 6 - - - - -
6 - 6 6 - - - - -
- 6 6 - - - - - -
- - 6 - 6 - - - - -
- 6 6 - - - - - - - 6 -
  6 - - - - - 6 6 - - - -
    6 6 - - - 6 6 - - - - -
    6 6 6 - - - - - - -
    6 - 6 6 - - - - -
    6 6 6 - - - - - -
    6 - - - - - -
```

UPLAND MARGIN LAND GROUP

6 = Upland Margin

FIGURE 9.7 LAND USE AT THE TITHE COMMUTATION SURVEY OF 1837
GLASCWM

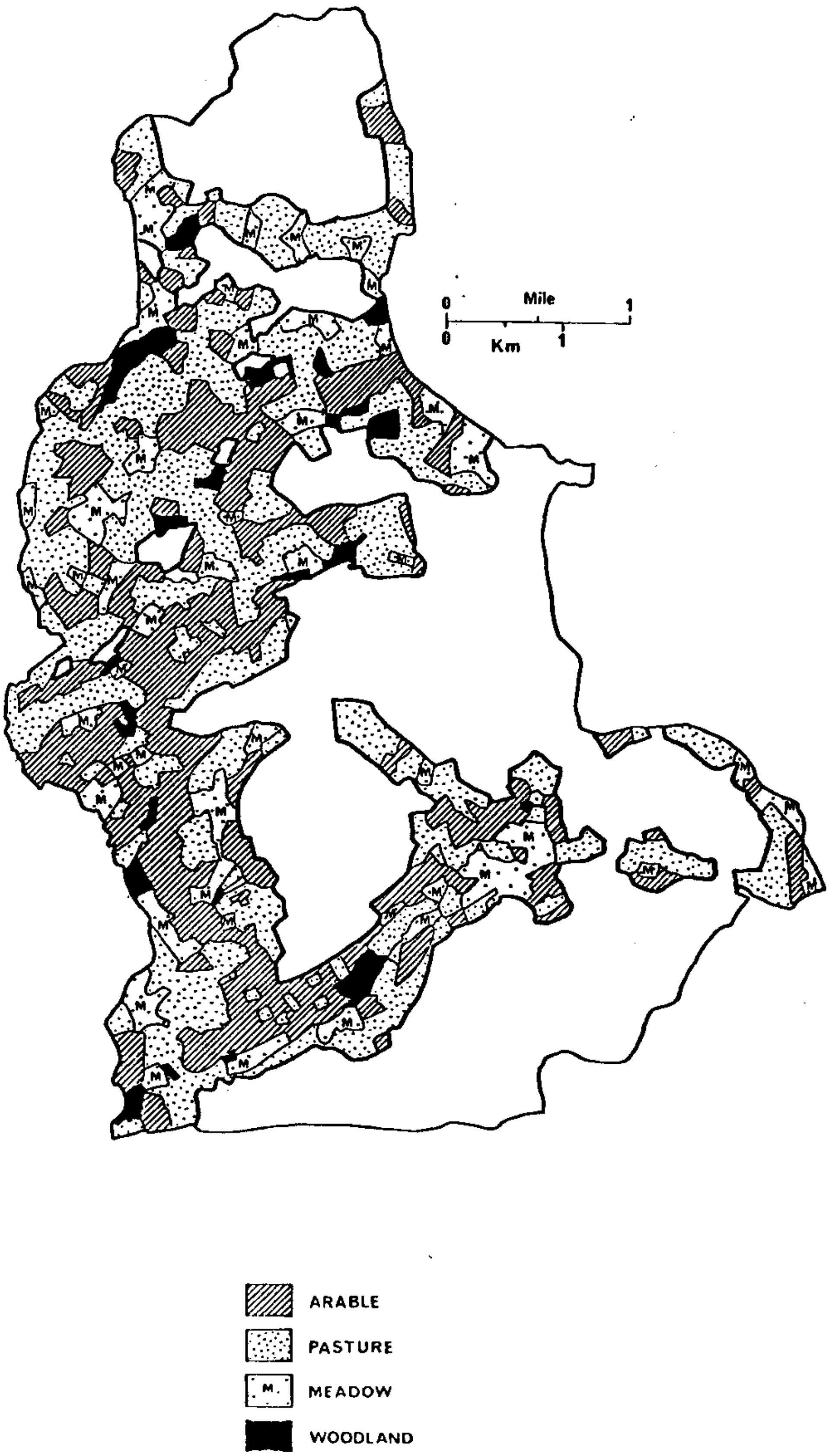


FIGURE 9.8 LAND USE AT THE FIRST LAND UTILIZATION SURVEY OF 1932

GLASCWM

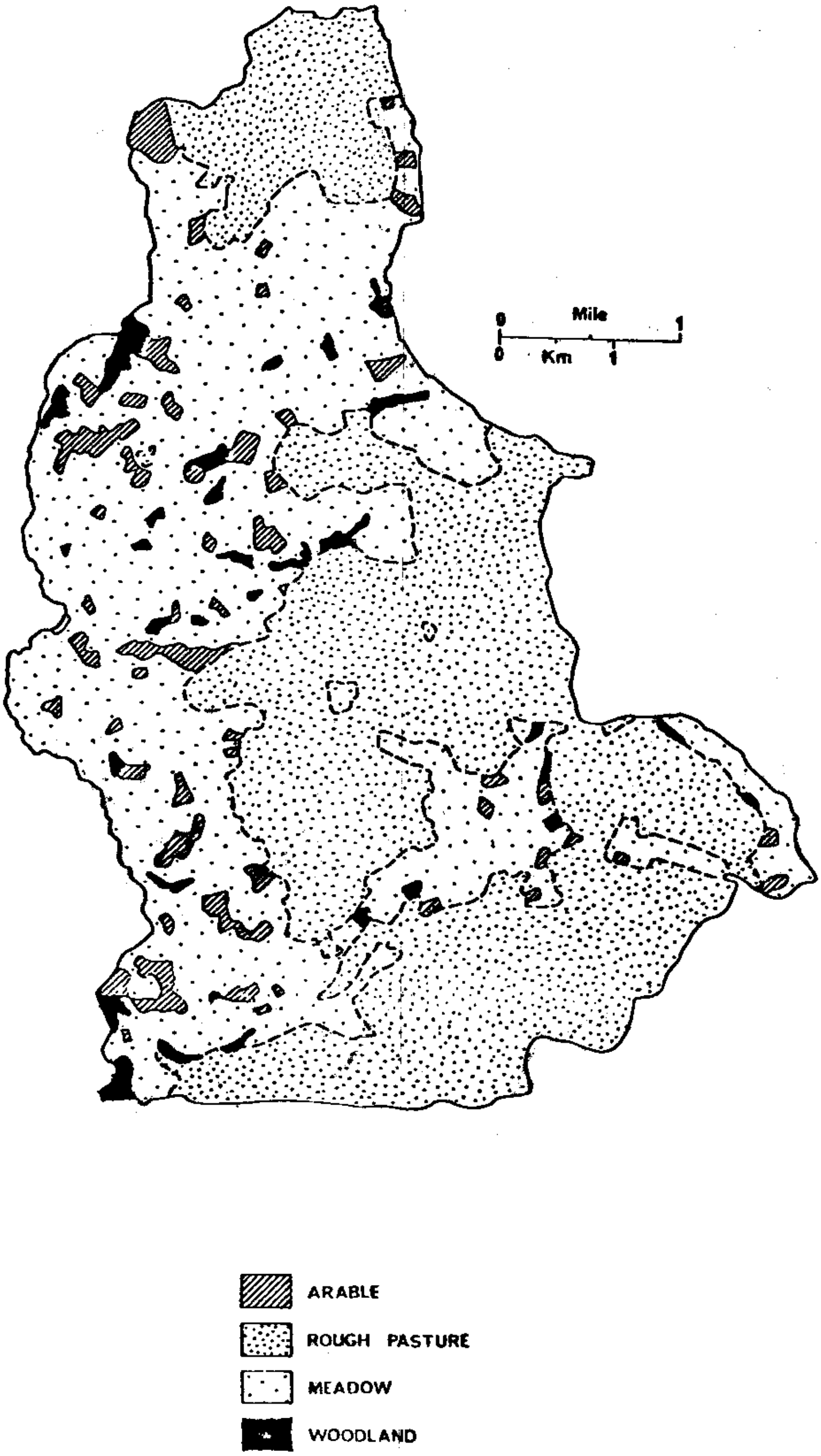


FIGURE 9.9 MOORLAND CORE, FRINGE AND FARMLAND TO 1965 - GLASCWM

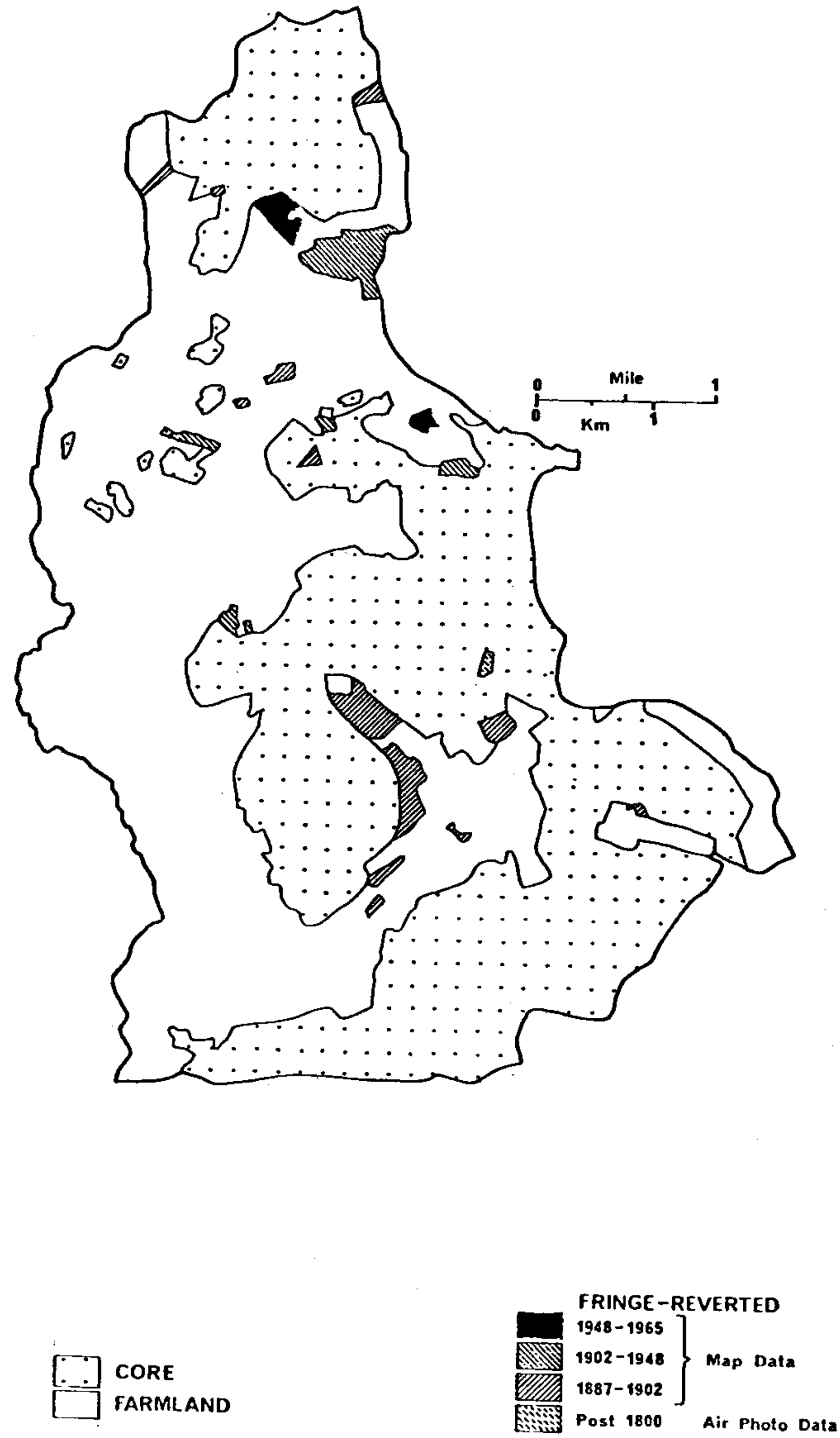


FIGURE 9.10 MOORLAND CORE, FRINGE AND FARMLAND TO 1978 - GLASCWM

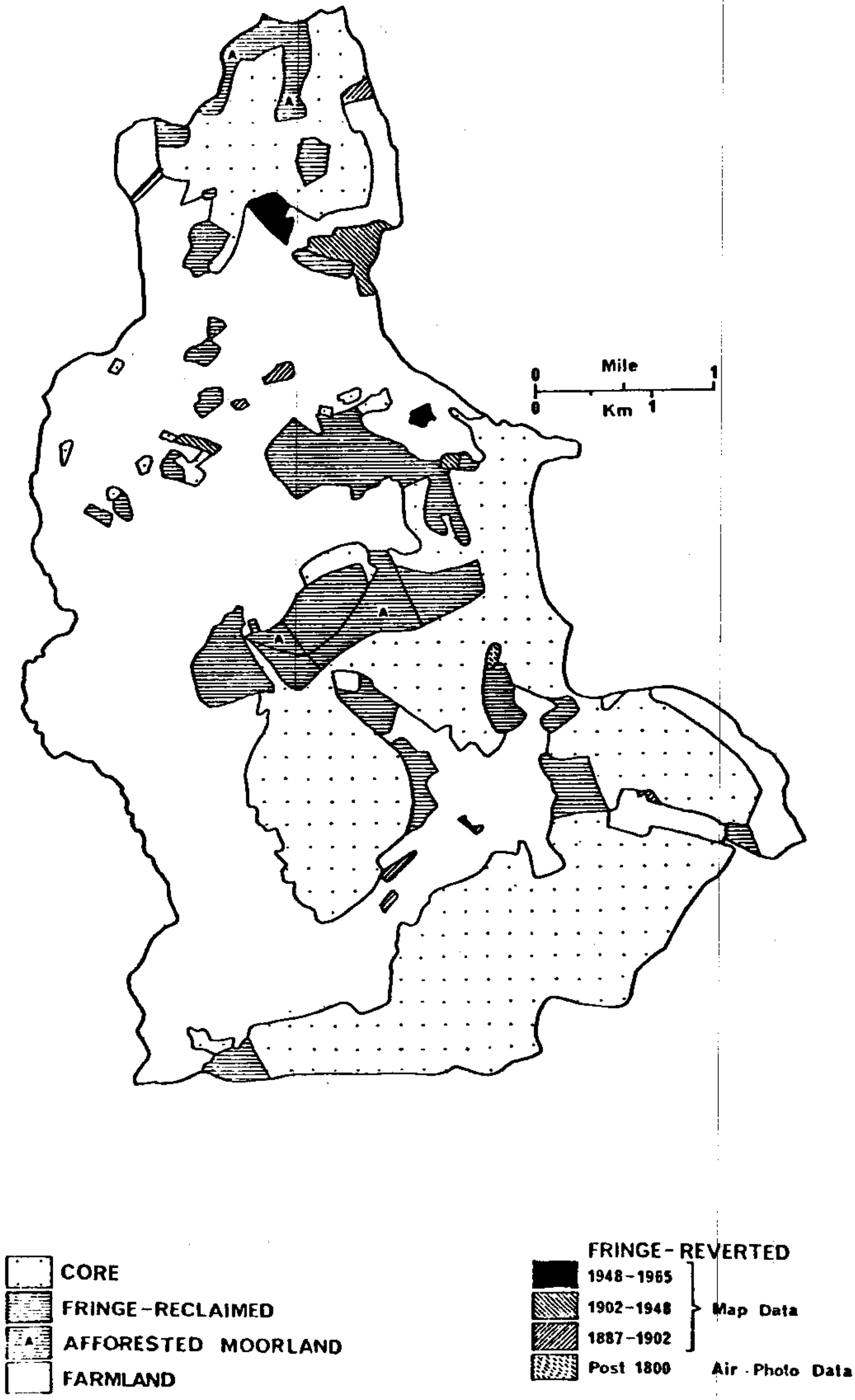
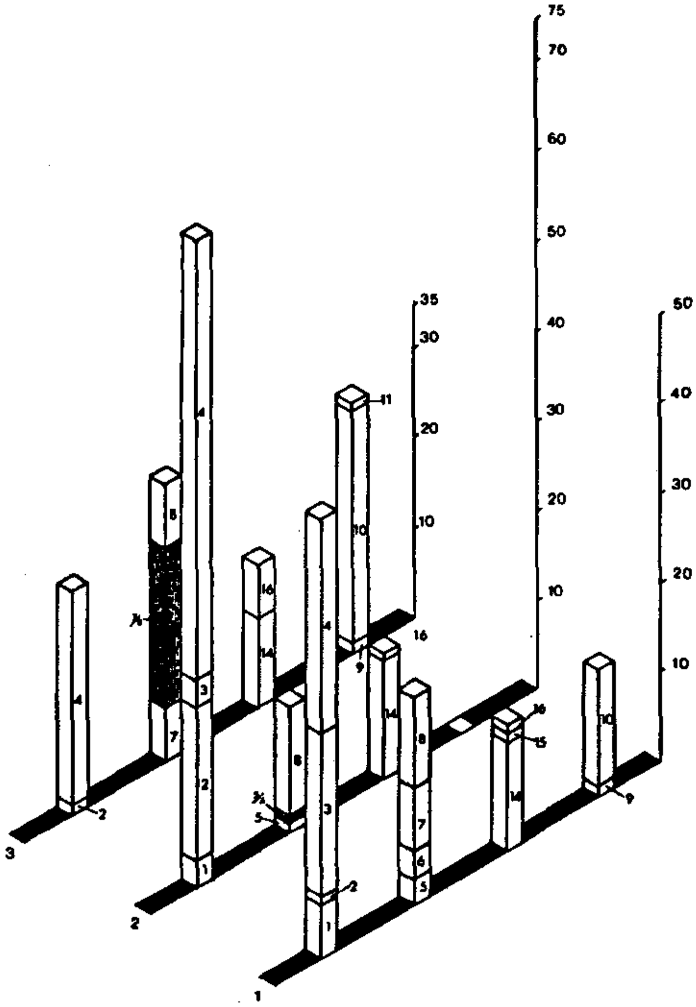


FIGURE 9.11 VEGETATION CLASS FREQUENCY AT MAIN SITES - GLASCWM

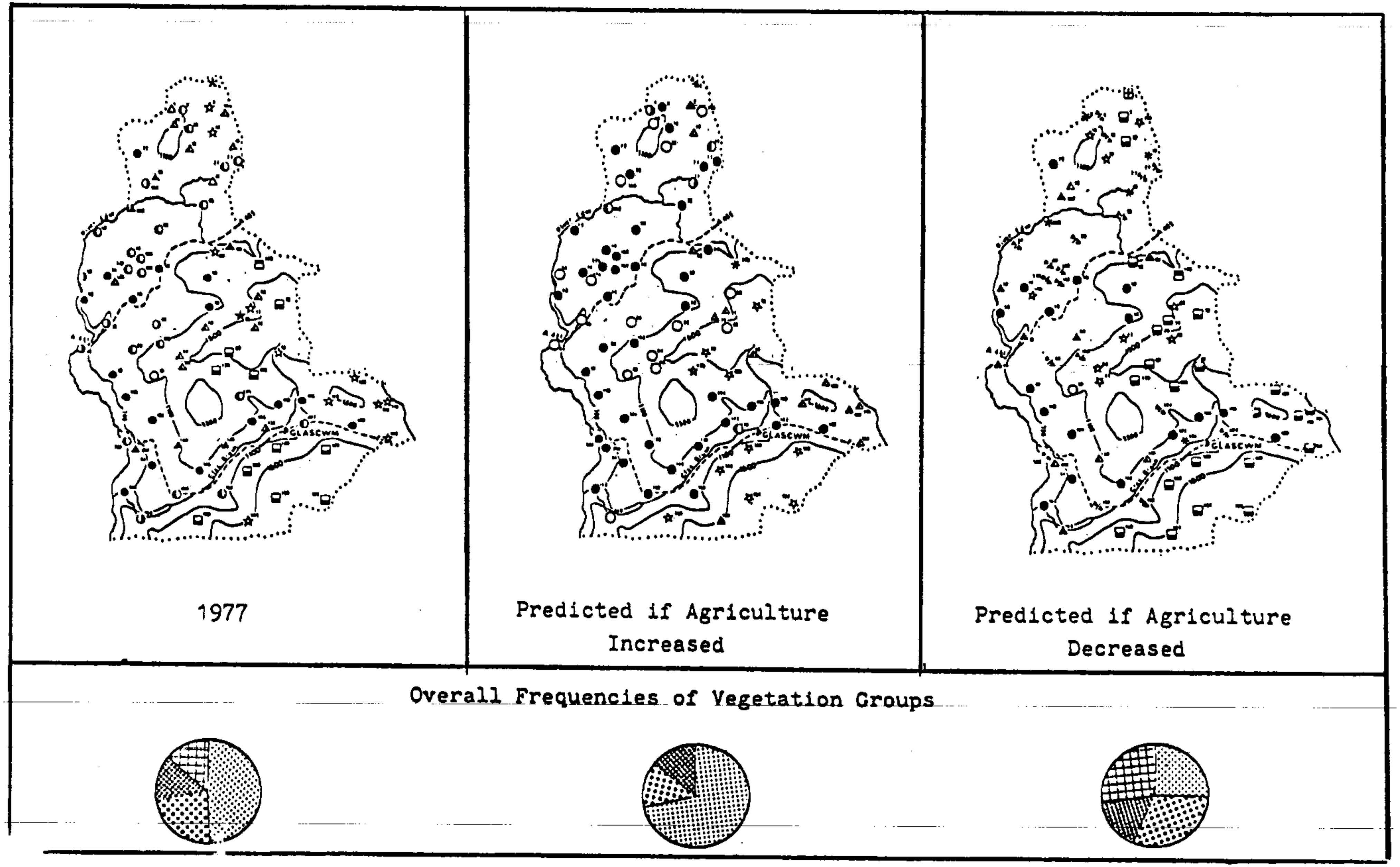



| Vegetation Group | Class | | % Main Sites in Vegetation Class 1 | 2 | 3 |
|---|---|---|---|---|---|
| Improved | 1 | Lolium/Holcus/Pteridium | 6 | 3 | - |
| Pastures | 2 | Lolium Grassland | 1 | 17 | 1 |
| | 3 | Lolium/Trifolium | 18 | 3 | - |
| | 4 | Herb rich Lolium Grassland | 24 | 49 | 24 |
| Rough | 5 | Agrostis/Juncus | 3 | 1 | - |
| Pastures | 6 | Festuca/Juncus | 3 | - | - |
| | 7 | Agrostis/Holcus | 7 | - | 6 |
| | 8 | Festuca/Agrostis | 10 | 12 | 7 |
| | 5/6 | Agrostis/Juncus or Festuca/Juncus | - | 1* | - |
| | 7/8 | Agrostis/Holcus or Festuca/Agrostis | - | - | 18* |
| Grassy | 14 | Festuca/Vaccinium | 12 | 13 | 10 |
| Heaths | 15 | Festuca/Nardus/Vaccinium | 1 | - | - |
| | 16 | Festuca/Nardus/Molinia | 1 | 1 | 6 |
| Shrubby | 9 | Calluna/Molinia/Vaccinium | 1 | - | 1 |
| Heaths | 10 | Vaccinium/Calluna | 13 | - | 26 |
| | 11 | Nardus/Sphagnum/Calluna | - | - | 1 |

1. Recorded Main Sites, 1972.
2. Predicted Changes at Main Sites if Agriculture Increased, 10 + years.
3. Predicted Changes at Main Sites if Agriculture Decreased, 10 + years.

* Under a regime involving intensification of agriculture Class 16, Festuca/Nardus/Molinia, could move towards either Class 5 Agrostis/Juncus or Class 6, Festuca/Juncus which is closely related to it. Similarly, with reduction in the level of agricultural activity, Class 3, Lolium/Trifolium could move towards Class 7, Agrostis/Holcus or Class 8 Festuca/Agrostis. These changes are indicated on the relevant histograms by the shaded areas.

FIGURE 9.12 LOCATION AND CLASSIFICATION OF VEGETATION MAIN SITES - GLASCWM



KEY TO FIGURE 9.12

| Group | Class | Vegetation |
|---|---|---|
| Group 1. Improved Pastures | Class 1 | Lolium/Holcus/Pteridium |
| | Class 2 | Lolium |
| | Class 3 | Lolium/Trifolium |
| | Class 4 | Herb – rich Lolium |
| Group 2. Rough Pastures | Class 5 | Agrostis/Juncus |
| | Class 6 | Festuca/Juncus |
| | Class 7 | Agrostis/Holcus |
| | Class 8 | Festuca/Agrostis |
| Group 3. Grassy Heaths | Class 14 | Festuca/Vaccinium |
| | Class 15 | Festuca/Nardus/Vaccinium |
| | Class 16 | Festuca/Nardus/Molinia |
| Group 4. Shrubby Heaths | Class 9 | Calluna/Molinia/Vaccinium |
| | Class 10 | Vaccinium/Calluna |
| | Class 11 | Nardus/Sphagnum/Calluna |
| | Class 12 | Eriophorum/Calluna |
| | Class 13 | Calluna |

KEY TO FIGURES 9.12 AND 9.13

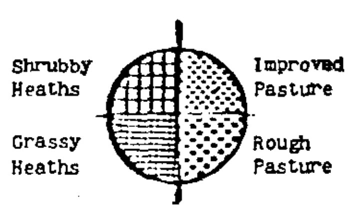
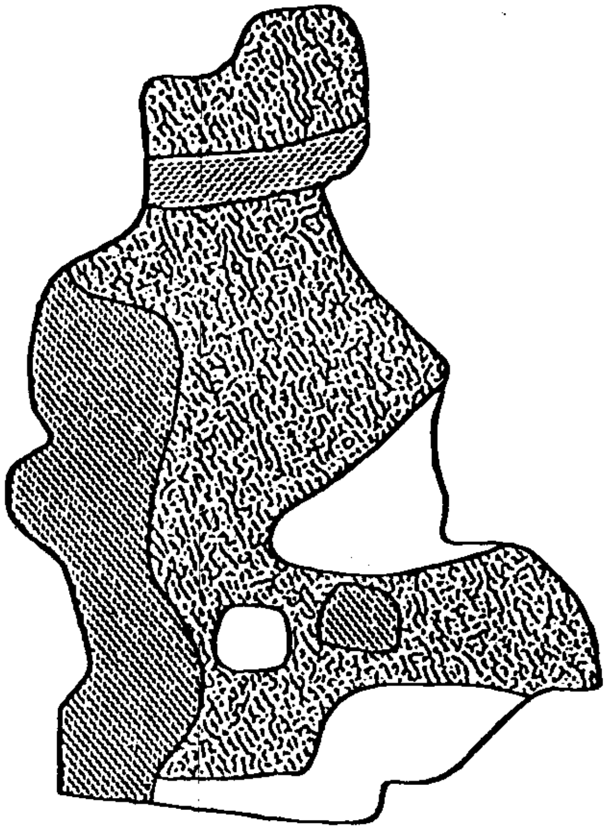


FIGURE 9.13 LAND GROUP-VEGETATION GROUP ASSOCIATIONS-GLASCWM



VEGETATION GROUP FREQUENCIES AT SITES IN LAND GROUPS

PREDICTED CHANGES AT MAIN SITES

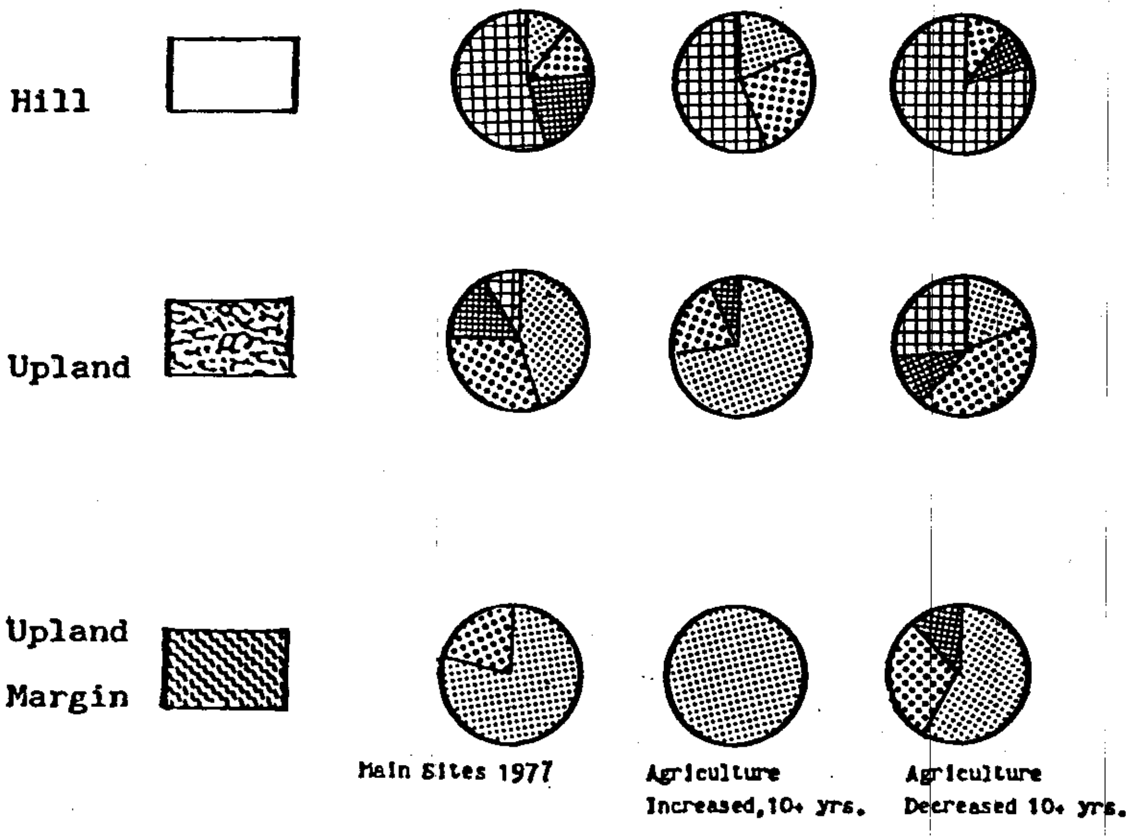
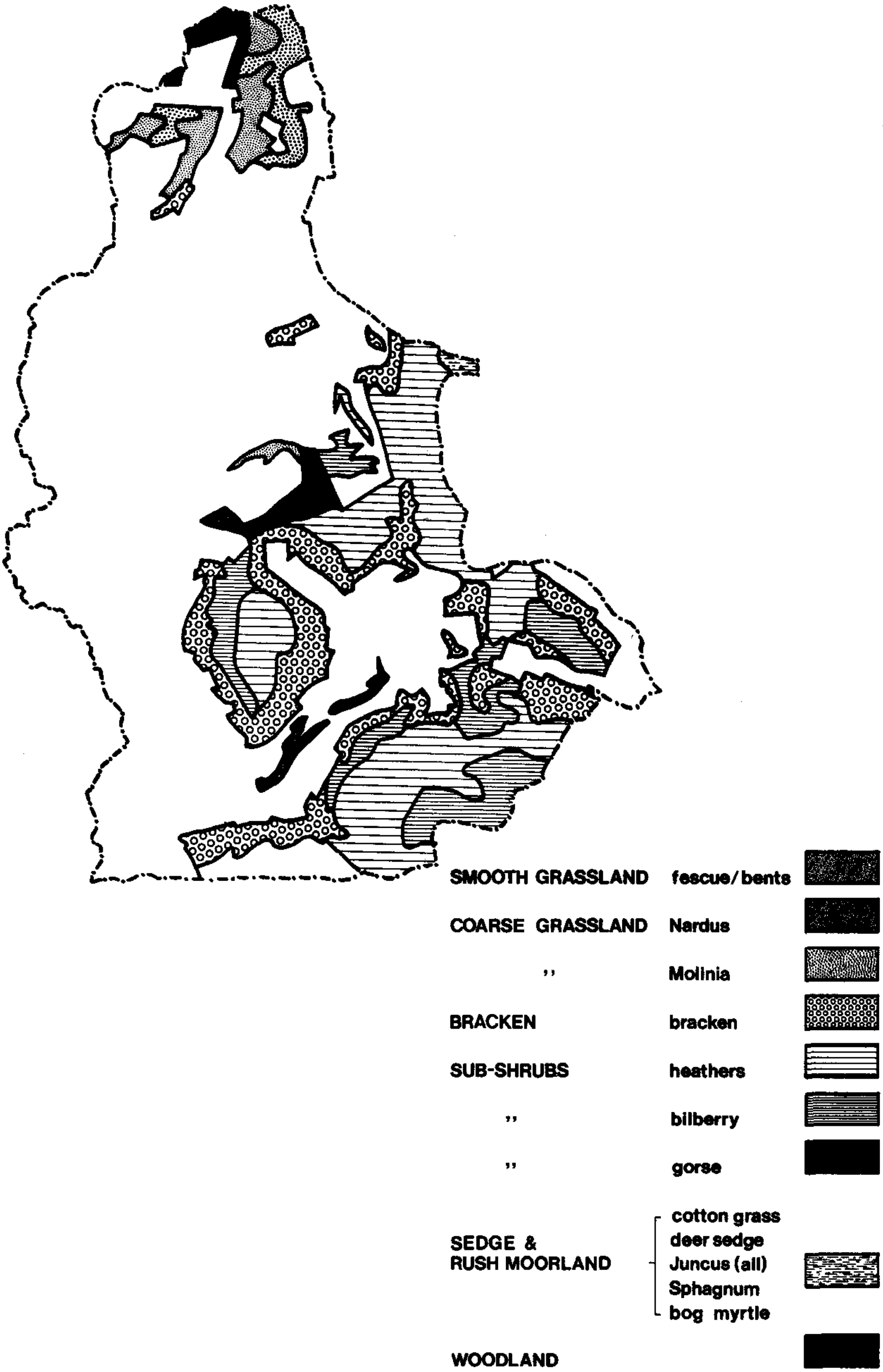
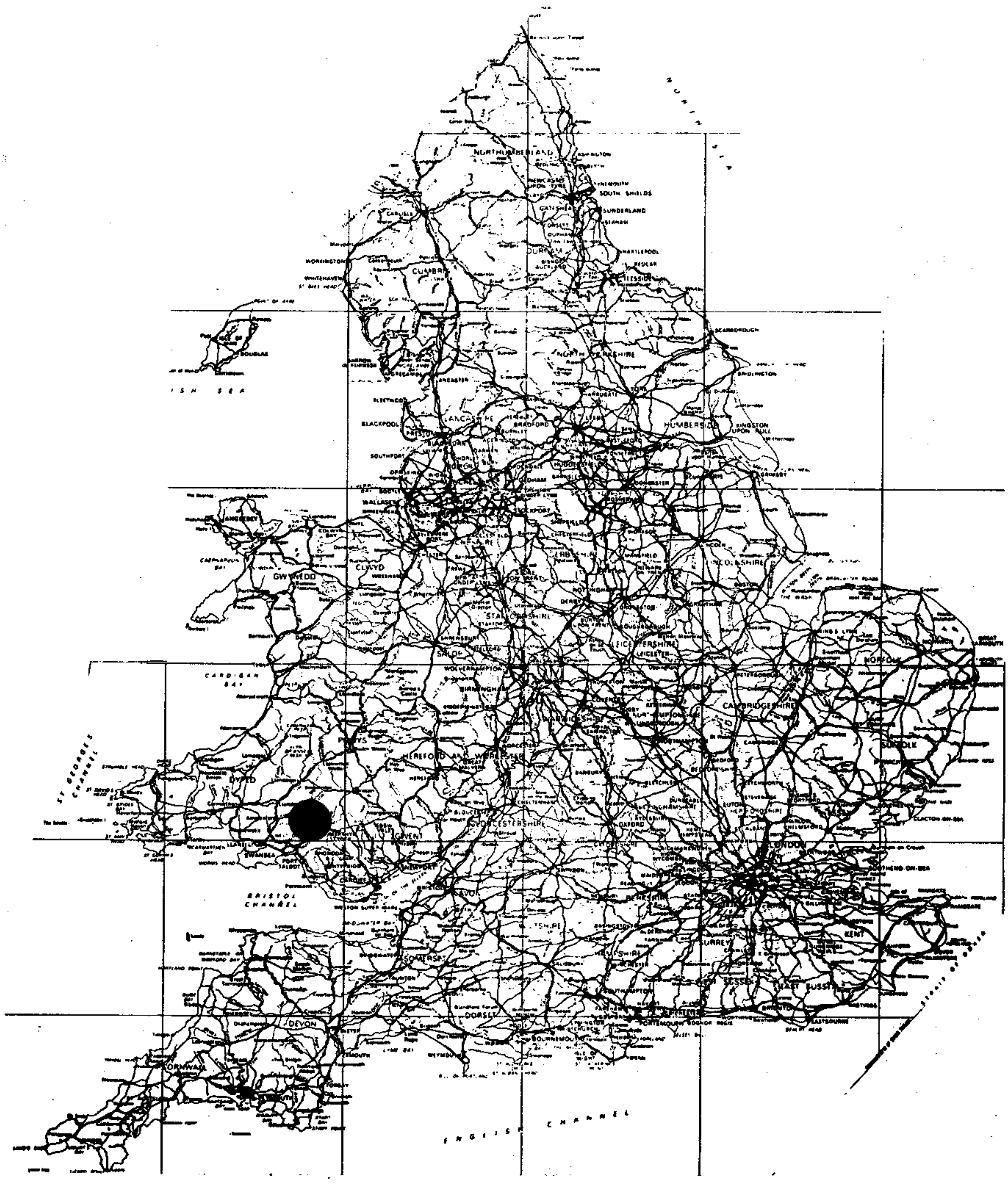


FIGURE 9.14 UPLAND LANDSCAPES STUDY VEGETATION MAP OF GLASCWM

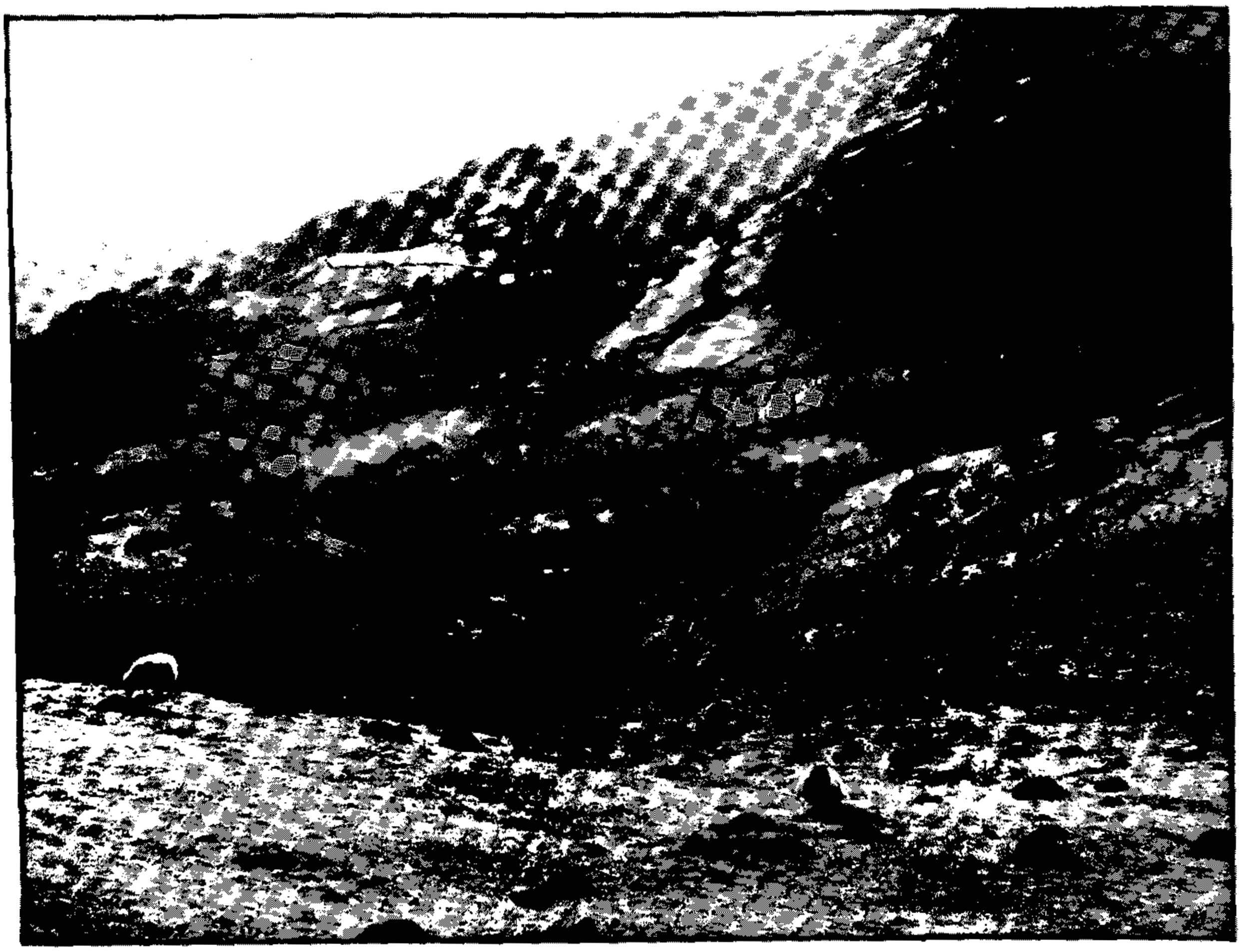



(Map by Geoffrey Sinclair, Environmental Information Services)

# YSTRADGYNLAIS HIGHER
# and
# GLYNTAWE

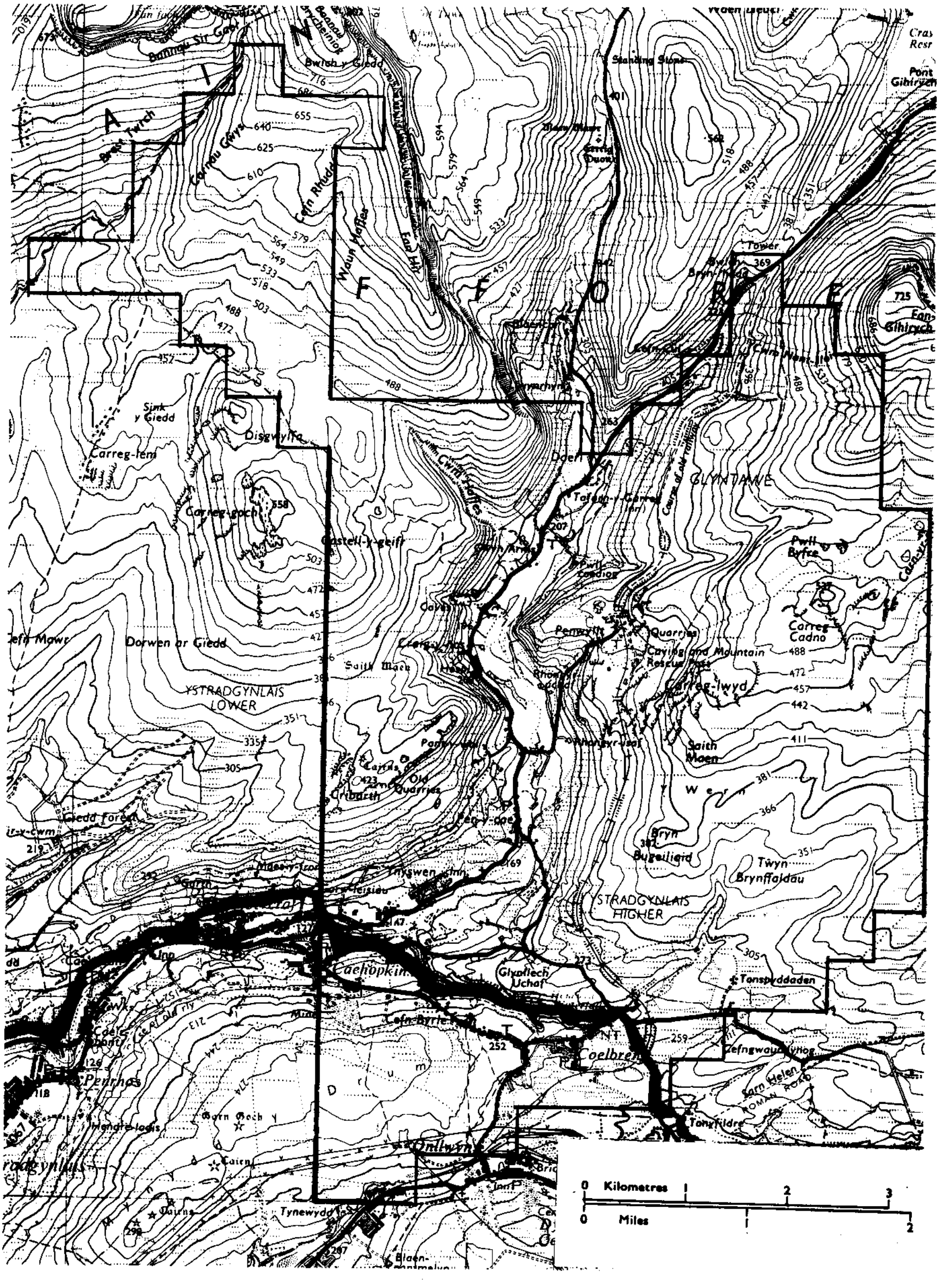


YSTRADGYNLAIS - PLATE 1



View from Penwyllt looking south westwards. Small fields bounded by hedgerows and banks contribute to the landscape character. In the foreground the vegetation is rough pasture Festuca/Agrostis grassland, class 8, dotted with numerous mole-hills.
(Photo by P.Ainsworth)

FIGURE 10.1 THE STUDY AREA OF YSTRADGYNLAIS HIGHER AND GLYNTAWE

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# STUDY AREA 10: YSTRADGYNLAIS HIGHER AND GLYNTAWE, POWYS

## PHYSICAL ENVIRONMENT

The combined parishes of Ystradgynlais Higher and Glyntawe (Figure 10-1) cover 55 $km^2$ and are situated in the west of the Brecon Mountains region, about 25 km northeast of Swansea. They are bisected by the Swansea-Brecon road (A4067) that follows the valley of the River Tawe. Most of the area, north of the Caehopkin-Coelbren road, lies within the Brecon Beacons National Park.

Altitude sectors (Figure 10-2) are related to the approximately north-south valley which cuts the area to give a relatively low altitude central zone dominated by land below 244 m (800 ft) (Part I, Plate 15). Land dominated by altitudes between 244 and 427 m (800-1 400 ft) flanks this valley to occupy much of the central and southern parts of the area (Plate 1). In the north, higher land above 427 m (1 400 ft) dominates the northwestern and northeastern projecting sectors of Glyntawe, with a maximum altitude of 760 km (2 500 ft) reached near the summit of Fan Foel in the northwest. Gentle slopes (<5°) dominate a band along the south and east (Figure 10-3), and the lower part of the Tawe valley, with moderate slopes (5-11°) prominent over much of the centre and north. Areas dominated by steep and very steep slopes are subordinate, being found particularly on the western side of the Tawe valley.

Climatically the area can be classified, relative to the 12 study areas, as warm and wet (Part I, 2.32) with mean daily temperatures for January and October estimated as 2.3 and 9.0°C. The annual average of daily sunshine hours is 4.0, with an annual average number of days with snow lying of 15. The length of the growing season for the district which includes Ystradgynlais is given by Smith (1976) as 229 days (6 April-21 November) at an altitude of 297 m (975 ft). With a considerable altitude difference between the valley floor and the high summits, clearly there is also a considerable climatic range from these averages within the area (see Part I, 2.31 for consideration of temperature change with altitude). Rainfall is high (1 601-2 220 mm, c. 64-88 in pa) over about 80% of the area (Figure 10-4) while the highest ground in the north of the area has very high rainfall (2 201-2 600 mm, c. 88-104 in pa).

Geologically, the area is situated mainly on Carboniferous rocks. Coal Measure sandstones and shales occur in the southwest, Millstone Grit sandstones in a central sector, and Carboniferous Limestone Series rocks in the north. The variety of these rocks provides the coal and stone which have been and are important in the economy of the area. The northern corners of the parish pass out of Carboniferous system rocks onto older rocks of the Old Red Sandstone, which here, like many of the Carboniferous strata, are also hard sandstones. Much of the central and southern sectors are mapped as covered by glacial drift. This is particularly so on the more readily eroded Carboniferous Limestone rocks.

On the national soil map the entire area is included in a unit dominated by Peaty Gleys with associated Peaty Soils, Gleys and Peaty Podzols, but peaty and peaty-topped soils are less prominent in the central valley and the southern part of the area where non-peaty Gleys and better drained mineral soils are frequent.

The national agricultural land classification maps show a narrow band of grade 4 land along the Tawe Valley, but the greater part of the area is classed as grade 5, the lowest quality category.

The topographic picture of the area given in outline in Figure 10-5 again emphasises the central valley as comprising most of the sector which has settlement features of roads, buildings and frequent field boundaries. The balance of the settled area is on the plateau sector in the southeast. The distribution of land types is shown in Figure 10.6 Upland margin land characterises the central valley, with a flanking zone of steep upland, and an area of upland plateau in the south. Hill land is present as 2 blocks in the northeast and northwest. The northeastern block is a complex of steep hill and hill land in the north, and of hill and high plateau land in the south and east, while the northwestern block is mainly in the hill land type.

## LAND-USE HISTORY

Within the study area are important limestone caves at Dan yr Ogof (now open as a tourist attraction) in which evidence of Bronze Age man has been found. The Romans certainly used the area, with a Roman road passing a fort site just to the south. Little detail is known of the history of the area until, from the early 18th century, industry came in to exploit its mineral resources and timber. Timber was gradually sought from further afield to feed the copper furnaces at Swansea and the ironworks in the extreme southwest of Breconshire which can be dated to at least the early 17th century. Iron then began to be worked at Ystradgynlais itself and coal mined at Ystalyfera a short distance to the southwest.

Stone began to be quarried, including material suitable for silica brick production at Penwyllt (Part I, Plates 15 and 33), but coal was the major employer that brought people to the area, increasing its population from 993 in 1801 to 3 758 in 1851.

The Tithe Commutation Survey of 1839-40 described how 'the parish is full of valuable minerals', and Osborne (1978) has shown that the rise in the potential value of these deposits had a bearing on the rate and scale of enclosure of the commons in the 18th and 19th centuries. It was in the 1830s that ways were found of using the local anthracite in iron blast furnaces. Once discovered, 30 years of prosperity followed, until the increasing trend toward the use of steel, together with competition from imports, led to spasmodic and eventually permanent closure of the ironworks. Meanwhile, the construction of railways had encouraged greater exploitation of the anthracite deposits and the growth of a flourishing export trade through South Wales ports. Because anthracite remained more in demand, the area did not suffer as severely in the 1920s and 30s as those did that were producing bituminous coal (Minchinton 1961). Since 1945 however the local coalmines have all closed. Opencast mining was begun and remains active in the southern tip of the area (Part I, Plate 15), but this too may be approaching the end of its life (ULS 1979).

The pattern of farming was also outlined in the Tithe Survey of 1839-40. Industrial development and the people it brought gave farmers a local market, particularly for milk products and meat. Glyntawe then covered 365 ha (900 acres) of which 60 ha (150 acres) were arable. Sixteen ha (40 acres) were occupied by 'woods and plantations'. 4 ha (10 acres) by 'gardens', and the remaining 285 ha (700 acres) by 'meadow and pasture'. The livestock population comprised 34 cows, 46 bullocks, 19 horses and 440 sheep. Hedge timber was made up of much oak and ash. The survey did not distinguish the present parish of Ystradgynlais Higher. The then extent of Ystradgynlais was given as 4 850 ha (12 000 acres), said to include 2 230 ha (5 500 acres) of common. Only 110 ha (265 acres), were arable, on soils described as very poor red loams over limestone and on which a rotation was followed of 3 years under wheat, barley or oats, then 7 to 8 years under clover and grass. Meadow and pasture covered 2 040 ha (5 035 acres). The 'yellow clay soils' of these were so badly drained that yields were low in many parts. Woodland occupied 490 ha (1 200 acres) in which there was 'tolerably good growth of oak in some parts and some ash'.

Although agricultural statistics between 1900 and 1965 are shown for some areas in graphs in Part I, they were not available for these parishes. ULS (1979) say there has been no change in their area of crops and grass between 1884 and 1978. About 25% of the combined parishes remain common land (ULS 1979) some of which is currently used for coal and limestone extraction. The Forestry Commission has acquired around 10% of the area in the southeast, with to the north of this forested sector a block owned by the Nature Conservancy Council and managed as the Ogof Fynnon Ddu National Nature Reserve, conserved in the interest of its underlying cave system.

The area was surveyed by the Ordnance Survey first in 1878 and revised in 1903. Maps covering the south part of Ystradgynlais were again revised in 1914, but no further revision was carried out for the remainder of the area until 1948, when a provisional series of large scale maps was prepared. From analyses of OS maps, supplemented by air photographs, Figure 10-7 shows the identified sectors of moorland core, moorland fringe and farmland (see Part I, 4.49-4.50). Of 620 ha of moorland fringe, 375 ha have been afforested since 1945. The non-afforested moorland fringe is concentrated in the upland margin (containing 53% of the fringe), upland plateau (26% of fringe) and steep upland (19% of fringe) land types, which themselves occupy 19, 10 and 17% respectively of the total area.

VEGETATION

In 1977 the vegetation at 70 main sites was recorded in Ystradgynlais. Figure 10-8 includes the frequencies of vegetation classes at these sites and Figure 10-9 gives their individual location and classification.

Ystradgynlais is one of only 2 study areas, (Llanfachreth is the other), in which all 16 vegetation classes were present. If woodlands are also considered, Ystradgynlais is just second to Llanfachreth, (by one woodland class), in overall vegetation variety. The frequency of several of the grassland and heath vegetation classes however is low, 6 classes being present at only 1 or 2 sites each.

At sites along the valley of the Tawe the vegetation is mainly improved pastures and rough pastures (Plate 1 and Part I, Plate 33). At sites on higher ground flanking the valley the vegetation is mainly heaths, particularly grassy heaths (Part I, 3.16). Twentytwo per cent of the main sites in the area are <u>Festuca/Vaccinium</u> heath, class 14 , and 16% are <u>Festuca/Nardus/Molinia</u> heath, class 16 (see Part I, Plates 33, 34): among the shrubby heaths (Part I, 3.18), 8% of sites are <u>Vaccinium/Calluna</u> heath, class 10, and 12% are <u>Nardus/Sphagnum/Calluna</u> heath, class 11. <u>Festuca/Vaccinium</u> and <u>Vaccinium/Calluna</u> heaths are found on the better drained soils and the other 2 heath classes are associated with pockets of poorly drained peaty soils. <u>Festuca/Nardus/Molinia</u> heath, class 16, occurs principally on lower slopes near the valley floor.

Ystradgynlais is still quite well wooded, with woodlands along the valley of the Tawe and its minor tributaries (Part I, Plate 15). Twelve woodland sites were examined. Of these, 7 can be classified as upland acid woodlands (Part I, Table 3-4), 2 as lowland acid woodlands and 3 as lowland basic woodlands. Most are dominated by oak, associated with ash on more base rich soils, or with birch at higher elevations and on poorer soils. Regeneration was recorded as taking place in half of the woods. In the southeast the large sector planted with conifers forms part of a block of land covering 1 500 ha that extends outside the study area. Within the study area, most of the forest planting of the early 1970s was destroyed by fire in 1976 (ULS 1979).

Table 10-1 relates the vegetation class at recorded main sites to the land type of the grid squares in which the sites are situated, while Figure 10-10 summarises the relationship of vegetation groups to land groups. Improved and rough pastures are concentrated in the upland margin land type and are absent from the hill land. Grassy heaths are present throughout the range of land types. Shrubby heaths are most common in the hill land.

## POTENTIAL VEGETATION CHANGE

With 90% of the study area in the Brecon Beacons National Park, the policies of the National Park Planning Committee must influence its future to a considerable extent. Recreational use of the area is increasing, with the populous South Wales industrial areas close by, and a Country Park and the Dan yr Ogof caves as particular attractions. The Park Planning Committee are anxious to sustain deciduous woodland and have planting schemes for 2 localities. In the south, outside the National Park, opencast coal mining is likely to continue for a few years at least. In general the mined land is restored for agriculture but in some cases it may be used for forestry. An estimate of the potential forestry land (Part I, Table 5-19) gives 42% of the area as potential forest, on assumptions that favourable land remains in agriculture and that most hill land below 427 m (1 400 ft) could be planted. Some farmers interviewed during the ULS survey (ULS 1979) said that they were interested in grassland improvement schemes which suggests that, if their interest turned to action, there could be loss of existing rough pastures and grassy heaths. The majority of farmers however said they planned to continue farming at their present level. In the ULS assessment of rough grazing suitability for improvement, applying the criteria developed by the ADAS Resource Planning Group, 68% was classified as 'not improvable', with almost all of this of 'some grazing value'. The remaining 32% is almost all graded as of limited improvability because of its physiographic character. On this assessment little option for easy improvement is actually available to farmers.

Applying the standardised courses of vegetation change to predict what could happen in Ystradgynlais from the principles of Part I, 5.74-5.77 and Figure 5-4, as summarised here in the table in Appendix 2, ignoring the option for forestry, Figure 10-9 shows the possible changes at individual sites, and Figure 10-8 the resulting frequencies of vegetation classes in the area.

The present most frequent vegetation classes at the sites sampled were, from the improved pasture group, herb-rich *Lolium* grassland (class 4); from the rough pastures *Agrostis*/*Juncus* grassland (class 5); and from the grassy and shrubby heaths respectively *Festuca*/*Vaccinium* heath (class 14) and *Nardus*/*Sphagnum*/*Calluna* heath (class 11). Class 4, herb-rich *Lolium* grassland, represents the agriculturally best class in the improved pasture succession and as such it would be maintained under stable or expansionist agricultural regimes. If this class became less intensively managed and very lightly grazed, change would be very slow, reverting through lower grades of improved pastures eventually to scrub woodland. The rough pasture of class 5 is often associated with soil wetness. In a climate of agricultural intensification it might be expected to be drained and upgraded to improved pasture. Under intensified agricultural use also, the grassy heath of class 14 would be expected to move towards a rough pasture community such as *Festuca*/*Agrostis* grassland, class 8. In agricultural decline, the *Agrostis*/*Juncus* grassland could move towards *Festuca*/*Nardus*/*Molinia* grassy heath, class 16, and the *Festuca*/*Vaccinium* grassy heath towards *Vaccinium*/*Calluna* heath, class 10. These classes also might well become scrub woodland in an area with many existing trees as seed sources. The prominent shrubby heaths of class 11 would change little if agricultural effort decreased, but could move towards grassy heath of class 16 under heavier grazing.

Remembering that the predicted changes are generalisations that cannot consider local site and management factors, it is estimated that an intensification of agriculture to a moderate degree in Ystradgynlais could lead to overall increases in improved pastures (from 18 to 35% of recorded sites) and rough pastures (from 17 to 39% of recorded sites). These increases would be counterbalanced by decreases in sites with grassy heaths (from 39 to 25%) and in sites with shrubby heaths (26 to 1%). A moderate decline in agricultural use would lead to falls in the frequency of improved pasture sites (18 to 12%), of rough pastures (17 to 9%), and of grassy heaths (39 to 14%), these being balanced by an increase in sites with shrubby heaths from 26 to 55%. In considering the overall impact of these predicted vegetation changes on the landscape, the outcome of increased agricultural use would involve (Part I, Table 5-17) a change in vegetation group at 80% of the recorded main sites, while in a situation of declining agricultural use 60% of the main sites would change their vegetation group.

Figure 10-10 includes the predicted balance of vegetation groups in each land group. Intensified agriculture could bring about more uniformity in the upland margin land and a substantial loss of heaths (including virtually all shrubby heaths) at sites in the upland and hill land. Declining agricultural effort could expand heaths and especially shrubby heaths at sites in all land groups.

Figure 10-11 reproduces the vegetation map of Ystradgynlais prepared in the Upland Landscapes Study (ULS 1979). Correlations of the ULS mapping units with the vegetation classes identified by ITE at main sites situated within the mapping units are given in Table 10-2. The 'farmland' unit here includes 22 ITE main sites, 90% of which have pasture vegetation. Sites in the other most extensive units, 'coarse grasslands' of different main species, are almost entirely heaths, about equally divided between grassy and shrubby heath classes. The changing proportions of vegetation classes at main sites in each ULS unit that would result from the standardised predicted changes following agricultural intensification or decline are given in Table 10-3. Because of the present importance of grassy heaths (39% of sites) and their prominent representation in 4 mapping units, the visual character of the vegetation in these units could change markedly as it could swing from the present balance towards either rough pastures or shrubby heaths.

## CONCLUSION

Ystradgynlais has a high proportion of grassy heaths and a moderate level of rough pastures among the recorded main sites. These groups are particularly liable to gradual change through management modification, either to agriculturally better grasslands or towards shrubby heaths and grassy heaths respectively if pressure declines. The potential for change is thus considerable. Additionally, woodland could readily spread from the present hedgerows and existing woods if agricultural use fell sharply. However though the potential for change is high, actual change may not reach this level. Many farmers expect to continue in the foreseeable future in the way they are farming now and the National Park will try to sustain the present landscape balance over most of the area. It is a widely used gateway to the Park from the industrial south and can be a magnet to draw off recreational use from other more sensitive or popular parts. Ecologically change could be great, but wider policy constraints could sustain the present vegetation character in the near future.

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SMITH, L.P. (1976). The Agricultural Climate of England and Wales. Tech. Bull. 35, Ministry of Agriculture, Fisheries and Food, HMSO London.

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TABLE 10-1 CORRELATION OF VEGETATION CLASSES AND LAND TYPES - YSTRADGYNLAIS

| Vegetation Group and Class | | Land Group and Type: Hill | | | Upland | | | Upland Margin (6) |
|---|---|---|---|---|---|---|---|---|
| | | Steep Hill (1)* | Hill (3) | High Plateau (4) | Steep Upland (5) | Upland (7) | Upland Plateau (8) | |
| Improved Pastures | 1 | | | | | | | 1 |
| | 2 | | | | | | | 1 |
| | 3 | | | | 1 | | | 2 |
| | 4 | | | | | | 1 | 7 |
| Rough Pastures | 5 | | | | | 1 | | 6 |
| | 6 | | | | 1 | | | |
| | 7 | | | | 1 | | | 1 |
| | 8 | | | | | | | 2 |
| Grassy Heaths | 14 | 2 | 4 | 2 | 4 | | 1 | 2 |
| | 15 | | | | 1 | | | |
| | 16 | | 1 | | 7 | | 2 | 1 |
| Shrubby Heaths | 9 | | | | | | | 1 |
| | 10 | | 1 | 2 | 1 | | | 1 |
| | 11 | 2 | 4 | 2 | | | | |
| | 12 | | | | 1 | | | |
| | 13 | 1 | | | | | 1 | 1 |

As number of sites of each vegetation class located in each land type.
* Land type numbers as used on computer maps, Figure 10-6.

TABLE 10-2 CORRELATION OF ULS VEGETATION MAPPING UNITS AND ITE VEGETATION CLASSES AT MAIN SITES - YSTRADGYNLAIS

| ULS Mapping Unit | Number of ITE Main Sites in Area of ULS Unit | ITE Vegetation Class 1977 | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Improved Pastures | | | | Rough Pastures | | | | Grassy Heaths | | | Shrubby Heaths | | | | |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 14 | 15 | 16 | 9 | 10 | 11 | 12 | 13 |
| Smooth Grassland | 9 | | | | | | | | 1 | 4 | 1 | 1 | | | | | 2 |
| Coarse Grassland/*Nardus* | 12 | | | | | | | | | 5 | | 2 | | 2 | 3 | | |
| Coarse Grassland/*Molinia* | 16 | | | | 1 | | | | | 3 | | 5 | | 4 | 2 | | 1 |
| Bracken | 6 | | | | | 1 | | 1 | | 3 | | 1 | | | | | |
| Sub-shrubs/Heathers | 3 | | | | | | | | | | | | | | 3 | | |
| Sub-shrubs/Bilberry | 1 | | | | | | | | | 1 | | | | | | | |
| Sub-shrubs/Gorse | | | | | | | | | | | | | | | | | |
| Sedge & Rush Moorland | 1 | | | | | 1 | | | | | | | | | | | |
| Farmland | 22 | 1 | 1 | 3 | 7 | 5 | 1 | 1 | 1 | | | 1 | | | | | 1 |

As number of recorded main sites in each ITE vegetation class that are located in each ULS unit

TABLE 10-3 PREDICTIONS OF CHANGE IN THE BALANCE OF VEGETATION GROUPS AT MAIN SITES LOCATED IN ULS MAPPING UNITS - YSTRADGYNLAIS

| ULS Mapping Unit | ITE Vegetation Groups | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Improved Pastures | | | Rough Pastures | | | Grassy Heaths | | | Shrubby Heaths | | |
| | A | B | C | A | B | C | A | B | C | A | B | C |
| Smooth Grassland | | 1 | | 1 | 6 | | 6 | 2 | 1 | 2 | | 8 |
| Coarse Grassland/*Nardus* | | | | | 7 | | 7 | 5 | | 5 | | 12 |
| Coarse Grassland/*Molinia* | 1 | 1 | 1 | | 8 | | 8 | 7 | | 7 | | 15 |
| Bracken | | 2 | | 2 | 4 | 1 | 4 | | 1 | | | 4 |
| Sub-shrubs/Heathers | | | | | | | | 3 | | 3 | | 3 |
| Sub-shrubs/Bilberry | | | | | 1 | | 1 | | | | | 1 |
| Sub-shrubs/Gorse | | | | | | | | | | | | |
| Sedge & Rush Moorland | | 1 | | 1 | | | | | 1 | | | |
| Farmland | 12 | 20 | 8 | 8 | 1 | 5 | 1 | 1 | 7 | 1 | | 2 |

As number of recorded main sites falling in each ITE vegetation group that are located in each ULS unit

A - situation as recorded 1977

B - predicted balance of vegetation if agricultural use increased, 10+ yrs

C - predicted balance of vegetation if agricultural use decreased, 10+ yrs

FIGURE 10.2 ALTITUDE SECTORS - YSTRADGYNLAIS

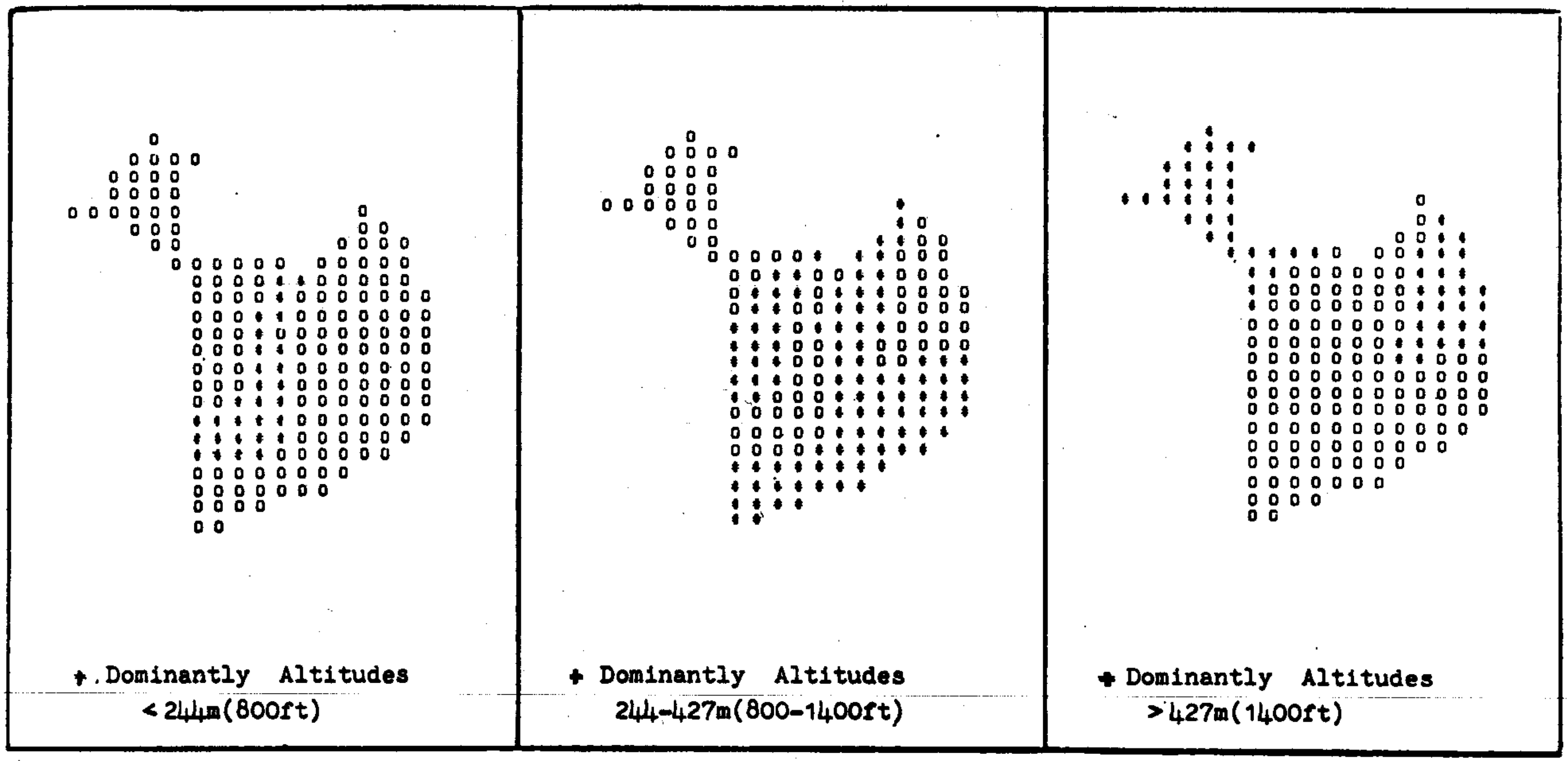


FIGURE 10.3 SLOPE SECTORS - YSTRADGYNLAIS

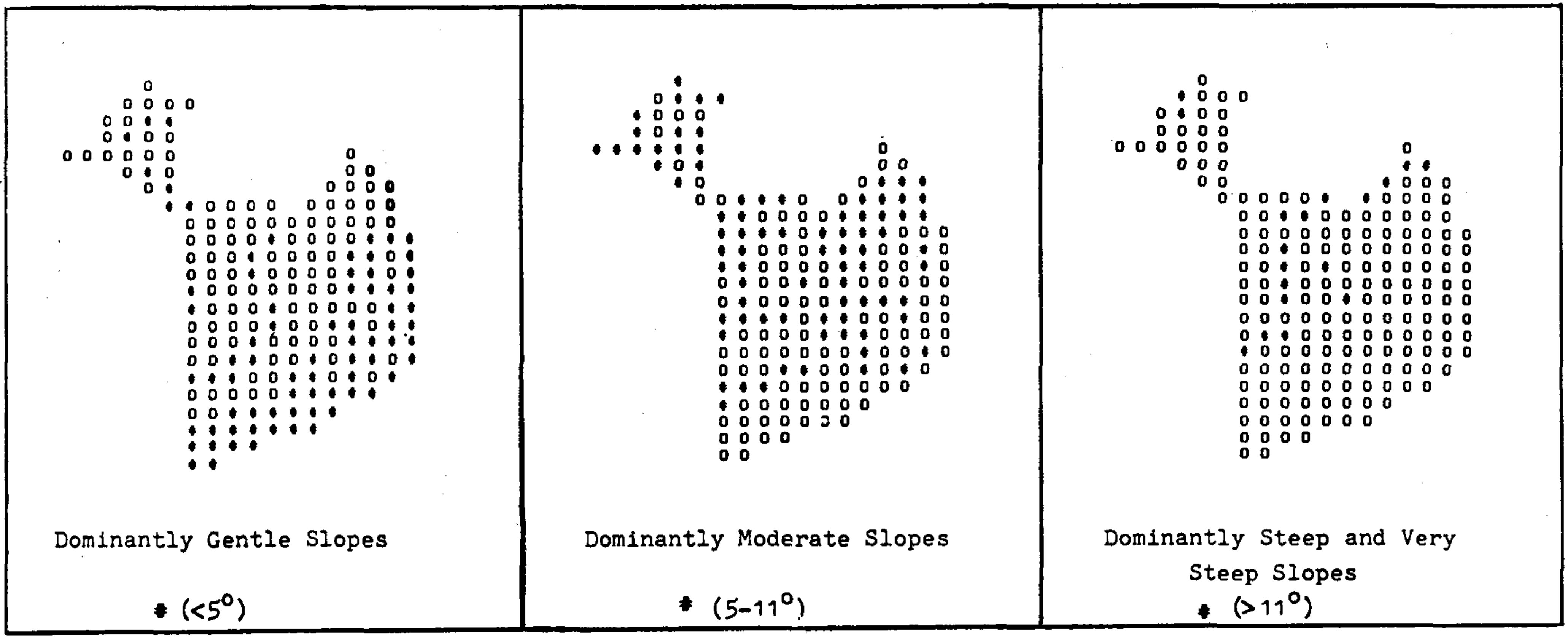
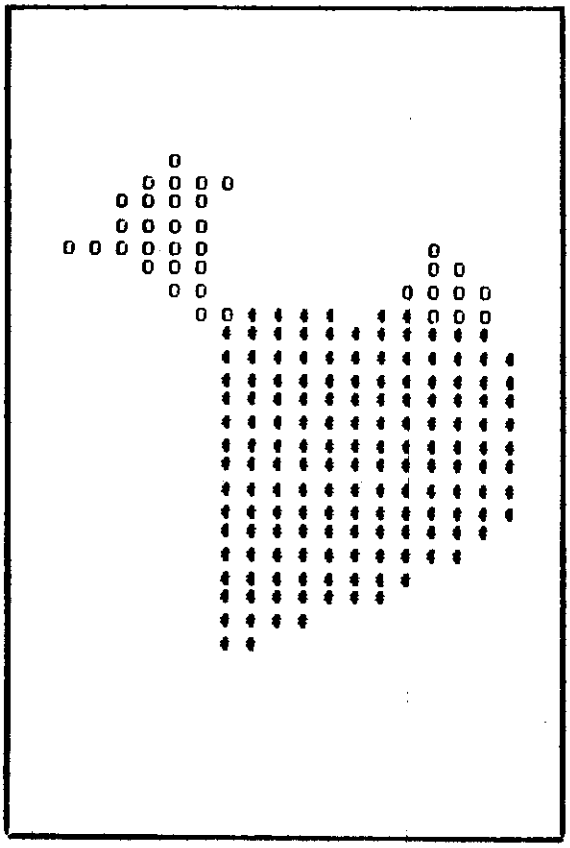


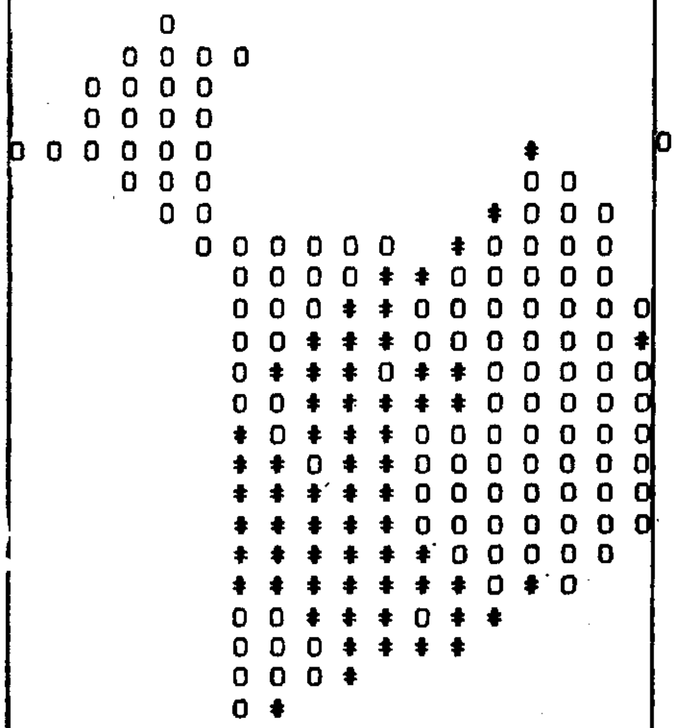
FIGURE 10.4 RAINFALL SECTORS - YSTRADGYNLAIS



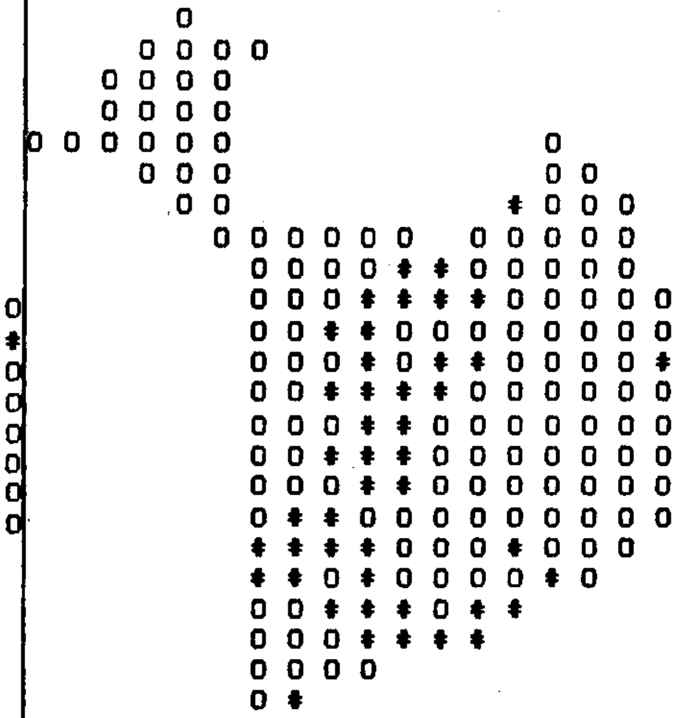
* High Rainfall (1601-2200mm,64-88in pa)

o Very High Rainfall (2201-3000mm,88-120in pa)

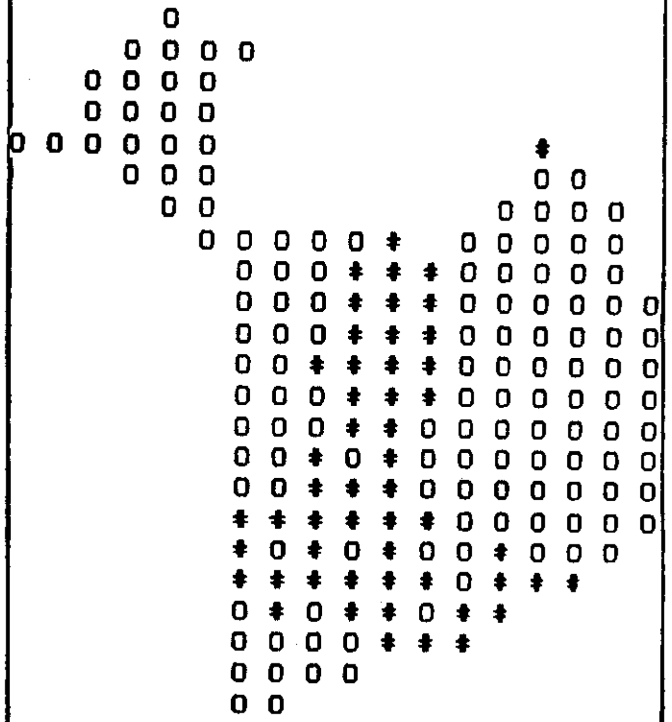
FIGURE 10.5 TOPOGRAPHIC CHARACTERISTICS - YSTRADGYNLAIS



\# Roads Present



\# Buildings Present



\# Frequent Field Boundaries Score > 10, on scale 0-25

FIGURE 10.6 LAND TYPES – YSTRADGYNLAIS

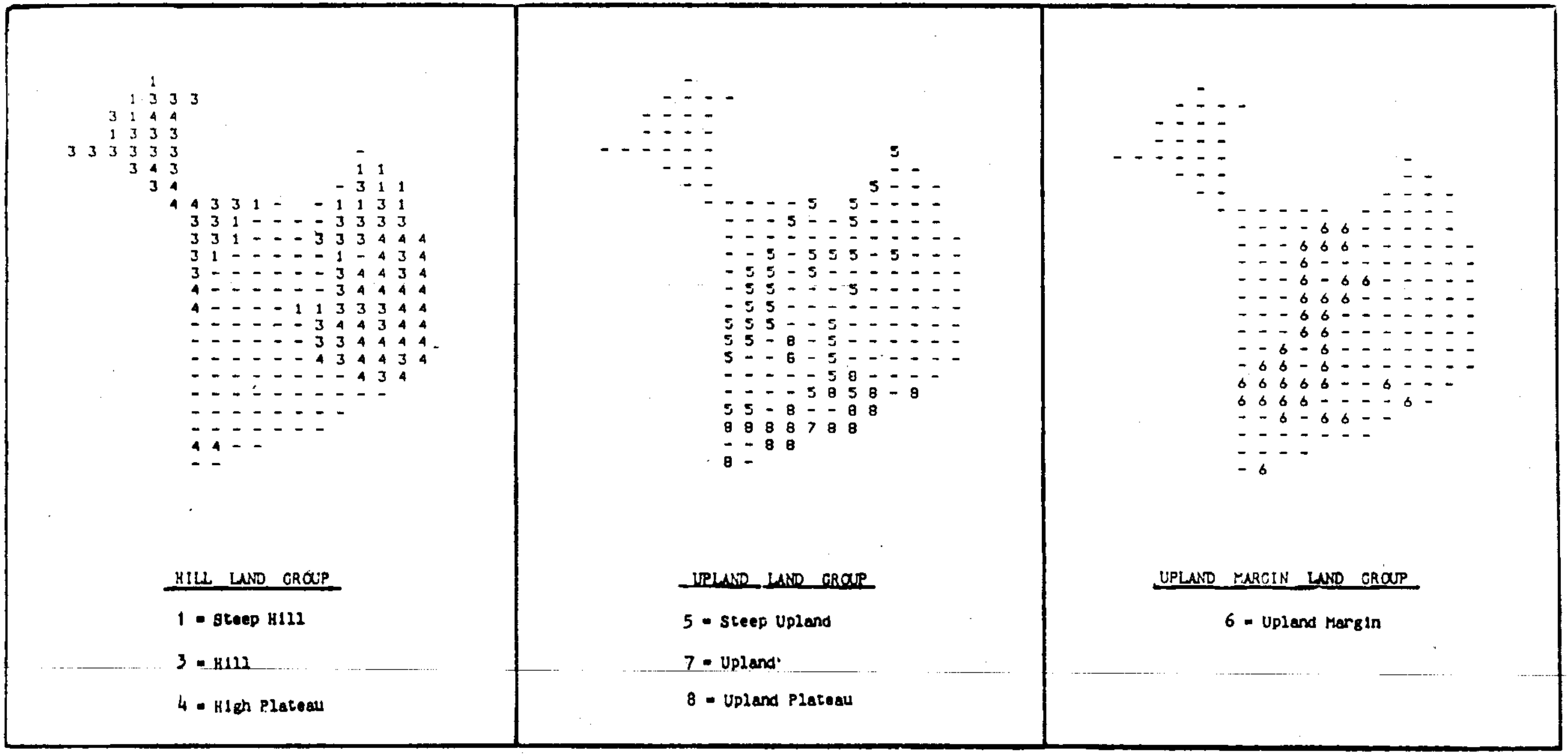
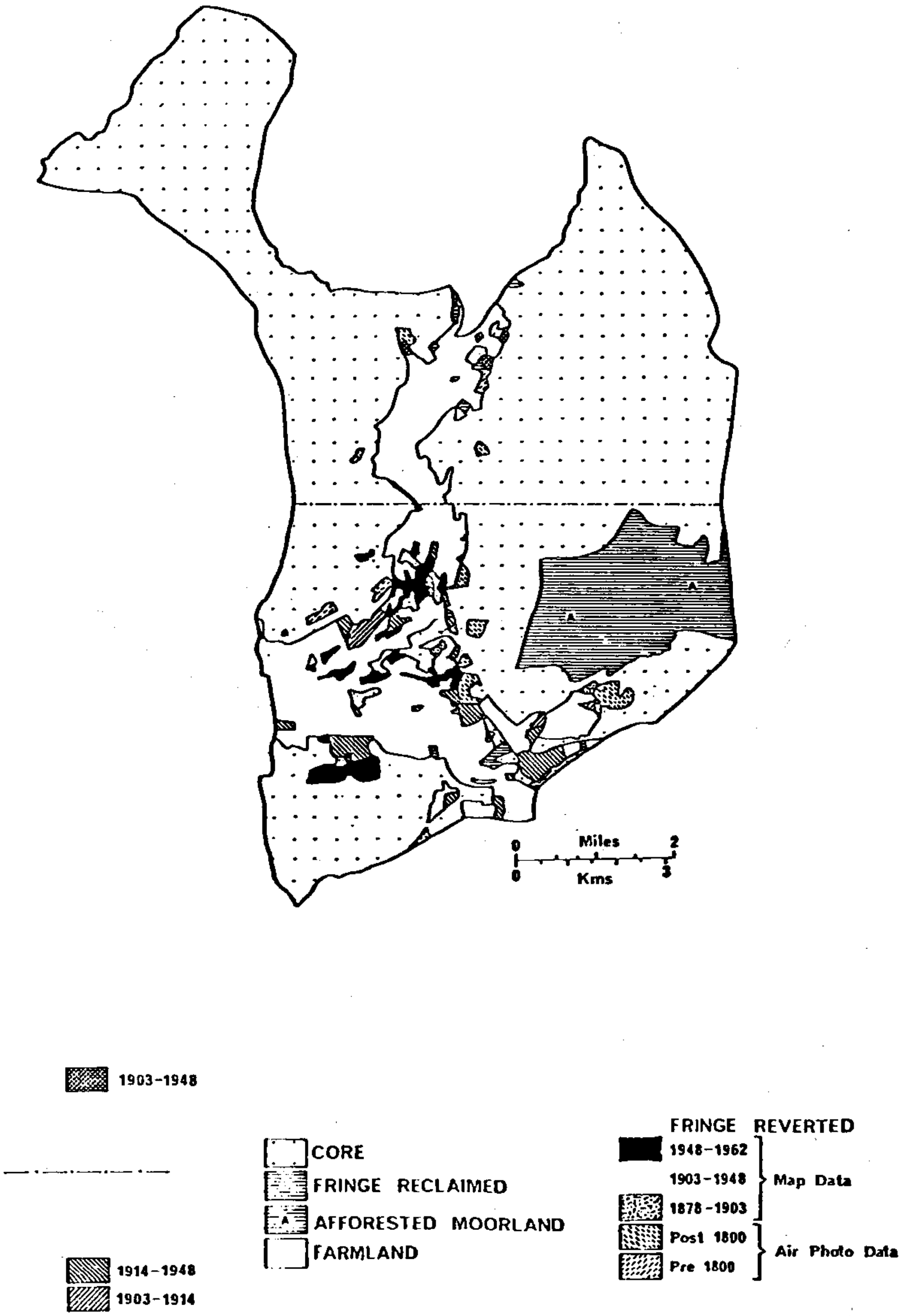
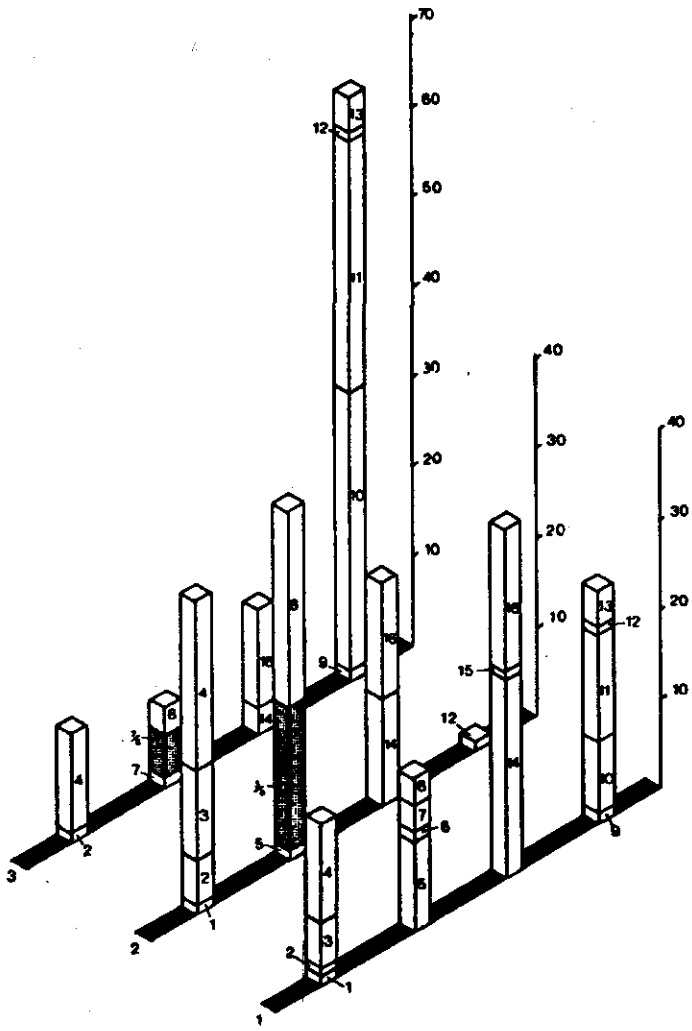


FIGURE 10.7 MOORLAND CORE, FRINGE AND FARMLAND - YSTRADGYNLAIS



# FIGURE 10.8 VEGETATION CLASS FREQUENCY AT MAIN SITES - YSTRADGYNLAIS

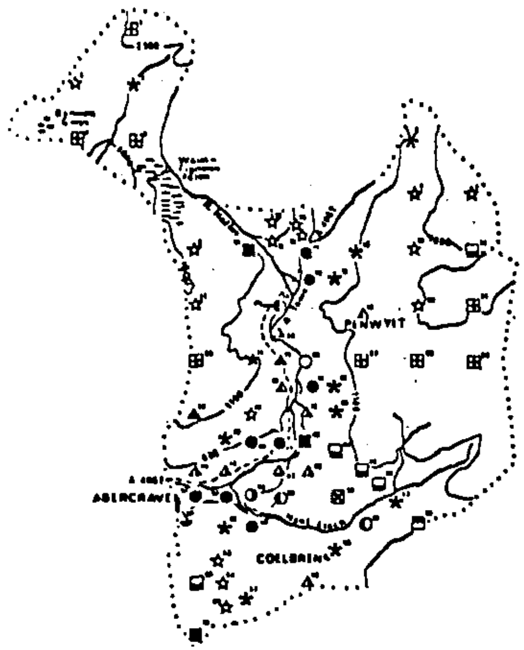


| Vegetation Group | Class | | % Main Sites in Vegetation Class 1 | 2 | 3 |
|---|---|---|---|---|---|
| Improved Pastures | 1 | Lolium/Holcus/Pteridium | 1 | 1 | - |
| | 2 | Lolium Grassland | 1 | 5 | 1 |
| | 3 | Lolium/Trifolium | 5 | 10 | - |
| | 4 | Herb rich Lolium Grassland | 11 | 19 | 11 |
| Rough Pastures | 5 | Agrostis/Juncus | 10 | 1 | - |
| | 6 | Festuca/Juncus | 1 | - | - |
| | 7 | Agrostis/Holcus | 3 | - | 1 |
| | 8 | Festuca/Agrostis | 3 | 22 | 3 |
| | 5/6 | Agrostis/Juncus or Festuca/Juncus | - | 16* | - |
| | 7/8 | Agrostis/Holcus or Festuca/Agrostis | - | - | 5* |
| Grassy Heaths | 14 | Festuca/Vaccinium | 22 | 12 | 3 |
| | 15 | Festuca/Nardus/Vaccinium | 1 | - | - |
| | 16 | Festuca/Nardus/Molinia | 16 | 13 | 11 |
| Shrubby Heaths | 9 | Calluna/Molinia/Vaccinium | 1 | - | 1 |
| | 10 | Vaccinium/Calluna | 8 | - | 31 |
| | 11 | Nardus/Sphagnum/Calluna | 12 | - | 28 |
| | 12 | Eriophorum/Calluna | 1 | 1 | 1 |
| | 13 | Calluna | 4 | - | 4 |

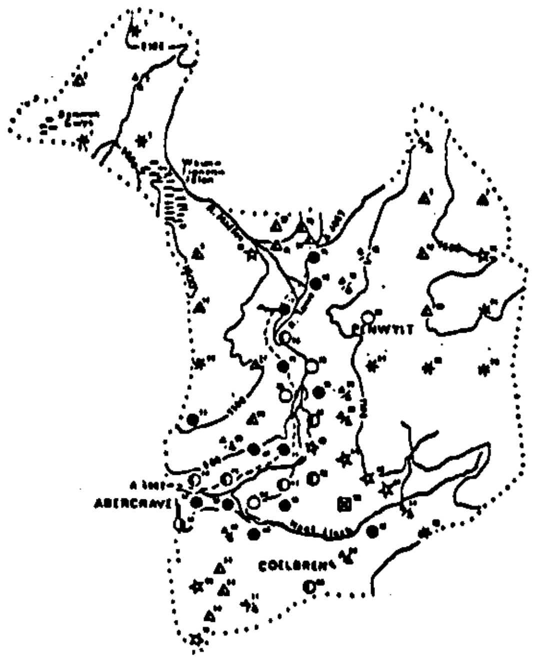
1. Recorded Main Sites, 1977
2. Predicted Changes at Main Sites if Agriculture Increased, 10 + Years.
3. Predicted Changes at Main Sites if Agriculture Decreased, 10 + Years.

* Under a regime involving intensification of agriculture Class 16, Festuca/Nardus/Molinia, could move towards either Class 5, Agrostis/Juncus or Class 6, Festuca/Juncus which is closely related to it. Similarly, with reduction in the level of agricultural activity Class 3, Lolium/Trifolium could move towards Class 7, Agrostis/Holcus or Class 8, Festuca/Agrostis. These changes are indicated b. the shaded areas on the relevant histograms.

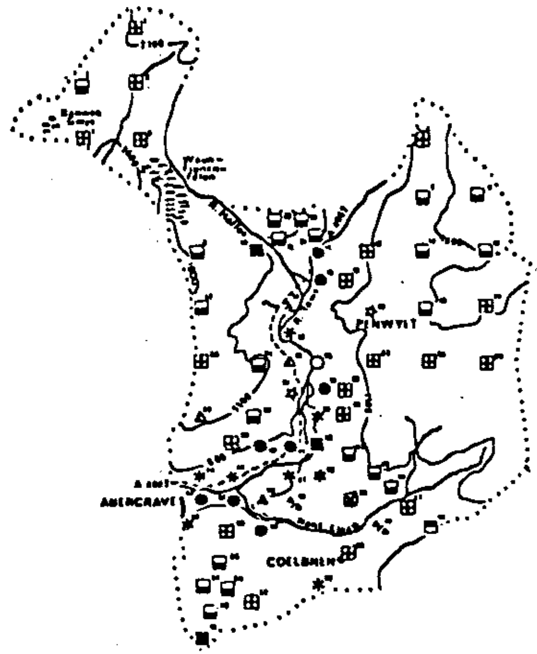
FIGURE 10.9 LOCATION AND CLASSIFICATION OF VEGETATION MAIN SITES - YSTRADGYNLAIS




1977

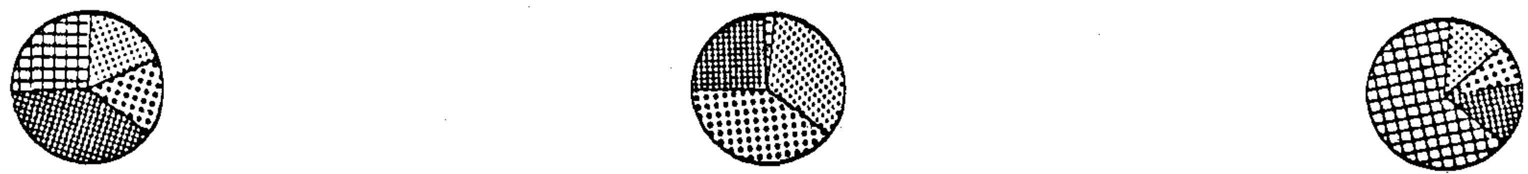



Predicted if Agriculture Increased




Predicted if Agriculture Decreased

Overall Frequencies of Vegetation Groups



## KEY TO FIGURE 10.9

| | | |
|---|---|---|
| **Group 1.** Improved Pastures | Class 1 : | Lolium/Holcus/Pteridium |
| | Class 2 : | Lolium |
| | Class 3 : | Lolium/Trifolium |
| | Class 4 : | Herb — rich Lolium |
| **Group 2.** Rough Pastures | Class 5 : | Agrostis/Juncus |
| | Class 6 : | Festuca/Juncus |
| | Class 7 : | Agrostis/Holcus |
| | Class 8 : | Festuca/Agrostis |
| **Group 3.** Grassy Heaths | Class 14: | Festuca/Vaccinium |
| | Class 15: | Festuca/Nardus/Vaccinium |
| | Class 16: | Festuca/Nardus/Molinia |
| **Group 4.** Shrubby Heaths | Class 9 : | Calluna/Molinia/Vaccinium |
| | Class 10: | Vaccinium/Calluna |
| | Class 11: | Nardus/Sphagnum/Calluna |
| | Class 12: | Eriophorum/Calluna |
| | Class 13: | Calluna |

## KEY TO FIGURES 10.9 AND 10.10

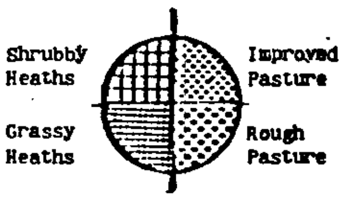
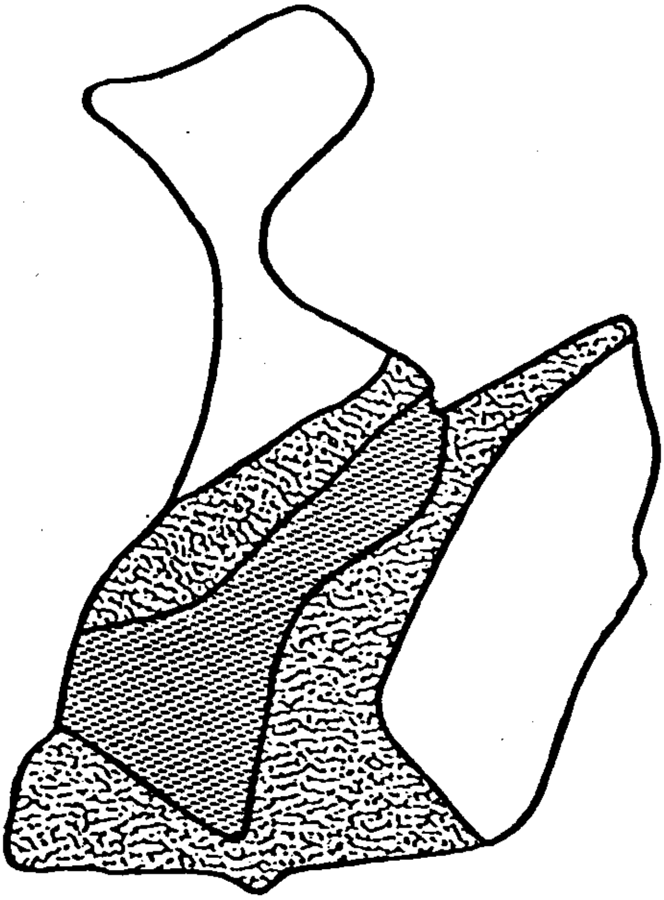


FIGURE 10.10 LAND GROUP-VEGETATION GROUP ASSOCIATIONS-YSTRADGYNLAIS



VEGETATION GROUP FREQUENCIES AT SITES IN LAND GROUPS

PREDICTED CHANGES AT MAIN SITES

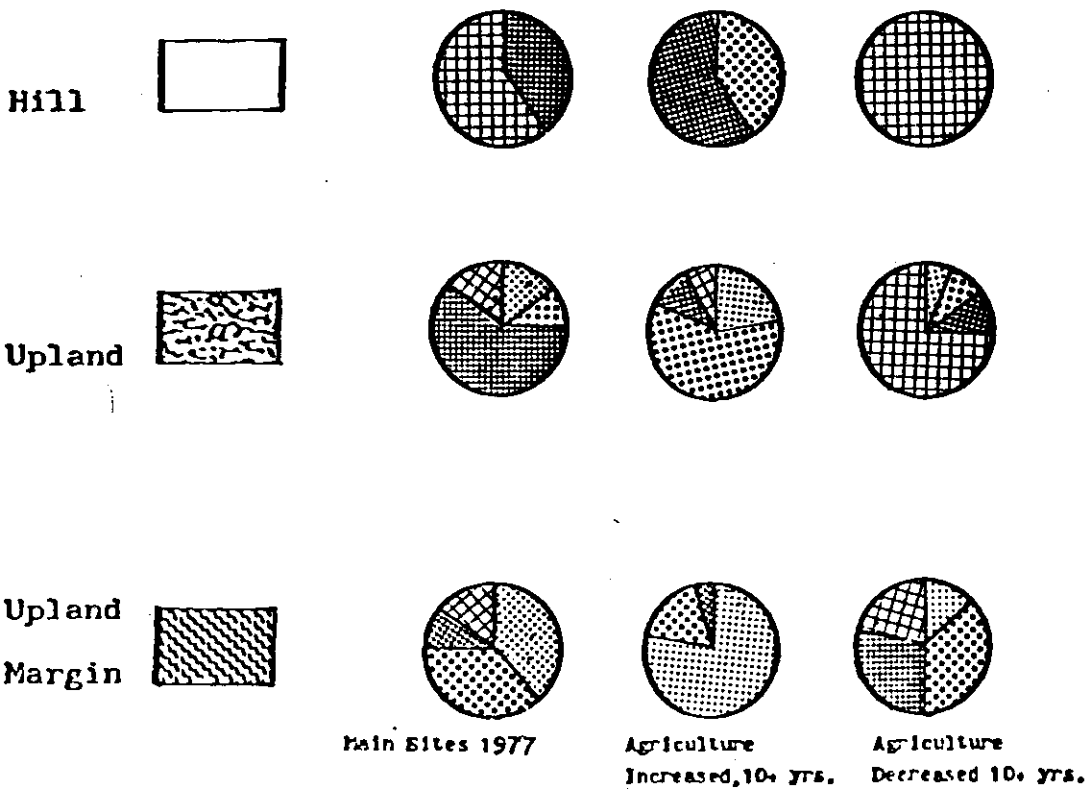
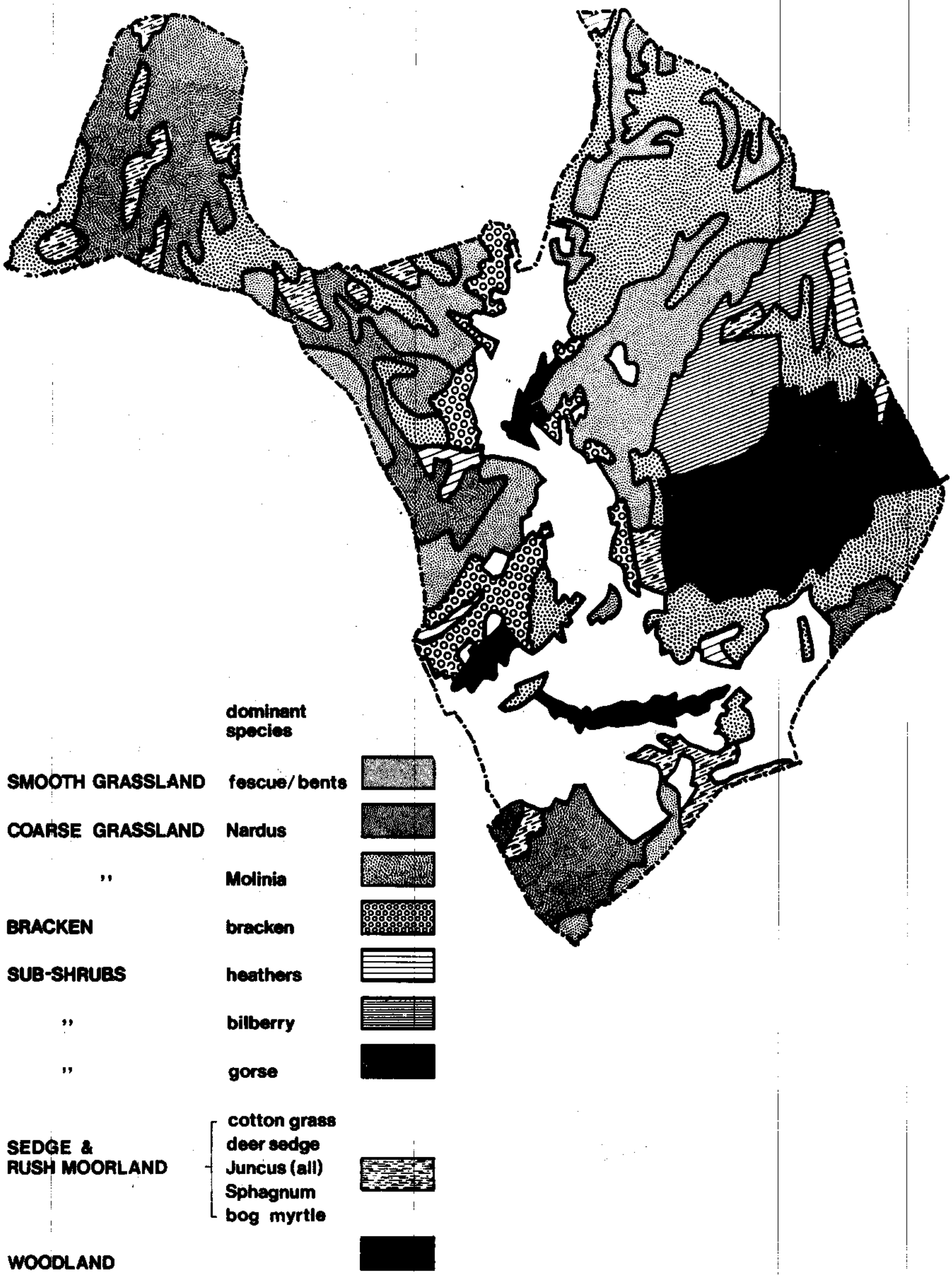
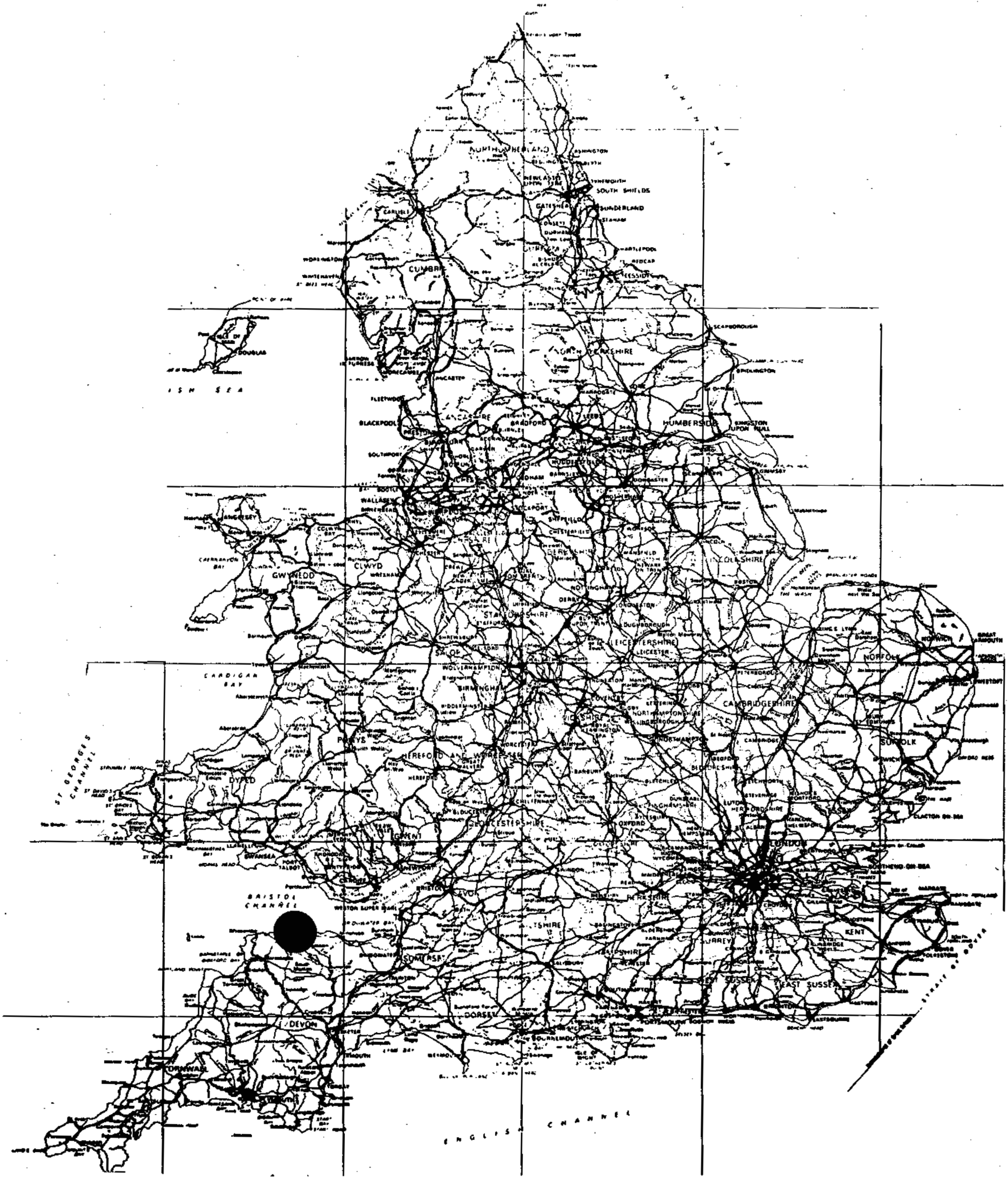


FIGURE 10.11 UPLAND LANDSCAPES STUDY VEGETATION MAP OF YSTRADGYNLAIS HIGHER AND GLYNTAWE

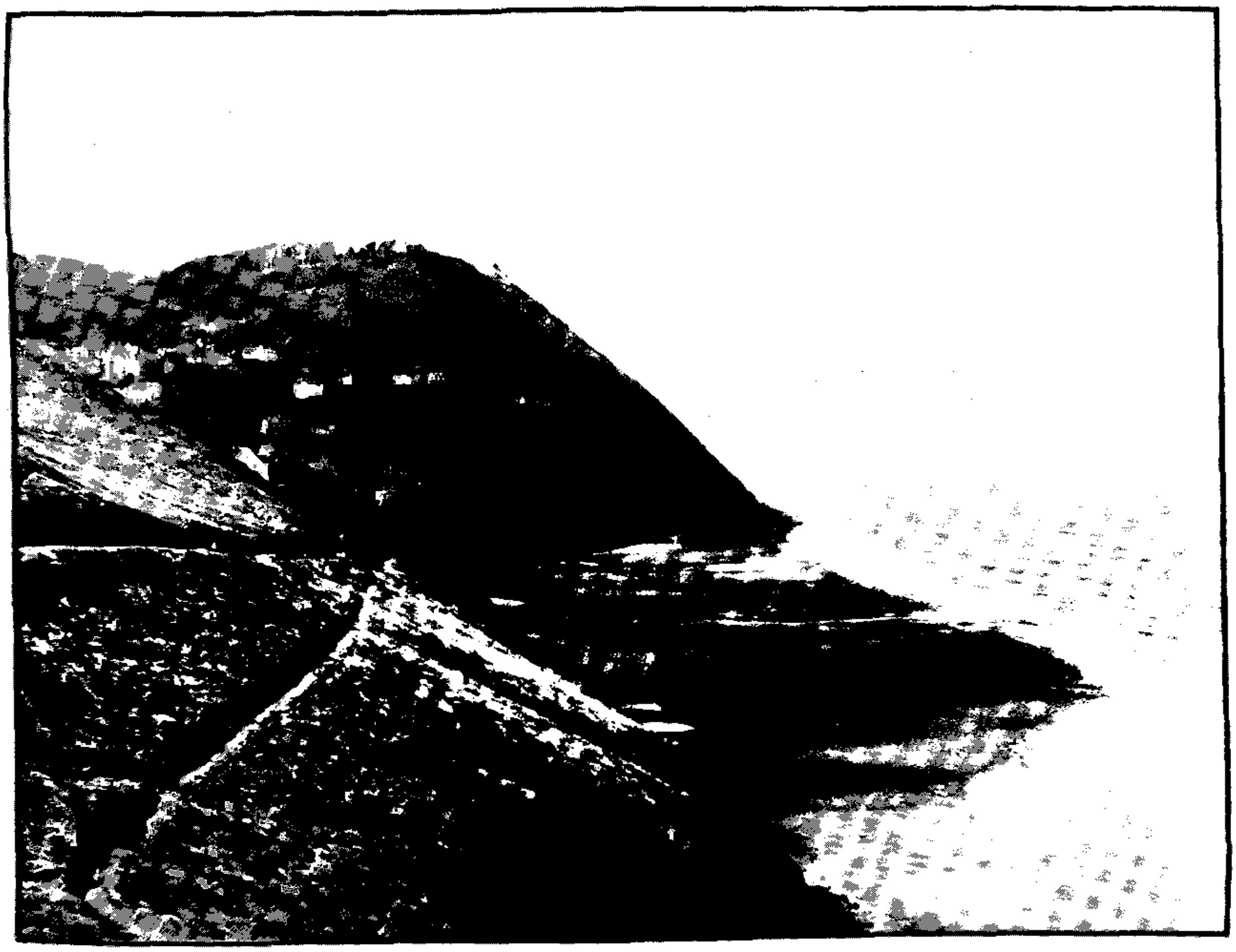



(Map by Geoffrey Sinclair, Environmental Information Services)

# LYNTON

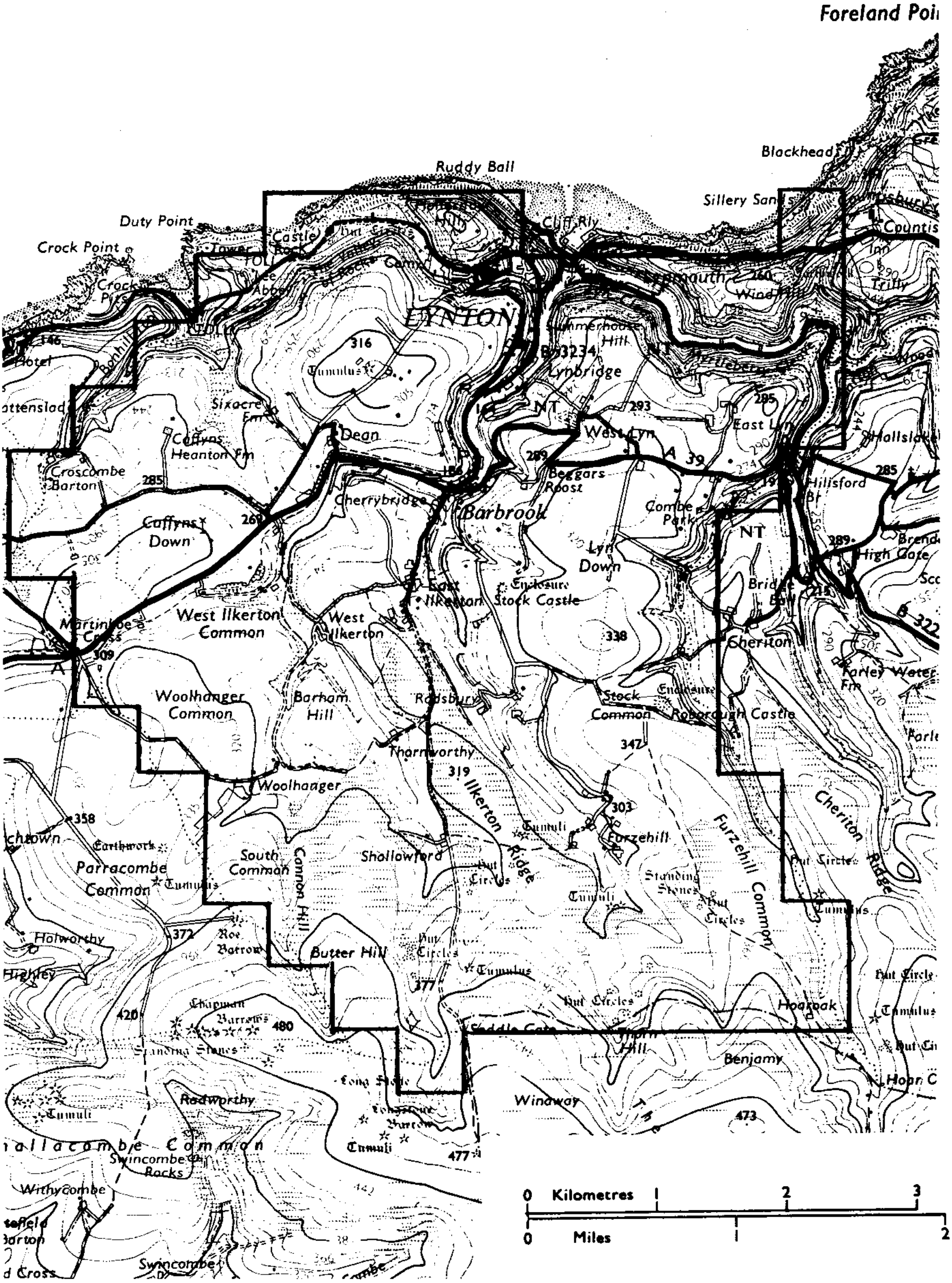

NORTHUMBERLAND
SOUTH SHIELDS
SUNDERLAND
CUMBRIA
NORTH YORKSHIRE
HUMBERSIDE
BLACKPOOL
LANCASHIRE
GWYNEDD
CLWYD
STAFFORDSHIRE
LEICESTERSHIRE
NORFOLK
CAMBRIDGESHIRE
SUFFOLK
BIRMINGHAM
HEREFORD AND WORCESTER
DYFED
GLOUCESTERSHIRE
LONDON
BRISTOL CHANNEL
KENT
SOMERSET
DEVON
DORSET
CORNWALL
EAST SUSSEX
ENGLISH CHANNEL

LYNTON - PLATE 1



View from the Porlock Road over the steep coastal cliffs looking towards Hollerday Hill, with hotels on the edge of Lynton just visible on the left of the picture. Grassy heath vegetation survives on the steep slopes while on the more gentle slopes above them improved grassland is generally established.
(Photo by P.Ainsworth)

FIGURE 11.1   THE STUDY AREA OF LYNTON



# STUDY AREA 11: LYNTON, DEVON

## PHYSICAL ENVIRONMENT

Lynton (Figure 11-1) is situated in the Exmoor region on the north coast of Devon near the northwestern corner of the Exmoor National Park. It covers 31 $km^2$, extending inland from a steeply sloping cliffed coast (Plate 1) along a series of southward rising ridges, intersected by deep valleys with fast running, short rivers (Part I, Plate 16). These include the West Lyn, flowing with its tributaries from Thorn Hill in the south of the area to the Bristol Channel coast at Lynmouth in the north, and the streams which join to form the East Lyn river, also reaching the sea at Lynmouth. The greater part of the area is dominated by altitudes between 244 and 427 m (800-1 400 ft), with lower ground near the coast in the northernmost quarter and a small extent that is mainly above 427 m in the extreme southwest around Butter Hill (Figure 11-2). Slopes are mostly gentle or moderate along the ridges which rise towards the moorland core of Exmoor. The ridges are separated by steeply sloping and heavily wooded valleys flanking the East and West Lyn Rivers and their tributaries. These wooded valleys are, like the steeply plunging cliff slopes around Lynmouth, important scenic attractions in the local landscape.

The study area, in relation to the 12 considered, is classifiable as warm and moderately wet (Part I, 2.32). The annual average of daily sunshine hours is 4.0, with mean daily temperatures in January and October estimated as 3.9 and 10.6°C and an average of 10 days with snow lying. There is a steep rainfall gradient, with closely spaced isohyets crossing the study area in a generally east-west direction. Figure 11-3 shows there to be low or moderate (801-1 200 mm, c. 40-48 in pa) rainfall in the north. Fairly high rainfall (1 201-1 600 mm, c. 48-64 in pa) follows from around Barbrook south to Furzehill, while south again there is a high rainfall sector (1 601-2 000 mm, c. 64-80 in pa) on the fringe of central Exmoor. The length of the growing season in the climatic region which includes Lynton, at an average height of 208 m, is given in Smith (1976) as 267 days (21 March-13 December).

Geologically the area entirely overlies Lower Devonian sedimentary rocks, the northern part being on slaty shales of the Lynton Beds, and the southern part on the Hangman Grits, which are mainly gritty sandstones and shales. The area is mapped as free of any drift cover. On the national soil map, Lynton is in a mapping unit dominated by Brown Earths, with associated Brown Podzolic Soils and Gleys.

From the national agricultural land classification maps, grade 5 land occurs over the coastal cliff zone, the steep valley sides, and the southernmost quarter to one-third of the study area, approximately south of a line Shallowford to Roborough Castle. The remainder is mainly mapped as the agriculturally better grade 4. This study area is one (the other is Llanfachreth) in which a trial of a more detailed classification of agricultural land in the hills and uplands has been carried out in as yet unpublished work by Research Officers of the ADAS (Land Service) Resource Planning Group. A modified version of this scheme has been applied by ULS to the study areas and is referred to in the section covering potential vegetation change.

Topographically Lynton has a relatively uniform settlement pattern, a high density of roads and a generally high frequency of field boundaries (Figure 11-4). The main sectors that have few or no roads, buildings or a close network of field boundaries are the southern parts of the moorland ridges and the coastal cliff slopes.

Land types in the study area (Figure 11-5) are principally in the upland group, but with important extents of upland margin land near the coast and following the main valleys, and a smaller sector of hill land, mainly of the high plateau land type, in the extreme south.

## LAND-USE HISTORY

It was the presence of a harbour at Lynmouth that made this parish different from most of Exmoor in historic times by giving it seaward looking interests in fishing and transport. However, these two activities never supplanted agriculture as the principal industry in the study area, although Lynton and its scenic hinterland began to develop as a tourist resort when the French Revolutionary Wars of the 1790s restricted foreign travel. This activity continued to expand through Victorian and Edwardian times, with the creation of the resort village of Lynton, which with its hotels and other accommodation (Plate 1) was responsible for a trebling of the population in the parish between 1801 and 1901. Concentrated on Lynton and Lynmouth themselves, there continues in this part of the Exmoor National Park, with its fine coastal landscape and its woodland valleys largely in the care of the National Trust, a strong seasonal tourist economy that is a key element in the life of the area.

The Tithe Commutation Survey of 1840 (Public Record Office) recorded 130 ha (320 acres) of arable land, growing a rotation of green crops, wheat, oats or barley, then grass over a 4-20 year cycle. Meadow land used for hay occupied 80 ha (200 acres) while 725 ha (1 785 acres) were described as pasture and 365 ha (900 acres) as commons. Woodlands at this time were mainly coppice, producing wood for farm use.

An account of the field systems of Devon and Cornwall (Fox 1971) described how 'commons and wastes' were intermittently cultivated. Temporary intakes from the moors provided a bonus crop without reducing the pasture area needed for livestock. Because the practice was so widely accepted, there was often little mention of it in manorial records. It is possible that land identified on air photographs (see the end of this section) as formerly ploughed moorland may have been of this short-term type of intake. Once ploughed, crops were taken in succession over a few years until yields fell too low to justify further sowings, then the land was abandoned. In some instances, however, gorse was deliberately grown on former ploughland during the long interval until the land was again cultivated. This 'crop' provided fuel, particularly favoured for bread ovens; fodder for horses when chopped green; and, since it is a legume, helped to build up soil nitrogen towards the time when another crop might be taken.

During the 1850s some common land adjacent to Lynton was enclosed, but not without considerable opposition from those who claimed that Lyn Down had been 'so skinned over for fuel', that it was of little or no value for cultivation, and therefore not worth enclosing. The fact that at this time holidaymakers could wander at will over the common sheep walks added greatly to the charm and prosperity of Lynton as a resort, so that tourist and agricultural interests conflicted. In the event, agriculture won in this case, but 13 ha (33 acres) in the Valley of Rocks, allotted as 'recreation' ground to be left 'wild', remain as common today, together with extensive inland commons on Ilkeston Ridge and Furzehill Common on the moorland edge.

Statistical changes in agriculture in Lynton between 1900 and 1965 are included in the graphs of Figure 4-4 to 4-6 in Part I of this report. The tillage area fluctuated greatly, ending up in 1965 at about the 1900 extent. Cattle and sheep numbers both increased, particularly between 1955 and 1965. ULS (1979) estimate that between 1887 and 1979 the extent of crops and grass in the area increased to 58% from 46%, and that woodland remained substantially unchanged in extent.

The Ordnance Survey (OS) carried out its first large scale mapping of Lynton in the 1880s, with a revision in 1903. There followed a long gap until 1958, since when it has been possible to trace changes in the moorland edge from the various editions of the 1:63 360 and 1:50 000 maps supported by air photographs. Figure 11-6 shows the distribution of farmland, moorland fringe and moorland core (Part I, 4.49-4.50). The core occupies 885 ha (28% of the area) and the fringe 341 ha (11% of the area), only 43 ha of which are formerly improved land that has reverted to moorland. 23 ha of former ploughland were detected within the moorland core from air photographs. Figure 11-6 shows a larger extent of fringe than is included in the calculated area in Part I, Table 4-6. This is because, for Lynton alone of the 12 study areas, fringe was also identified using the Tithe Survey of 1837. As such data are not available for other areas, Table 4-6 has given the moorland fringe as identified from OS map sources and air photographs only, to give consistency between areas. The moorland fringe in Lynton is relatively concentrated in the upland margin land type which occupies 32% of the area but contains 64% of the fringe.

## VEGETATION

Vegetation was recorded in 1978 at 71 main sites, in the way described in Chapter 3 of Part I of this report. Figure 11-7 gives the frequency with which vegetation classes were present at these sites, and Figure 11-8 gives the location and classification of individual main sites (grid references of these are included in Appendix 3).

The outstanding characteristic of the grassland-moorland vegetation range in Lynton is the preponderance of improved pastures, accounting for 68% of the recorded sites (Part I, Plates 19, 20). However, the vegetation remains more varied than that of Monyash, Derbyshire (Study Area 6) which also has a notably high percentage of improved pastures. In Lynton, although improved pastures are dominant, examples of all 4 vegetation groups are present, falling in 13 vegetation classes.

Lynton can be treated as 2 sectors divided by a line running approximately between Woolhanger Farm in the west and Roborough Castle in the east. To the north, agriculture is more intensive, so that most sites examined there were improved pastures, mainly herb-rich _Lolium_ grassland, class 4 (51% of all sites, see Part I, Plate 20). Isolated rough pasture sites also occur in this sector (Part I, Plate 23). South of this line, where the 'hill' land types and the remaining commons are found, there has been less reclamation, and the moorland vegetation element is more in evidence (Part I, Plate 35). Grassy heath, class 14

_Festuca/Vaccinium_ heath, (present at 10% of the recorded sites) is the most widespread, and a further 12% of the sites were spread between 5 other heath classes. The shrubby heath class 13, _Calluna_ heath is illustrated from a Lynton site in Part I, Plate 36.

Lynton contains more deciduous woodland than other study areas do. ULS (1979) gave woodland as 6.7% of the area, concentrated along the valleys of the East and West Lyn and Hoaroak Water. Of 12 Lynton woods recorded in this study 6 are classifiable as lowland acid woodlands, 2 as lowland basic woodlands and 4 as upland acid woodlands. Oak is the preponderant tree regardless of the associated species present. Regeneration was noted in all the woods examined.

Table 11-1 shows the relationship between land types and vegetation classes in Lynton, and Figure 11-9 sketches the representation of vegetation groups at sites in each land group. Hill land is of limited extent, and the sites in it are principally grassy heaths. The prominent upland land group is overridingly agricultural, with improved pastures predominant in all 3 upland land types (70% of sites in this land group in Lynton are improved pastures). This preponderance is even greater in the upland margin land, where 81% of recorded sites are already improved pastures.

## POTENTIAL VEGETATION CHANGE

Much of the moorland away from the coast is capable of improvement and a great deal has already been reclaimed. ULS (1979) applied the hill land classification criteria being developed by ADAS to estimate that, of the present rough grazings, 45% were not improvable though mainly of some grazing value, 22% were of limited improvability, but 33% were improvable.

The Upland Landscapes Study (ULS 1979) report that considerable pressure exists amongst the farming community of Lynton for further reclamation and improvement of the moorland. This would particularly affect the limited remaining areas of inland freehold moorland in private ownership. The future of remaining common land is less certain in this National Park, in which the whole issue of moorland retention is of concern and debate (eg Porchester 1977). Although commercial forestry has been excluded from this area, a simplified assessment of land potential for forestry (Part I, 5.95-5.100) estimates from the land types present, that, while retaining about the present level of agriculture, all the remaining land is theoretically suitable for forestry (Table 5-19), ignoring possible local factors such as exposure, which would certainly exclude some coastal sectors.

Omitting consideration of these options for major agricultural and/or forestry direct changes, in favour of applying to Lynton sites the general courses of gradual change discussed in Part I (5.74-5.77 and Figure 5-4) and summarised in Appendix 2, the most prominent vegetation classes in Lynton are predicted to respond to agricultural intensification or decline as follows: herb-rich *Lolium* grassland, class 4, is unlikely to be allowed to deteriorate significantly; the limited rough pasture sites of *Agrostis*/*Holcus* grassland, class 7, could be improved to class 4 or decline to *Festuca*/*Agrostis* rough pasture, class 8; *Festuca*/*Vaccinium* grassy heath, class 14, could change under intensified agriculture to *Festuca*/*Agrostis* grassland, class 8, or, under agricultural decline, to *Calluna* heath, class 13; and the limited sites of shrubby heaths are likely in a gradual trend brought about by increased grazing pressure to change mainly to grassy heaths such as *Festuca*/*Nardus*/*Molinia* heath, class 16 or *Festuca*/*Vaccinium* heath, class 14. The likelihood of scrub woodland intervening in these trends in a declining agriculture situation at lower altitudes or less exposed sites is illustrated in an example from Lynton in Part I, Plate 23).

Figure 11-8 includes for individual main sites the vegetation classes predicted as capable of development on ecological grounds as a result of gradual intensification or decline in agricultural activity. The frequencies of vegetation classes in the study area that would result from these predicted changes are included in Figure 11-7. The predictions of vegetation change through gradual ecological trends under management influences are, as usual, based on the principles discussed in Part I (5.74-5.77) and not on specific considerations of local land and land management characteristics at the individual main sites. Improved pastures would, in circumstances of increased agricultural activity, increase at the recorded main sites (from 68 to 78%), with a parallel increase of rough pastures from 10 to 14% of sites. To compensate for these increases a fall is predicted in the percentage of grassy heaths (from 14 to 8%) and shrubby heaths would disappear from the recorded sites. The predictions following a decline in agricultural activity are for a decrease of improved pastures (to 52% of the recorded main sites) and of grassy heaths (to 5% of the sites), balanced by increases of rough pastures (to 22% of sites) and of shrubby heaths, to occupy 21% of recorded sites.

Under either intensified or declining agricultural activity leading to gradual change there would be a reduction in the range of vegetation at the recorded sites, with the number of vegetation classes falling from the 13 identified in 1978 to an estimated 8 classes. A decline in agriculture however would maintain a representation of all 4 vegetation groups, whereas the intensified agriculture course is predicted as leading to the disappearance of shrubby heaths in the shorter term, and ultimately of grassy heaths also. In terms of the percentage of main sites which would change their vegetation group, 32% of the recorded sites are predicted as liable to change if agriculture were to be intensified, compared to 35% if it were to decline.

Figure 11-9 includes the relationship between predicted changes in vegetation groups at sites and the land groups in which they are situated. Intensification could lead towards greater uniformity through grassland dominance in all land types. Decline would emphasise shrubby heaths rather than grassy heaths in the small hill land sector, increase rough pastures in the upland margin, but cause little conspicuous effect in the upland sector.

The vegetation map of Lynton produced in the Upland Landscapes Study (ULS 1979) is given here as Figure 11-10. Table 11-2 correlates the ITE vegetation classes at main sites with the ULS mapping units in which the sites are located. 'Farmland' dominates Lynton and in this area the sites in this unit are almost entirely improved pastures, in contrast to the more variable vegetation character of 'farmland' in some other areas. The ITE shrubby heaths here all fall in the 'sub-shrubs/heathers' map unit, again a sharper association between the 2 systems of vegetation recording than is found in all areas. Table 11-3 shows the predicted frequencies with which vegetation classes at main sites would occur in each ULS mapping unit if the standard assumptions of courses of vegetation change following agricultural intensification or decline were realised. The strongest change could occur in the limited extents of the 'smooth grassland' and 'coarse grassland' units, the sites in which could range between being all rough pastures, all grassy heaths as they are now, or all shrubby heaths.

## CONCLUSION

The principal impact on the present vegetation range in Lynton is likely to result from further intakes of moorland for intensive agriculture. The valley woods are already largely managed from a conservation and amenity standpoint, and major forestry expansion though possible is unlikely. Moorland in Lynton is very vulnerable to change because of its relatively favourable physiographic and climatic location. Although within the Exmoor National Park, there is little the Park authorities can apply now as a constraint on current trends for reclamation and improvement since much of the moor is privately owned. Agricultural expansion and landscape conservation are opposed interests in Lynton and the general possibility for Exmoor moorland of a four-fold increase in stocking densities (Porchester 1977) means that the economics of improvement are very attractive even to the extent of foregoing subsidies in order to overcome such planning obstacles as do exist. In the absence of legislation and funds to permit moorland purchase, or conservation orders and conservation grants to compensate for maintenance management of areas of moorland, then it seems likely that in the foreseeable future, inroads, possibly final, could be made into the remaining moorland core in Lynton. In this event, the only semi-natural vegetation confidently likely to persist would be the valley woodlands in the care of the National Trust and that of the exposed, steeply plunging coastal slopes that are unsuitable for agricultural improvement or afforestation.

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TABLE 11-1 CORRELATION OF VEGETATION CLASSES AND LAND TYPES - LYNTON

| Vegetation Group and Class | | Land Group and Type: Hill — Steep Hill (1)* | Hill — Hill (3) | Hill — High Plateau (4) | Upland — Steep Upland (5) | Upland — Upland (7) | Upland — Upland Plateau (8) | Upland Margin (6) |
|---|---|---|---|---|---|---|---|---|
| Improved Pastures | 1 | | | 1 | | | | 4 |
| | 2 | | | | | | | 1 |
| | 3 | | | | 3 | | | 3 |
| | 4 | | | | 5 | 12 | 10 | 9 |
| Rough Pastures | 5 | | | | | 2 | | |
| | 6 | | | | 1 | | | |
| | 7 | | | | 1 | 1 | | 2 |
| | 8 | | | | | | | |
| Grassy Heaths | 14 | 2 | 2 | | | | 2 | 1 |
| | 15 | | | | 1 | | | |
| | 16 | | 1 | | 1 | | | |
| Shrubby Heaths | 9 | | 1 | | | 2 | | |
| | 10 | | | | | | | |
| | 11 | | | | | | | 1 |
| | 12 | | | | | | | |
| | 13 | | | | | 1 | 1 | |

As number of sites of each vegetation class located in each land type.
* Land type numbers as used on computer maps, Figure 11-5.

TABLE 11-2 CORRELATION OF ULS VEGETATION MAPPING UNITS AND ITE VEGETATION CLASSES AT MAIN SITES -LYNTON

| ULS Mapping Unit | Number of ITE Main Sites in Area of ULS Unit | ITE Vegetation Class 1978 | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Improved Pastures | | | | Rough Pastures | | | | Grassy Heaths | | | Shrubby Heaths | | | | |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 14 | 15 | 16 | 9 | 10 | 11 | 12 | 13 |
| Smooth Grassland | 3 | | | | | | | | | 3 | | | | | | | |
| Coarse Grassland/*Nardus* | | | | | | | | | | | | | | | | | |
| Coarse Grassland/*Molinia* | 3 | | | | | | | | | 2 | | 1 | | | | | |
| Bracken | 2 | 1 | | | | | | 1 | | | | | | | | | |
| Sub-shrubs/Heathers | 10 | 1 | | | | | | | | 2 | | 1 | 3 | | 1 | | 2 |
| Sub-shrubs/Bilberry | 1 | | | 1 | | | | | | | | | | | | | |
| Sub-shrubs/Gorse | 1 | | | | | | | 1 | | | | | | | | | |
| Sedge & Rush Moorland | 3 | | | | 1 | 2 | | | | | | | | | | | |
| Farmland | 48 | 3 | 1 | 5 | 35 | | 1 | 2 | | | 1 | | | | | | |

As number of recorded main sites in each ITE vegetation class that are located in each ULS unit

TABLE 11-3 PREDICTIONS OF CHANGE IN THE BALANCE OF VEGETATION GROUPS AT MAIN SITES LOCATED IN ULS MAPPING UNITS - LYNTON

| ULS Mapping Unit | ITE Vegetation Groups | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Improved Pastures | | | Rough Pastures | | | Grassy Heaths | | | Shrubby Heaths | | |
| | A | B | C | A | B | C | A | B | C | A | B | C |
| Smooth Grassland | | | | | 3 | | 3 | | | | | 3 |
| Coarse Grassland/*Nardus* | | | | | | | | | | | | |
| Coarse Grassland/*Molinia* | | | | | 3 | | 3 | | | | | 3 |
| Bracken | 1 | 2 | | 1 | | 2 | | | | | | |
| Sub-shrubs/Heathers | 1 | 1 | | | 3 | 1 | 3 | 6 | | 6 | | 9 |
| Sub-shrubs/Bilberry | 1 | 1 | | | | 1 | | | | | | |
| Sub-shrubs/Gorse | | 1 | | 1 | | 1 | | | | | | |
| Sedge & Rush Moorland | 1 | 3 | 1 | 2 | | | | | 2 | | | |
| Farmland | 44 | 47 | 36 | 3 | 1 | 10 | 1 | | 1 | | | 1 |

As number of recorded main sites falling in each ITE vegetation group that are located in each ULS unit

A - situation as recorded 1978
B - predicted balance of vegetation if agricultural use increased, 10+ yrs
C - predicted balance of vegetation if agricultural use decreased, 10+ yrs

FIGURE 11.2 ALTITUDE SECTORS - LYNTON

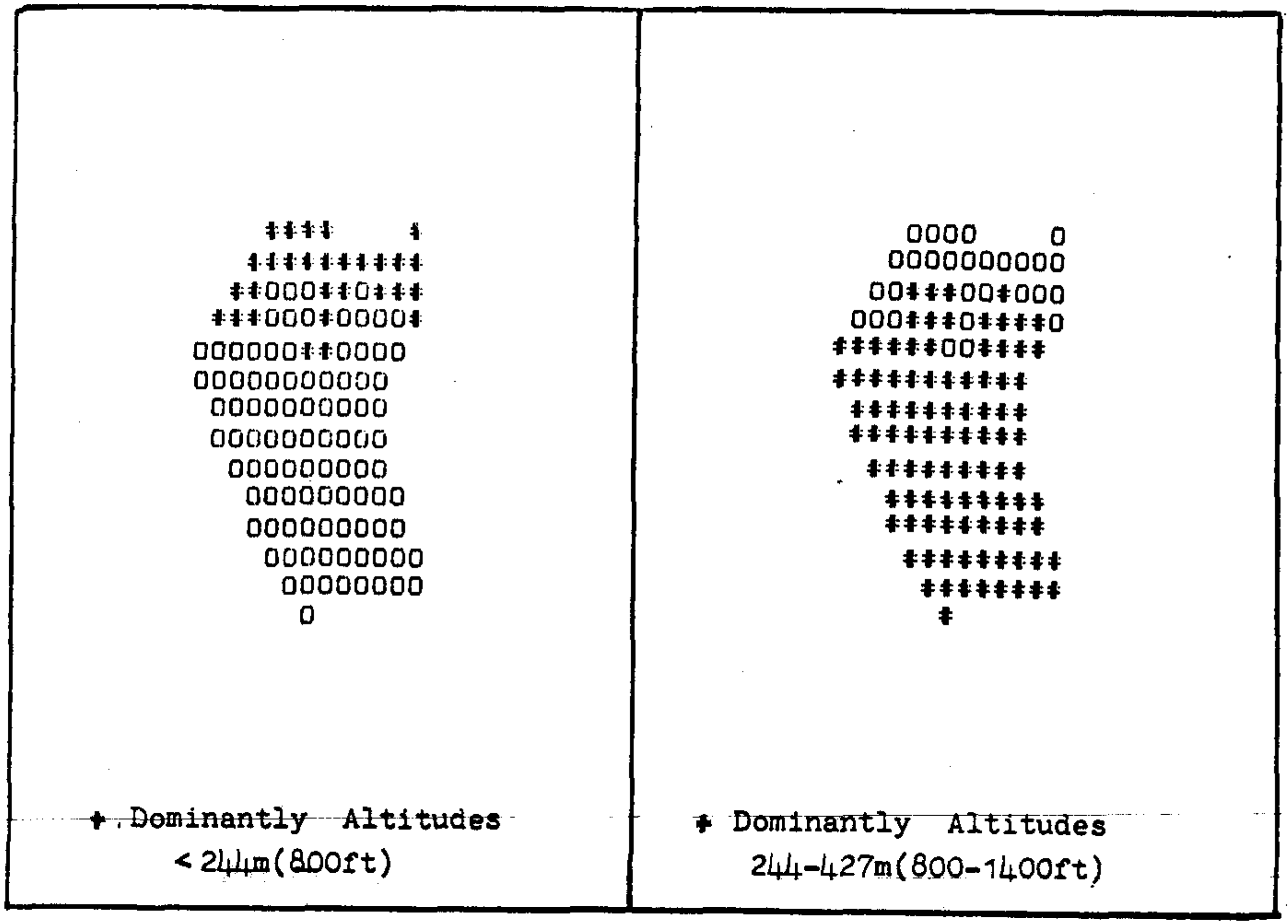


FIGURE 11.3 RAINFALL SECTORS - LYNTON

```
    ####    #
   ##########
  ###########
 ############
OOOOOOOOOOOO
OOOOOOOOOOO
 OOOOOOOOOO
 OOOOOOOOOO
  OOOOOOOOO
   OOOOOOOOO
   OOOOOOOOO
    OOOOOOOOO
     OOOOOOOO
      O
```

# Moderate Rainfall

(1001-1200mm,40-48in pa)

```
    OOOO    O
   OOOOOOOOOO
  OOOOOOOOOOO
 OOOOOOOOOOOO
############
###########
 ##########
 ##########
  #########
   #########
   OOOOOOOOO
    OOOOOOOOO
     OOOOOOOO
      O
```

# Fairly High Rainfall

(1201-1600mm,48-64in pa)

```
    OOOO    O
   OOOOOOOOOO
  OOOOOOOOOOO
 OOOOOOOOOOOO
OOOOOOOOOOOO
OOOOOOOOOOO
 OOOOOOOOOO
 OOOOOOOOOO
  OOOOOOOOO
   OOOOOOOOO
   #########
    #########
     ########
      #
```

# High Rainfall

(1601-2200mm,64-88in pa)

FIGURE 11.4 TOPOGRAPHIC CHARACTERISTICS - LYNTON

```
    ####    #
   ##0#######
  ##0########
 ############
############
##0########
 #######0##
 #0########
  #########
   #######00
   0#0#####0
    000000##0
     0#00000#
      0

# Roads Present
```

```
    0###    0
   #00####00#
  00000###000
 ##0########0
##00#####0##
000##0##0##
 0######00#
 00000000##
  000###000
   #0000##00
   000#0##00
    000000000
     0000000#
      0

# Buildings Present
```

```
    00##    0
   0####000#0
  ########000
 ###########0
#00######0##
#00######0#
 ##0#######
 0####0####
  0########
   ##0#0###0
   000#00##0
    000000000
     0000000#
      0

# Frequent Field Boundaries
  Score > 10, on scale 0-25
```

## FIGURE 11.5 LAND TYPES - LYNTON

```
    ----    -
   ----------
  -----------
 ------------
------------
-----------
 ----------
 ----------
  ---------
   --------1
   3-4------
    -3333---3
     1-31311-
      1
```

<u>HILL LAND GROUP</u>

1 = Steep Hill

3 = Hill

4 = High Plateau

```
    5---    5
   55----55--
  5558----555
 -----5---5-5
-7557---777-
888777-7785
 77758-788-
 -88-7-57--
  887877785
   77778-78-
   -5--8-778
    5----5-8-
     -5------
      -
```

<u>UPLAND LAND GROUP</u>

5 = Steep Upland

7 = Upland

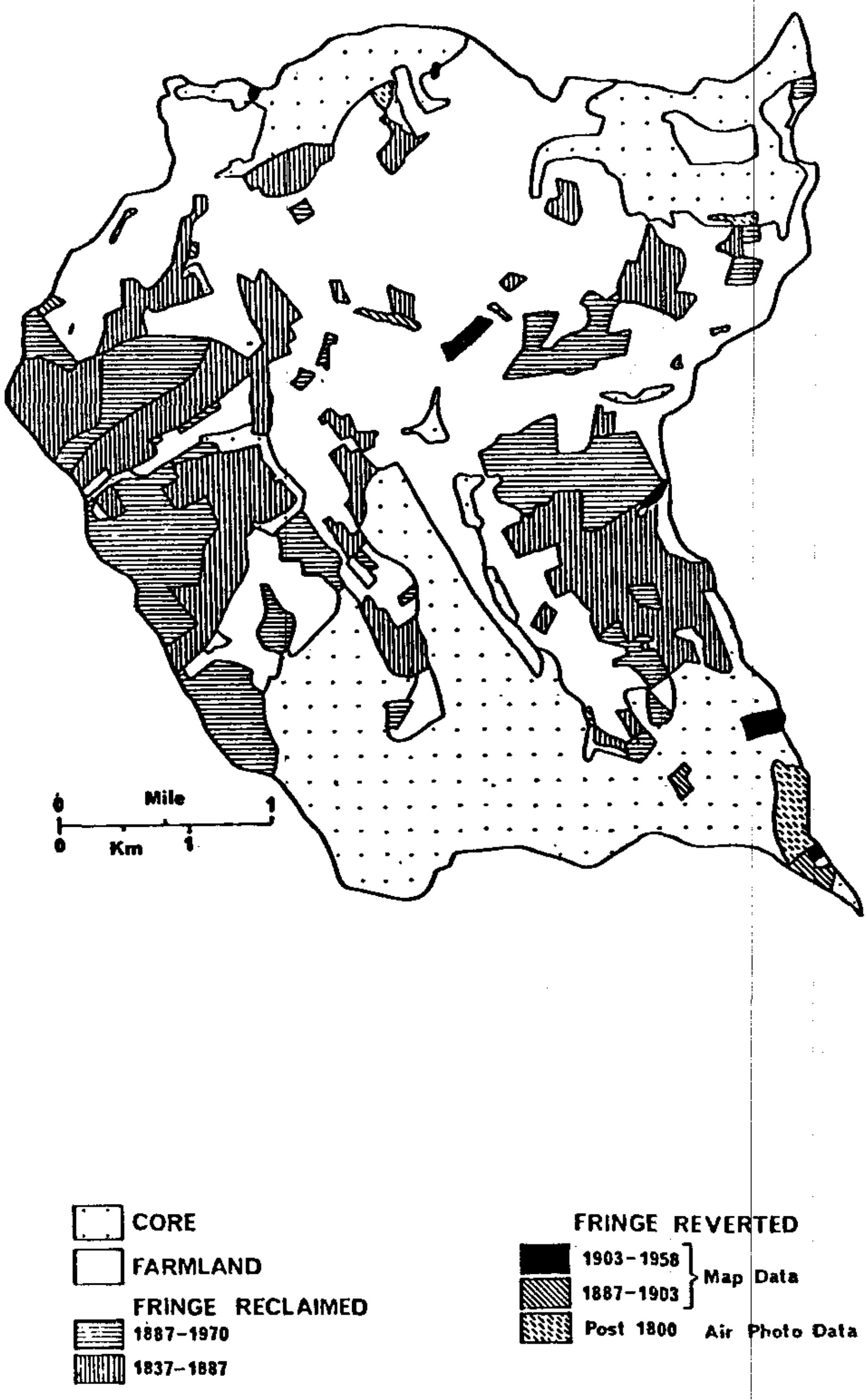
8 = Upland Plateau

```
    -666        -
   --6666--66
  ----6666---
 66666-666-6-
6----666---6
------6----
 -----6---6
 6--6-6--66
  ---------
   -----6---
   ---6-6---
    ------6--
     -------6
      -
```

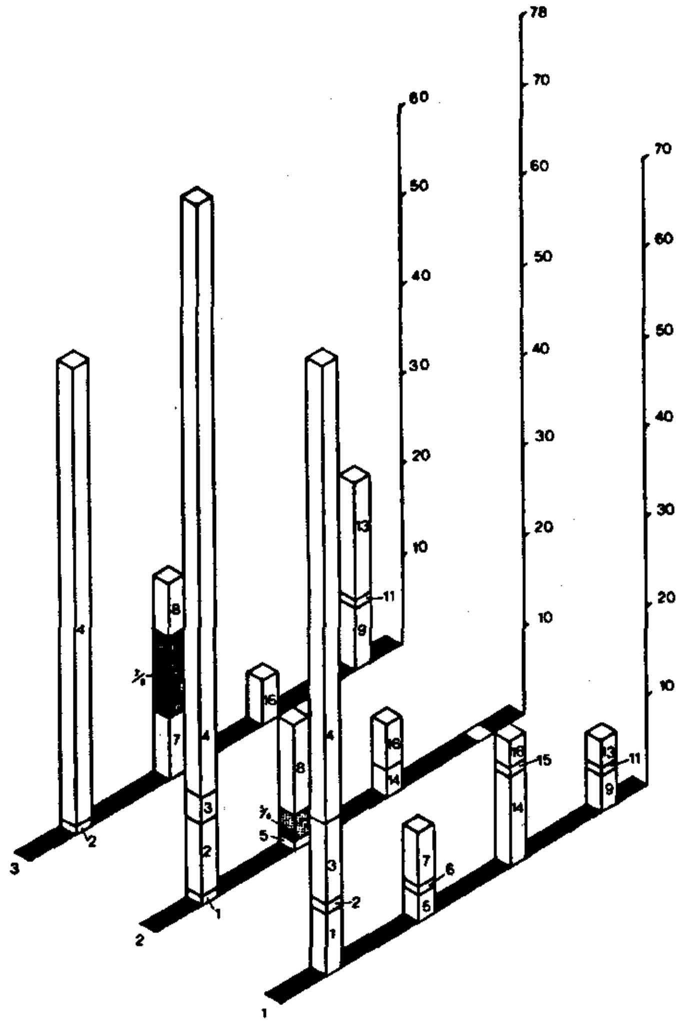
<u>UPLAND MARGIN LAND GROUP</u>

6 = Upland Margin

FIGURE 11.6 MOORLAND CORE, FRINGE AND FARMLAND - LYNTON



## FIGURE 11.7 VEGETATION CLASS FREQUENCY AT MAIN SITES - LYNTON

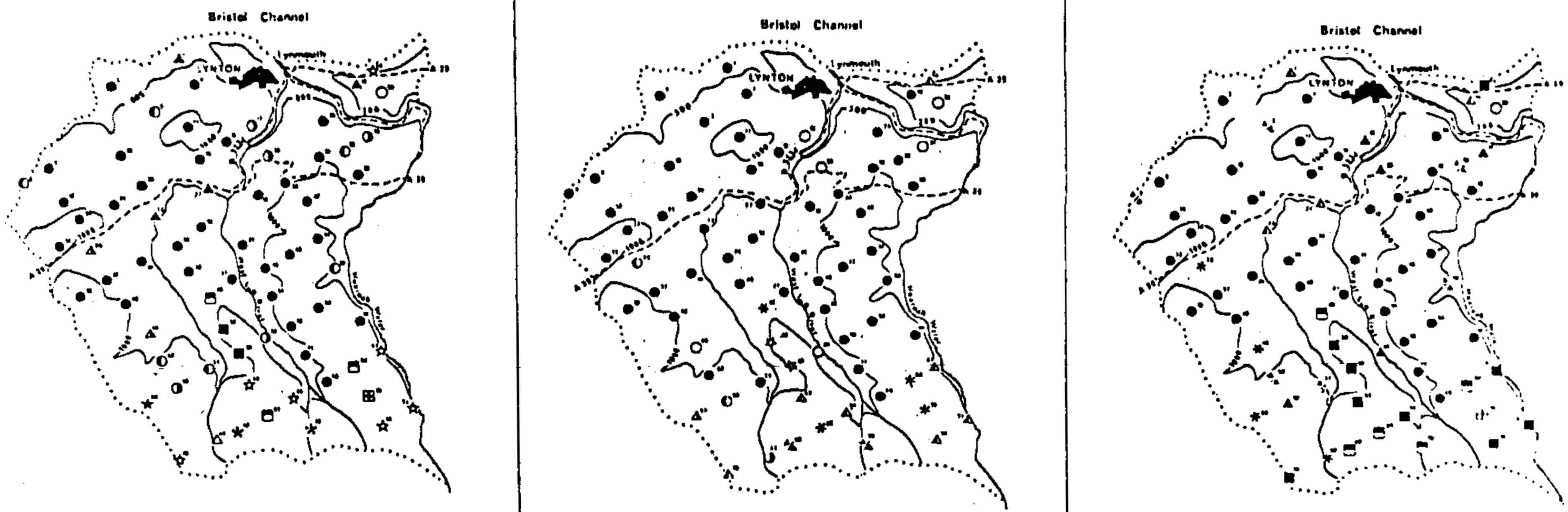



| Vegetation Group | Class | | % Main Sites in Vegetation Class 1 | 2 | 3 |
|---|---|---|---|---|---|
| Improved Pastures | 1 | Lolium/Holcus/Pteridium | 7 | 1 | - |
| | 2 | Lolium Grassland | 1 | 8 | 1 |
| | 3 | Lolium/Trifolium | 9 | 3 | - |
| | 4 | Herb rich Lolium Grassland | 51 | 66 | 51 |
| Rough Pastures | 5 | Agrostis/Juncus | 3 | 1 | - |
| | 6 | Festuca/Juncus | 1 | - | - |
| | 7 | Agrostis/Holcus | 6 | - | 7 |
| | 8 | Festuca/Agrostis | - | 10 | 6 |
| | 5/6 | Agrostis/Juncus or Festuca/Juncus | - | 3* | - |
| | 7/8 | Agrostis/Holcus or Festuca/Agrostis | - | - | 9* |
| Grassy Heaths | 14 | Festuca/Vaccinium | 10 | 3 | - |
| | 15 | Festuca/Nardus/Vaccinium | 1 | - | - |
| | 16 | Festuca/Nardus/Molinia | 3 | 5 | 5 |
| Shrubby Heaths | 9 | Calluna/Molinia/Vaccinium | 4 | - | 7 |
| | 11 | Nardus/Sphagnum/Calluna | 1 | - | 1 |
| | 13 | Calluna | 3 | - | 13 |

1. Recorded Main Sites, 1978
2. Predicted Changes at Main Sites if Agriculture Increased, 10 + years.
3. Predicted Changes at Main Sites if Agriculture Decreased, 10 + years.

* Under a regime involving intensification of agriculture Class 16, Festuca/Nardus/Molinia, could move towards either Class 5, Agrostis/Juncus or Class 6, Festuca/Juncus which is closely related to it. Similarly, with reduction in the level of agriculture Class 3, Lolium/Trifolium could move towards Class 7, Agrostis/Holcus or Class 8, Festuca/Agrostis. These changes are indicated on the relevant histograms by the shaded areas.

FIGURE 11.8 LOCATION AND CLASSIFICATION OF VEGETATION MAIN SITES - LYNTON

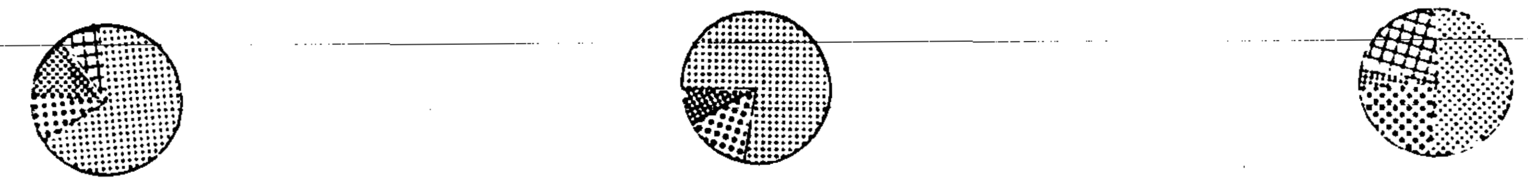



1978

Predicted if Agriculture Increased

Predicted if Agriculture Decreased

Overall Frequencies of Vegetation Groups



KEY TO FIGURE 11.8

| Group | Class | Vegetation |
|---|---|---|
| Group 1. Improved Pastures | Class 1 | Lolium/Holcus/Pteridium |
| | Class 2 | Lolium |
| | Class 3 | Lolium/Trifolium |
| | Class 4 | Herb — rich Lolium |
| Group 2. Rough Pastures | Class 5 | Agrostis/Juncus |
| | Class 6 | Festuca/Juncus |
| | Class 7 | Agrostis/Holcus |
| | Class 8 | Festuca/Agrostis |
| Group 3. Grassy Heaths | Class 14 | Festuca/Vaccinium |
| | Class 15 | Festuca/Nardus/Vaccinium |
| | Class 16 | Festuca/Nardus/Molinia |
| Group 4. Shrubby Heaths | Class 9 | Calluna/Molinia/Vaccinium |
| | Class 10 | Vaccinium/Calluna |
| | Class 11 | Nardus/Sphagnum/Calluna |
| | Class 12 | Eriophorum/Calluna |
| | Class 13 | Calluna |

KEY TO FIGURES 11.8 AND 11.9

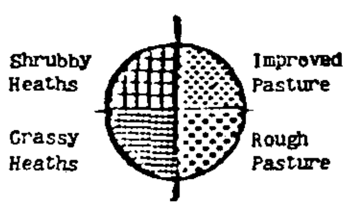
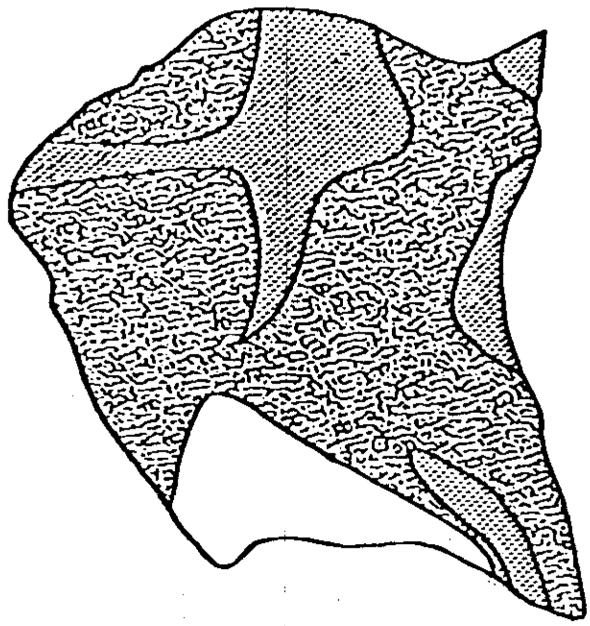


FIGURE 11.9 LAND GROUP-VEGETATION GROUP ASSOCIATIONS - LYNTON



VEGETATION GROUP FREQUENCIES AT SITES IN LAND GROUPS

PREDICTED CHANGES AT MAIN SITES

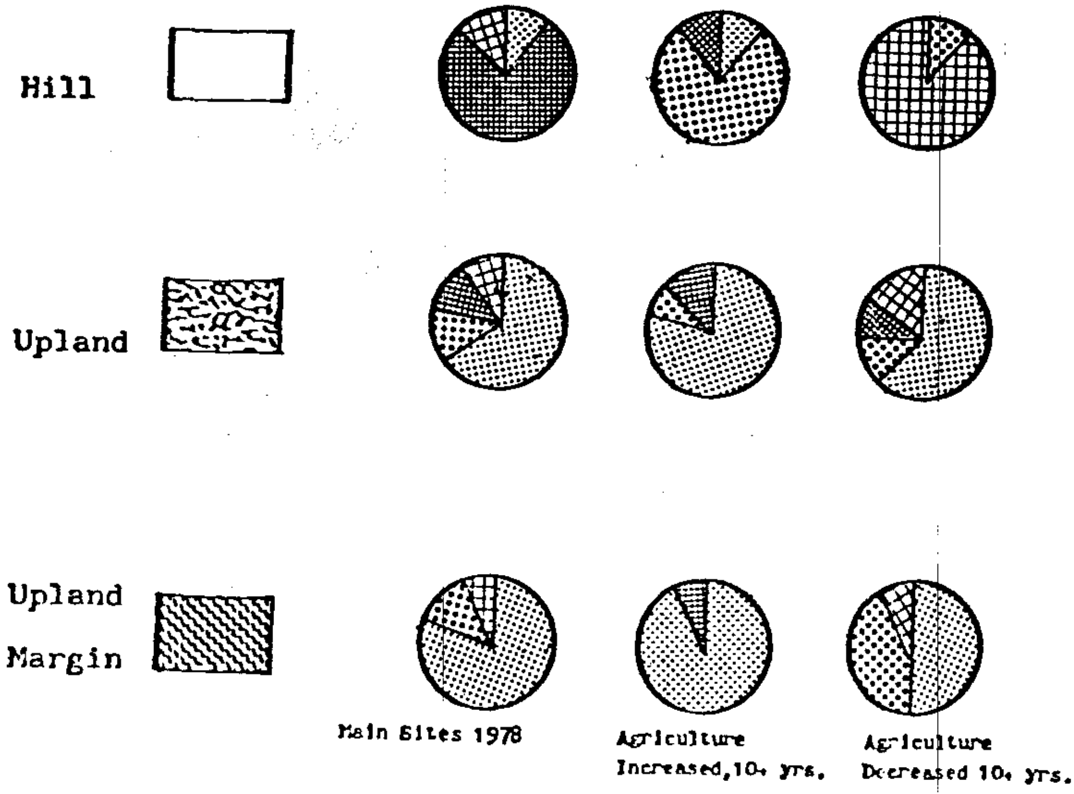


FIGURE 11.10   UPLAND LANDSCAPES STUDY VEGETATION MAP OF LYNTON

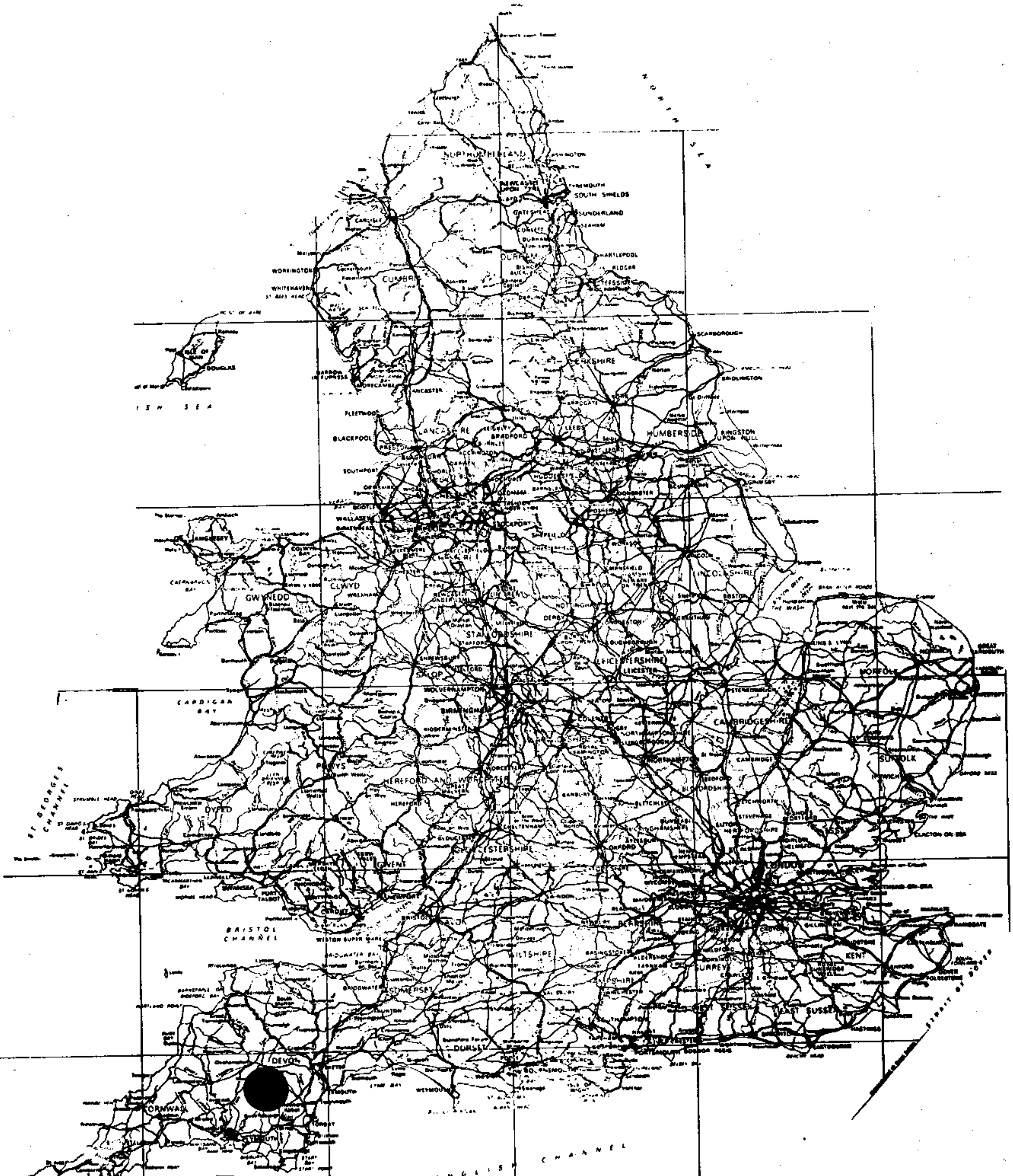
| | dominant species |
|---|---|
| SMOOTH GRASSLAND | fescue/bents |
| COARSE GRASSLAND | Nardus |
| ,, | Molinia |
| BRACKEN | bracken |
| SUB-SHRUBS | heathers |
| ,, | bilberry |
| ,, | gorse |
| SEDGE & RUSH MOORLAND | cotton grass<br>deer sedge<br>Juncus (all)<br>Sphagnum<br>bog myrtle |
| WOODLAND | |

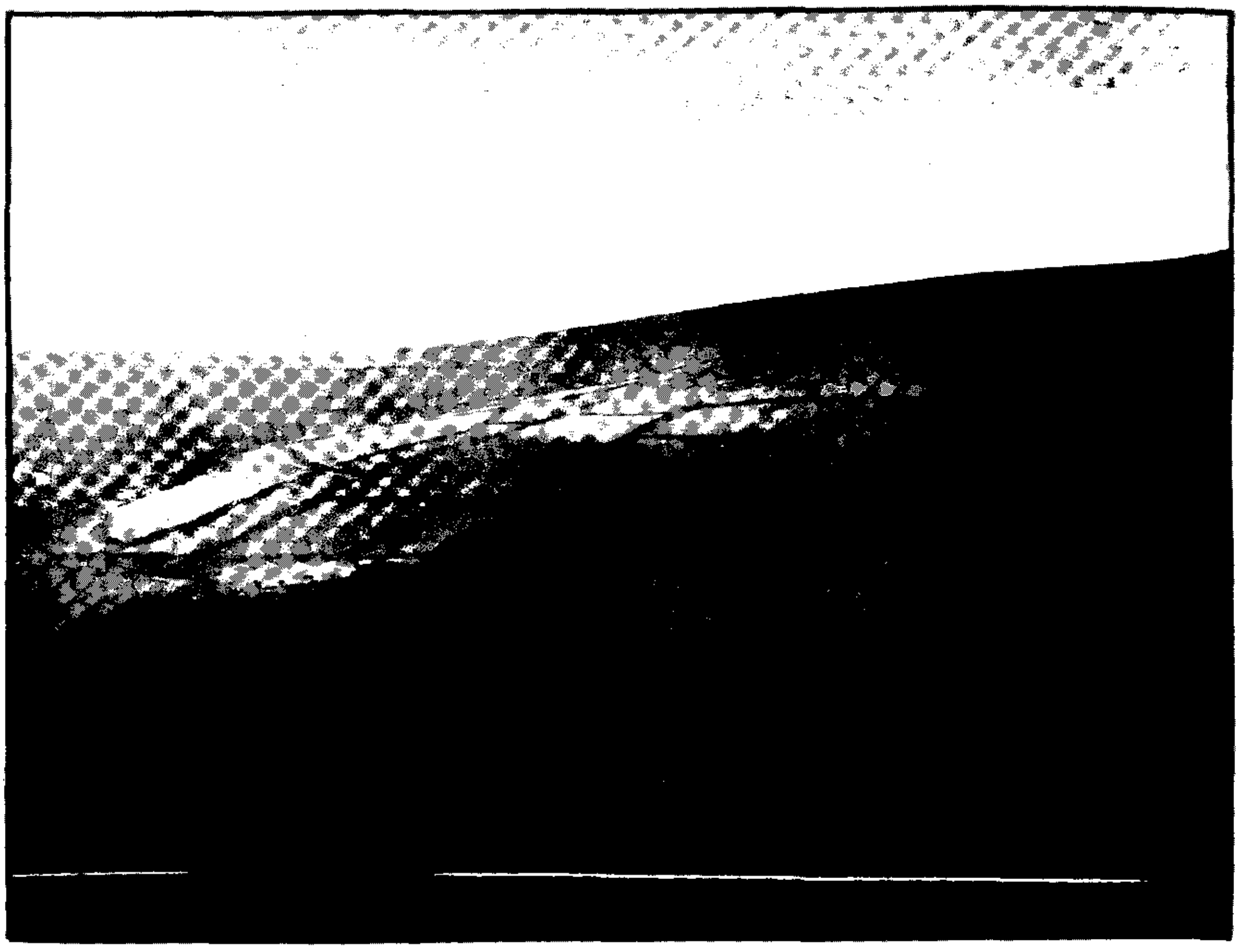
(Map by Geoffrey Sinclair, Environmental Information Services)

# WIDECOMBE in the MOOR

# and

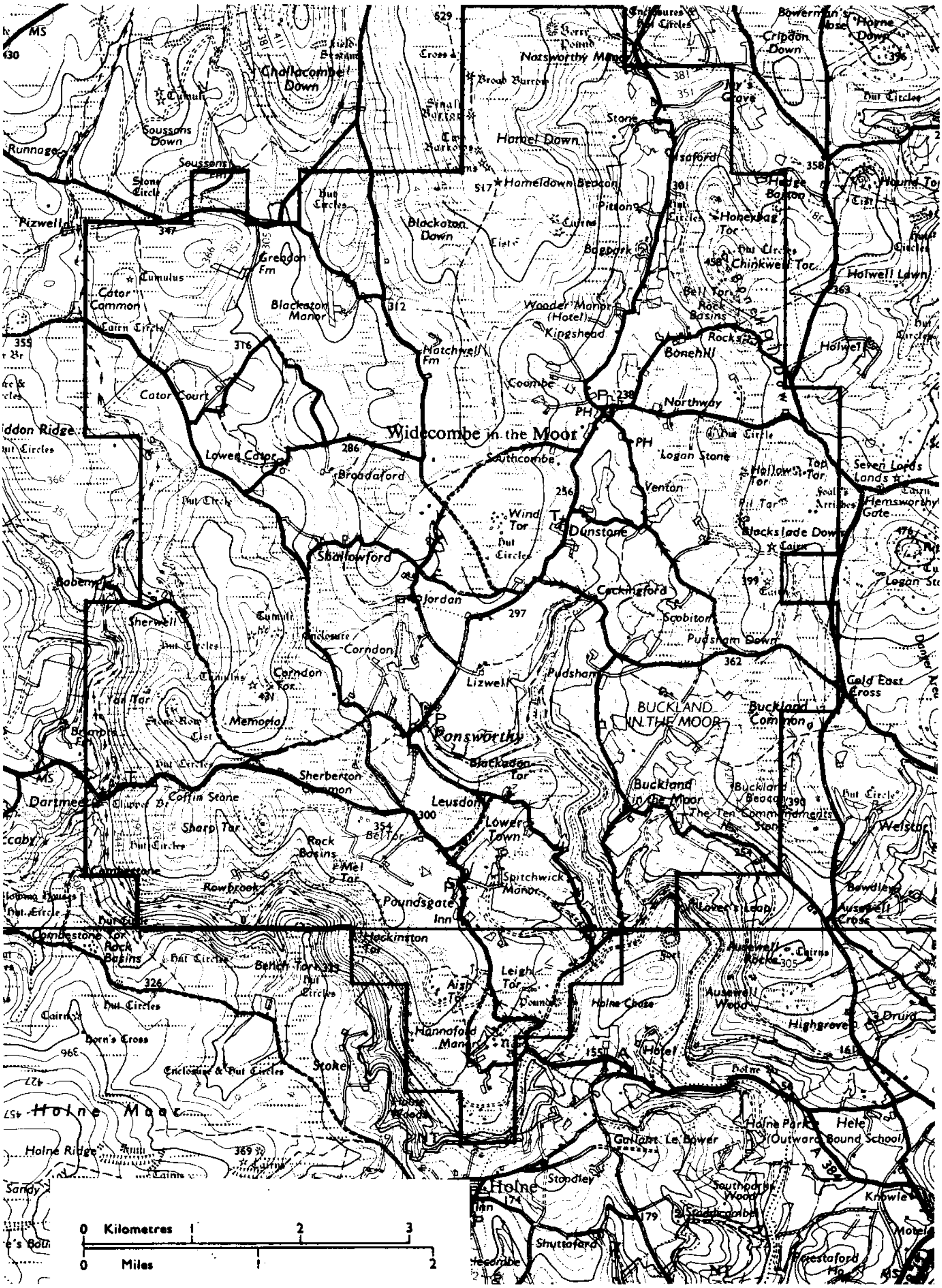
# BUCKLAND in the MOOR





View from Bonehill Down across the East Webburn valley towards the south eastern edge of Hamel Down. The large fields on the background slopes are probably 19$^{th}$ century enclosures. The more irregular, smaller fields with hedgerow boundaries in the valley floor are much older. Foreground vegetation is probably shrubby heath of class 13, Calluna heath, in its bracken phase. (Photo by P.Ainsworth)

FIGURE 12.1 THE STUDY AREA OF WIDECOMBE IN THE MOOR
AND BUCKLAND IN THE MOOR



# STUDY AREA 12: WIDECOMBE IN THE MOOR AND BUCKLAND IN THE MOOR, DEVON

## PHYSICAL ENVIRONMENT

The study area of Widecombe and Buckland (Figure 12-1), in the Dartmoor region, is 51 $km^2$ in extent and lies wholly within the Dartmoor National Park on its western fringe, northwest of Ashburton. Altitudes between 122 and 427 m (401-1 400 ft) dominate the area (Figure 12-2), but there is a small sector of low ground including altitudes below 122 m around Buckland and Hannaford Manor in the south, and a higher altitude sector including land above 427 m on Hamel Down in the north (Plate 1). Most of the area (some 65%) is dominated by moderate slopes (Part I, Plate 17), but there are also significant parts dominated by steep and very steep slopes along the valleys of the Dart, the Webburn and the East Webburn, and on the eastern slopes of Hamel Down.

Climatically Widecombe, in relation to the 12 study areas, can be described as warm and moderately wet (Part I, 2.32). January and October monthly mean temperatures, from approximate data off national maps, are estimated as 3.1 and 10.1$^{o}$C. With a height different of around 280 m between the south and the north of the area, mean temperatures are likely to be the order of 1.5-2.0$^{o}$C colder in the highest sectors than they are in the lowest (Part I, 2.31). Annual average daily sunshine hours are 4.0 and the average number of days with snow lying is 15. The length of growing season for grass has been calculated (Smith 1976) as between 293 days (8 March-26 December) at 80 m, and 257 days (25 March-7 December) at 240 m in the South Devon-Dartmoor areas. Most of the area has fairly high rainfall (1 201-1 600 mm, c. 48-64 in pa) with a small part in the southwest having high rainfall (1 601-2 220 mm, c. 64-88 in pa). As remarked in Part I, 2.33, Widecombe is the one study area that falls entirely in the climatically non-marginal category, as defined by Parry (1978).

Geologically the greater part of the area overlies Dartmoor granite, while the southeast corner, approximately south of a line between Poundsgate and Buckland, overlies weakly metamorphosed Carboniferous shales and grits (Culm Measures). The only 'drifts' mapped are narrow bands of alluvium along the river courses, especially those of the East and West Webburn Rivers, so that soils generally reflect the underlying or adjacent rock types. The depth of weathered granite-derived material on which soils are developed over most of the area is however quite variable. The granite in this area mainly carries soils which are moderately acidic intergrades between typical lowland Brown Earths and the more strongly acid and leached moorland podzol soils. The national soil map thus shows most of Widecombe within a mapping unit dominated by these Brown Podzolic Soils with associated Brown Earths. More acid moorland soils, dominated by Peaty Podzols in a complex with subordinate poorly drained Peaty Gleys and Gleys, Brown Podzolic Soils, shallow skeletal soils ('Rankers') and Peaty Soils, occupies a sector 1-2 km deep along the northwestern margin of the area, from Hamel Down westwards. In the southeast, coinciding with the Culm Measure outcrop, a sector is shown dominated by Brown Earths, with subordinate poorly drained Gley Soils and Brown Podzolic Soils.

On the agricultural land classification map the best quality land is a small extent in grade 3, around Spitchwick in the lower altitude, Brown Earth sector in the south. Grade 4 land is widespread, around Poundsgate, the villages of Buckland and Widecombe, and along the valleys of the East and West Webburn Rivers. A complex mosaic of grades 4 and 5 land occurs over the remainder of the area, with grade 5 occupying most of the higher ground.

Topographic characteristics are shown in Figure 12-3. Road access is good throughout, at least in terms of frequency, and this has its impact by encouraging tourist traffic to virtually the whole area. Settlement has also spread widely, but with concentrations in Widecombe, Ponsworthy, Buckland and Poundsgate. The intensively farmed sectors, as assessed by the frequency of field boundaries, also emphasise the widespread use of the area in the present or past, only commom land (ULS 1979) being generally free of a close network of field boundaries.

The distribution of land types (Part I, 4.15 and Table 4-1) is shown in Figure 12-4. The upland land group occupies 64% of the area, the upland land type being most prominent, with some steep upland particularly along the valley sides, and a sector of upland plateau in the northwest. Upland margin land is important in the south in the area previously noted as of lower altitude over Culm Measure shaly and sandstone rocks. Hill land is of limited extent, with the largest tract covering the common land of Hamel Down in the north.

## LAND-USE HISTORY

In prehistoric times the evidence of settlements (Part I, Plate 18), cairns and the boundary banks known as 'parallel reaves' (Part I, 4.23) shows that a sizeable population then lived in southern and western Dartmoor. The next substantial phase of settlement followed the arrival of the Saxons in the 7th century

AD. Pressures on land gradually increased to extend settlement to altitudes above 305 m (1 000 ft). The importance of these uplands as livestock grazing in the regional economy, and the organised way this grazing was managed, are seen in the system by which, in the 13th century, parishes such as Buckland and Widecombe paid dues for summer moorland grazing only to the extent that they could maintain their stock in winter on their farms (Part I, 4.25). It is likely that during the 12th and 13th centuries cultivation was at its maximum. Additional farm income was later provided by rabbit warrens (Part I, 4.28).

In the early 19th century, enclosures extending the farmed land became features of land management (Plate 1), sometimes with shelter belts. At this time cultivation extended again to a new peak. Vancouver (1808) noted that, by judicious cultivation, farmers produced 'excellent turnips, barley, clover, wheat, oats ... , beans and peas'. His description of the higher ground in the area as 'excessively broken into abrupt and huge irregularities, terminating in craggy and frightful precipices' is however a rather more dramatic reaction to the scenery of Widecombe than we would feel today. In the Tithe Commutation Survey of 1840 for Widecombe parish, 64% was described as common and moor, while 21% was cultivated, and 4% was wooded (Public Record Office). The view taken of Widecombe then was that it was 'in the heart of Dartmoor' and consequently 'exposed in a very great degree to winds and storms ... ', again a description we would not find easy to recognise. Buckland at that time was almost all within one ownership and described as being very poor.

The study area was surveyed by the Ordnance Survey (OS) first in 1884. Using successive editions of OS maps, recent air photographs, and the field maps of the 1st Land Utilisation Survey from the late 1930s (Part I, 4.50-4.52) it is possible to identify the location of moorland core, moorland fringe and farmland at different periods. From this study, Figure 12-5 shows the extents of core, fringe and farmland to be 48, 12 and 40% respectively. The distribution of moorland core particularly follows that of the common lands (ULS 1979) along the eastern, southwestern and north central borders of the area, with only limited, fragmented areas of core remaining in the single ownership sectors. The significance of commons in retaining up to now a moorland character in this study area is emphasised in the ULS. The moorland fringe sector is almost equally divided between moorland reclaimed for agriculture, and farmland reverted to moor (Part I, Table 4-6). Considering the distribution of moorland fringe in relation to the distribution of land types, the moorland fringe is concentrated in the upland and upland plateau land types (these contain 70% of fringe areas) with the remainder almost all in the steep upland and upland margin land. Of these types, relatively more moorland fringe occurs in the upland plateau land than would be expected from its representation in the area. This is in general conformity with the average situation in the 12 study areas as a group (Part I, Table 5-13).

For changes in the extent of tillage and in stock numbers, Ministry of Agriculture statistics for the study area between 1900 and 1965 have been summarised in Part I, Figures 4-4 to 4-7. With tillage, the graph shows a slow general fall, interrupted by a temporary increase between 1940 and 1945 and a sharp fall between 1960 and 1965. For livestock, there are contrasting patterns. Sheep numbers slowly declined between 1900 and 1935, then dropped sharply by some 50% between 1935 and 1940, remaining at a generally steady level since then. Cattle remained generally steady in numbers between 1900 and 1955, then increased abruptly by some 50% between 1955 and 1965. ULS (1979) estimate that between 1884 and 1977 the area of crops and grass increased significantly from 34 to 42% of the total area. In this same period woodland fell by about 2% of the area, to occupy 7.6% in 1977.

During the 1960s and 1970s there has been further land reclamation for agriculture. As shown in Figure 12-6, part of this land was moorland fringe that had reverted after earlier cultivation, but significant areas have been reclaimed from land that had persisted as moorland since at least around 1800. This active reclamation from moorland core rather than from existing fringe is clearly important in ecological and landscape terms, since moorland core can differ in soil character and, as shown in Part I, 5.68-5.71, can often also differ in its vegetation from formerly farmed land that has reverted.

VEGETATION

Figure 12-7 includes the frequencies with which vegetation classes occurred at 75 main sites recorded in 1977. The location and classification of each site are given in Figure 12-8. Heath vegetation at recorded sites in Widecombe has two particular features. There is a low proportion (5%) of grassy heaths (Part I, 3.16), limited to Festuca/Vaccinium heath (class 14), occurring scattered throughout the area, and a high proportion of a single shrubby heath (Part I, 3.18) class, Calluna heath (class 13) which has the highest percentage occurrence (31%) of any class in the area. This dry heather moor vegetation shows a strong southwestern bias in its distribution through the 12 study areas. Important constituent species, along with heather (Calluna vulgaris), include bilberry (Vaccinium myrtillus), gorse (Ulex spp.) and bell-heather (Erica cinerea). In Widecombe this class is particularly concentrated on the common grazings. ULS (1979) have noted an increase of heather moor on common land between 1966 and 1977, associated with a fall in grazing pressure. Calluna/Molinia/Vaccinium heath, class 9, which may be considered as a wetter phase of Calluna heath, is also present, particularly in the northwest.

The contrasting end-groups of the vegetation range at main sites (improved pastures and shrubby heaths) together account for 75% of the recorded sites. This sharp contrast between a dominantly shrubby heath vegetation persisting especially on the common grazings and a dominantly improved grassland elsewhere, is a developing trend noted by ULS as a factor in landscape evolution.

The distribution of improved pastures and rough pastures particularly follows the valleys of the West and East Webburn Rivers (Part I, Plate 22). Improved pastures are mainly herb-rich Lolium grassland, class 4 (Part I, 3.12), a rye grass/clover dominated community typical of recently sown swards. Much of the rough pasture consists of Agrostis/Juncus and Festuca/Juncus grassland (classes 5 and 6), (Part I, 3.14), which have some degree of soil drainage impedence. Bracken, Pteridium aquilinum, is a constituent of all the rough pasture classes and also can occur in the most frequent improved pasture class, so that it is therefore widespread and prominent in the vegetation of the valley sides. ULS (1979) noted a substantial expansion in the prominence of bracken cover between 1966 and 1977.

Within the woodlands, which are particularly concentrated along the valleys of the Webburn and Dart (Part I, Plates 17, 22), vegetation was recorded at 13 sites. The 3 woodland groups, upland acid woodlands, lowland acid woodlands and lowland basic woodlands, (Part I, 3.25) all occur in Widecombe. The most common woodland type (5 sites recorded) is pedunculate oak/ash woodland, and there were 3 sites of acid oak/birch woodland. These woods are survivors of a major replanting of many woodlands with conifers which has been in progress since the period 1946-1951 (ULS 1979).

Table 12-1 gives the association between vegetation classes at main sites in the grassland-moorland range and the land types in this study area. Figure 12.9 includes a schematic illustration of the relationship between land groups and vegetation groups, using a sketch of land group distribution based on Figure 12.4. Hill land sites are dominated by Calluna heath but include the few grassy heaths. The dominant upland land group, and the upland land type within this, contains sites of improved pastures, rough pastures, and again, Calluna heath. Upland margin is dominated by improved pasture sites but also includes significant proportions of rough pasture and shrubby heath sites.

POTENTIAL VEGETATION CHANGE

In an area like Widecombe and Buckland, in which a prominent agriculture, a significant forestry interest and a substantial tourist pressure interact, in a National Park, to give often competing pressures on land-uses and vegetation, it is particularly difficult to predict trends of vegetation change over the next 20-30 years with any confidence.

A simple assessment of forestry potential (Part I, 5.95-5.100) based on land type proportions and an allocation of land preferentially to agriculture, then to forestry on standard assumptions rather than local land and ownership factors, suggests that (Part I, Table 5-19) very little 'unplantable' land is present and that around 40% could be used for forestry compared to the present 8%. Clearly forestry expansion as an alternative to retention of upland open land could be a critical policy issue here.

Agriculturally, ULS (1979) found that some two-thirds of farmers planned to maintain their present levels of management. On the other hand, the remainder said they wanted to increase stocking rates, improve rough grazing and/or buy more land. This course would lead to further grassland improvement schemes, particularly likely to involve upgrading present rough pastures. However, of the total rough grazing, ULS (1979) give 30% as 'not improvable' but 'of some grazing value', and 55% as having improvement potential limited for physiographic reasons, while only 15% is classed as readily improvable. They base their estimates on the criteria developed and under trial in hill and upland areas by the Agricultural Development and Advisory Service Resource Planning Group. ULS considers that stocking densities could be increased, particularly on moorland areas held by individual farmers on a freehold basis, and this would involve vegetation changes in such areas from shrubby heaths to grassy heaths, with piecemeal reclamation of land for pasture under intensive agriculture. ULS have also drawn attention to the possibility of legislation leading to substantial changes in the management of common grazings which again could eliminate many of the present shrubby heaths. Intensification of management might involve the use of herbicides for differential control of gorse and bracken. The overall effect of changes such as these would be to increase the proportion of improved pasture types along the valleys and to accelerate a shift from shrubby heaths to grassy heaths on the moorland.

However, alternatively, since the majority of farmers indicated to ULS that they did not intend to initiate major changes in their farming practice, and with National Park policies that seek to sustain much of the present landscape character, as well as the trend to higher energy costs, it is possible that the scale of eventual change due to agricultural intensification might be accommodated with less impact on the landscape.

Even if this is so, pressure from increased tourism is another factor to be considered. Walking, riding and camp fires concentrated in favoured open land locations could initiate fundamental changes in the composition of heath vegetation similar to those that could be caused by increased grazing pressures.

The outcome of a political and economic balance between these alternative major options is impossible to forecast. Turning though from these imponderables to a simplified picture of predicted vegetation change, application of the standard courses of change discussed in Part I (5.74-5.77 and Figure 5-4), as summarised in Appendix 2, could lead to the situations discussed below. The most frequent vegetation classes at the sampled sites were: from the improved pasture group, herb-rich Lolium grassland, class 4; in the rough pastures, Agrostis/Juncus grassland, class 5; in the grassy heaths, Festuca/Vaccinium heath, class 14; and in the shrubby heaths, Calluna heath, class 13. In considering the likely options for change, class 4 is at the agriculturally 'best' end of the improved pasture succession, representing recently reseeded grassland. The suggested trends under agricultural expansion or decline would be likely to maintain such grassland. If for any reason an area of this class became less actively managed it would be likely to change gradually through other improved pastures and eventually become scrub woodland as a result of the substantial sources of tree seed locally available. The rough pasture of class 5 is associated often with some degree of soil wetness and frequently has a high proportion of brambles and bracken present. Sites of this class may well represent an end point of improvement under less favourable economic conditions, but in a climate of agricultural intensification could be cultivated, reseeded, fertilised, and drained where necessary, to become improved pastures suitable for sustained use. Woodland again is a likely outcome of substantial decline in agricultural use of this class. The grassy heaths and shrubby heaths of classes 14 and 13 are indicated in Part I, Figure 5-4 as linked and liable to change between each other in response to intensified or reduced grazing and burning regimes, the former favouring grassy heaths, and reduction favouring shrubby heaths. Under increased use a change of the Festuca/Vaccinium heath towards rough pasture is more likely to lead to a drier rough pasture community such as Festuca/Agrostis grassland, class 8, than to the Agrostis/Juncus grassland that is the present most widespread rough pasture type.

Figure 12-8 includes predictions of vegetation classes that could develop at recorded sites on ecological grounds under the standard assumptions of gradual change due to a moderate level of agricultural intensification or decline. Figure 12-7 shows the differences these predicted changes would produce in the frequencies of vegetation classes at the recorded main sites. It must be emphasised again that these predictions are based only on the standard application of general principles and do not consider individual site and management conditions.

With this reservation, it is estimated that an intensification of agriculture to a moderate degree in Widecombe could lead to overall increases in the proportions of improved pastures and grassy heaths at the recorded sites, the former from 37 to 58% of sites and the latter from 5 to 37% of sites. These increases would be balanced by a fall in rough pasture vegetation (from 20 to 5% of sites), and the disappearance of shrubby heaths. The predicted outcome of a moderate decline in agricultural use would be for falls in sites with improved pastures (from 37 to 29%) and rough pastures (from 20 to 13%) balanced by an increase in grassy heaths (from 5 to 15% of sites) and in shrubby heaths (from 38 to 43% of sites). In considering the overall impact of these predicted vegetation changes on the landscape the increased agricultural intensity outcome could involve a change in vegetation group at 63% of sites, while the declining agriculture situation would have a less intensive effect, with 33% of the main sites changing their vegetation group.

Figure 12-9 shows the predicted changes at main sites in relation to land groups. With agricultural intensification hill land would change most markedly, with shrubby heaths replaced by grassy heaths, while declining agriculture would increase vegetation variety in the upland and upland margin land groups.

The Upland Landscapes Study vegetation map of Widecombe (ULS 1979) is included here as Figure 12-10. Table 12-2 correlates the ITE vegetation class at main sites*with the ULS mapping unit in which the sites are situated. The most prominent map unit, 'farmland', is dominated by pastures in this area but includes a few heath sites (see Appendix 3 for an overall correlation of ULS units and ITE classes for 11 areas). The 'bracken' unit necessarily covers a range of classes since this species can grow in a range of plant communities. Main sites in the 'sub-shrubs/gorse' unit are mainly *Calluna* heath. Table 12-3 gives the predicted balance of vegetation classes that could occur in the ULS map units if the standardised courses of change under agricultural intensification or decline took place. Heavier grazing, with other management pressures, could change sites in the 'bracken' and 'sub-shrubs/gorse' units to mainly grassy heaths rather than the shrubby heath plant communities that they now mostly are. These mapping units would change their character most conspicuously under intensified agriculture. With declining agriculture the moorland-pasture contrast would persist, though pasture sites would decrease and heaths increase in the 'farmland' and 'grassland' units.

* (including additional sites recorded in 1979, see Part I, 5.66-5.67)

## CONCLUSION

Widecombe is an area of relatively favourable environment and widely spread settlement in which agricultural intensification is reasonably possible. It also is an area of intensive recreational pressure under the planning aegis of a National Park, and has a suitable environment for forestry expansion. How these conflicting interests of agricultural or forestry expansion and landscape conservation will balance out over the next 20 years is uncertain. To add to the uncertainty, the future of the commons, which virtually sustain a strong heath vegetation component in the present landscape, is unknown. Unless active policies retain heath vegetation on these commons, and preserve the surviving deciduous woodlands, the present important contrast between heaths on moorland ridges and grassland in wooded valleys will be blunted or disappear. Heaths will decline and rough pastures and improved pastures increase to give a simplified farmland/forest balance to what is now a farmland/moorland/woodland/forest mosaic.

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TABLE 12-1 CORRELATION OF VEGETATION CLASSES AND LAND TYPES - WIDECOMBE

| Vegetation Group and Class | | Land Group and Type: Hill | | | Upland | | | Upland Margin (6) |
|---|---|---|---|---|---|---|---|---|
| | | Steep Hill (1)* | Hill (3) | High Plateau (4) | Steep Upland (5) | Upland (7) | Upland Plateau (8) | |
| Improved Pastures | 1 | | | | | 1 | 1 | 1 |
| | 2 | | | | | 2 | | 2 |
| | 3 | | | | | 2 | | 1 |
| | 4 | | | | 2 | 10 | 1 | 5 |
| Rough Pastures | 5 | | | | | 7 | | 1 |
| | 6 | | | | | 1 | 1 | |
| | 7 | | | 1 | | 2 | | 1 |
| | 8 | | | | | | | 1 |
| Grassy Heaths | 14 | | | 1 | 1 | 1 | | 1 |
| | 15 | | | | | | | |
| | 16 | | | | | | | |
| Shrubby Heaths | 9 | 1 | | | | 1 | 3 | |
| | 10 | | | | | | | |
| | 11 | | | | | | | |
| | 12 | | | | | | | |
| | 13 | 2 | 3 | 2 | 4 | 9 | 1 | 2 |

As number of sites of each vegetation class located in each land type.
* Land type numbers as used on computer maps, Figure 12-4.

TABLE 12-2 CORRELATION OF ULS VEGETATION MAPPING UNITS AND ITE VEGETATION CLASSES - WIDECOMBE

| ULS Mapping Unit | Number of ITE Sites in Area of ULS Unit | ITE Vegetation Class | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Improved Pastures | | | | Rough Pastures | | | | Grassy Heaths | | | Shrubby Heaths | | | | |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 14 | 15 | 16 | 9 | 10 | 11 | 12 | 13 |
| Smooth Grassland | 6 | 1 | | | | 2 | | | 1 | | | | | | | | 2 |
| Coarse Grassland/*Nardus* | | | | | | | | | | | | | | | | | |
| Coarse Grassland/*Molinia* | 2 | | | | | | 1 | | | | | | | | | | 1 |
| Bracken | 21 | | 1 | | | 1 | | 3 | | 3 | | | 2 | | | | 11 |
| Sub-shrubs/Heathers | 5 | | | | | | | | | | | | 1 | | | | 4 |
| Sub-shrubs/Bilberry | | | | | | | | | | | | | | | | | |
| Sub-shrubs/Gorse | 12 | | | | | | 1 | | | | | | 2 | | | | 9 |
| Sedge & Rush Moorland | | | | | | | | | | | | | | | | | |
| Farmland | 38 | 2 | 3 | 3 | 18 | 5 | | 1 | 1 | 1 | | 1 | | | | | 3 |

As number of recorded sites in each ITE vegetation class that are located in each ULS unit

TABLE 12-3 PREDICTIONS OF CHANGE IN THE BALANCE OF VEGETATION GROUPS AT SITES LOCATED IN ULS MAPPING UNITS - WIDECOMBE

| ULS Mapping Unit | ITE Vegetation Groups | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Improved Pastures | | | Rough Pastures | | | Grassy Heaths | | | Shrubby Heaths | | |
| | A | B | C | A | B | C | A | B | C | A | B | C |
| Smooth Grassland | 1 | 4 | | 3 | | 1 | | 2 | 3 | 2 | | 2 |
| Coarse Grassland/*Nardus* | | | | | | | | | | | | |
| Coarse Grassland/*Molinia* | | 1 | | 1 | | | | 1 | 1 | 1 | | 1 |
| Bracken | 1 | 5 | 1 | 4 | 3 | 3 | 3 | 13 | 1 | 13 | | 16 |
| Sub-shrubs/Heathers | | | | | | | | 5 | | 5 | | 5 |
| Sub-shrubs/Bilberry | | | | | | | | | | | | |
| Sub-shrubs/Gorse | | 1 | | 1 | | | | 11 | 1 | 11 | | 11 |
| Sedge & Rush Moorland | | | | | | | | | | | | |
| Farmland | 26 | 33 | 21 | 7 | 2 | 6 | 2 | 3 | 6 | 3 | | 5 |

As number of recorded sites falling in each ITE vegetation group that are located in each ULS unit

A - situation as recorded
B - predicted balance of vegetation if agricultural use increased, 10+ yrs
C - predicted balance of vegetation if agricultural use decreased, 10+ yrs

FIGURE 12.2 ALTITUDE SECTORS - WIDECOMBE

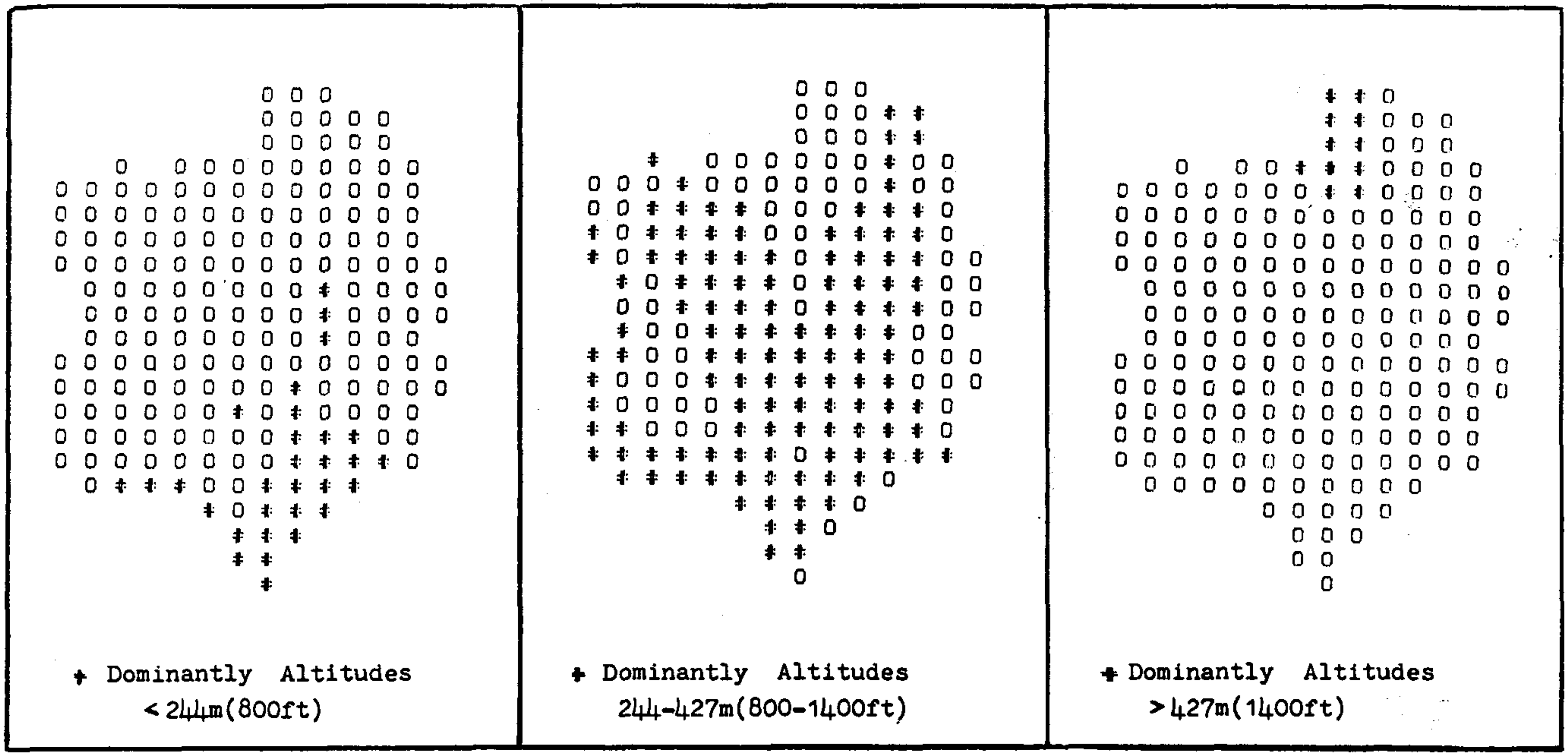


FIGURE 12.3 TOPOGRAPHIC CHARACTERISTICS - WIDECOMBE

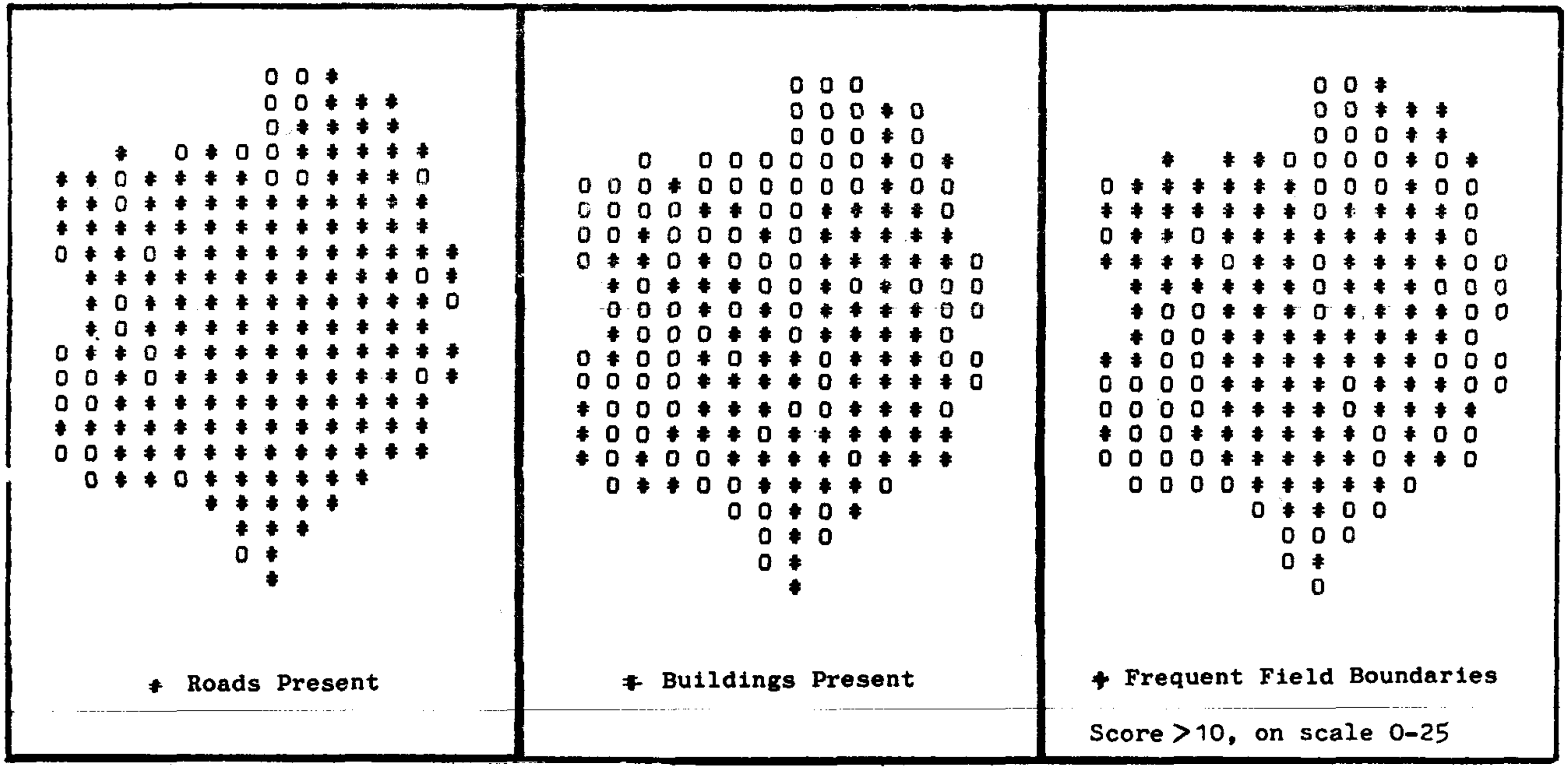


FIGURE 12.4 LAND TYPES – WIDECOMBE

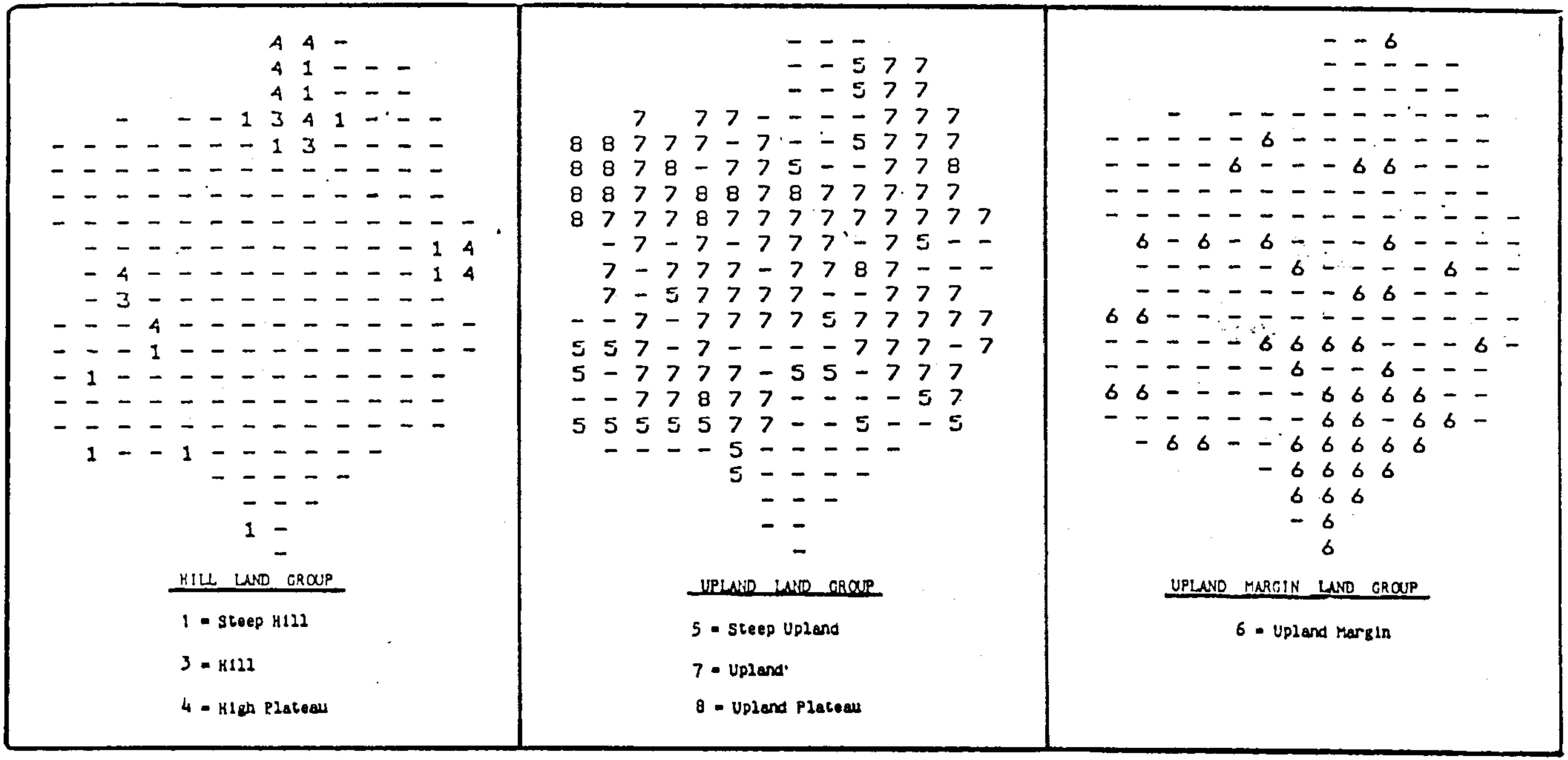


FIGURE 12.5 MOORLAND CORE, FRINGE AND FARMLAND - WIDECOMBE

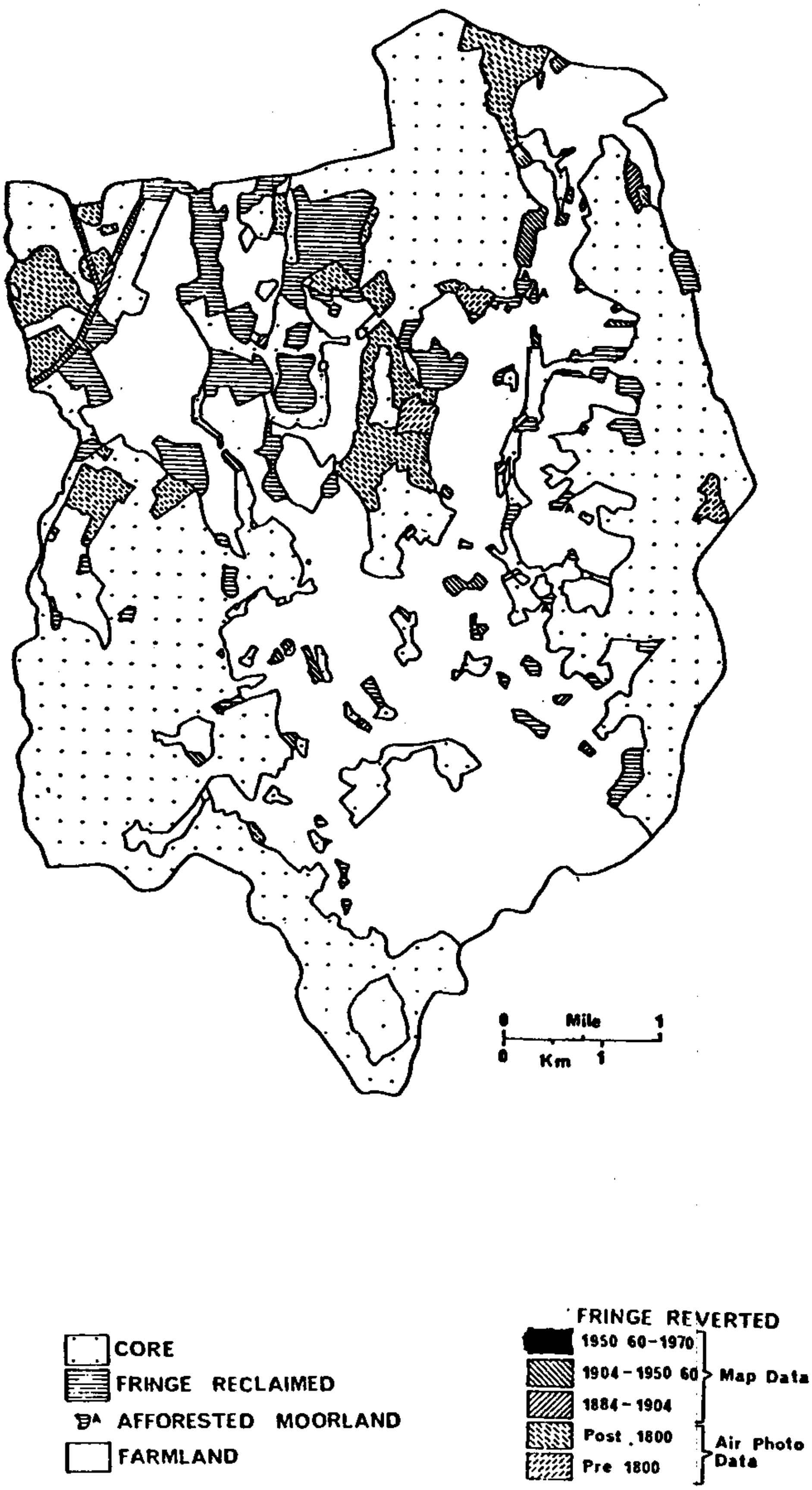


FIGURE 12.6 LAND RECLAIMED FOR AGRICULTURE, 1960-1975 - WIDECOMBE

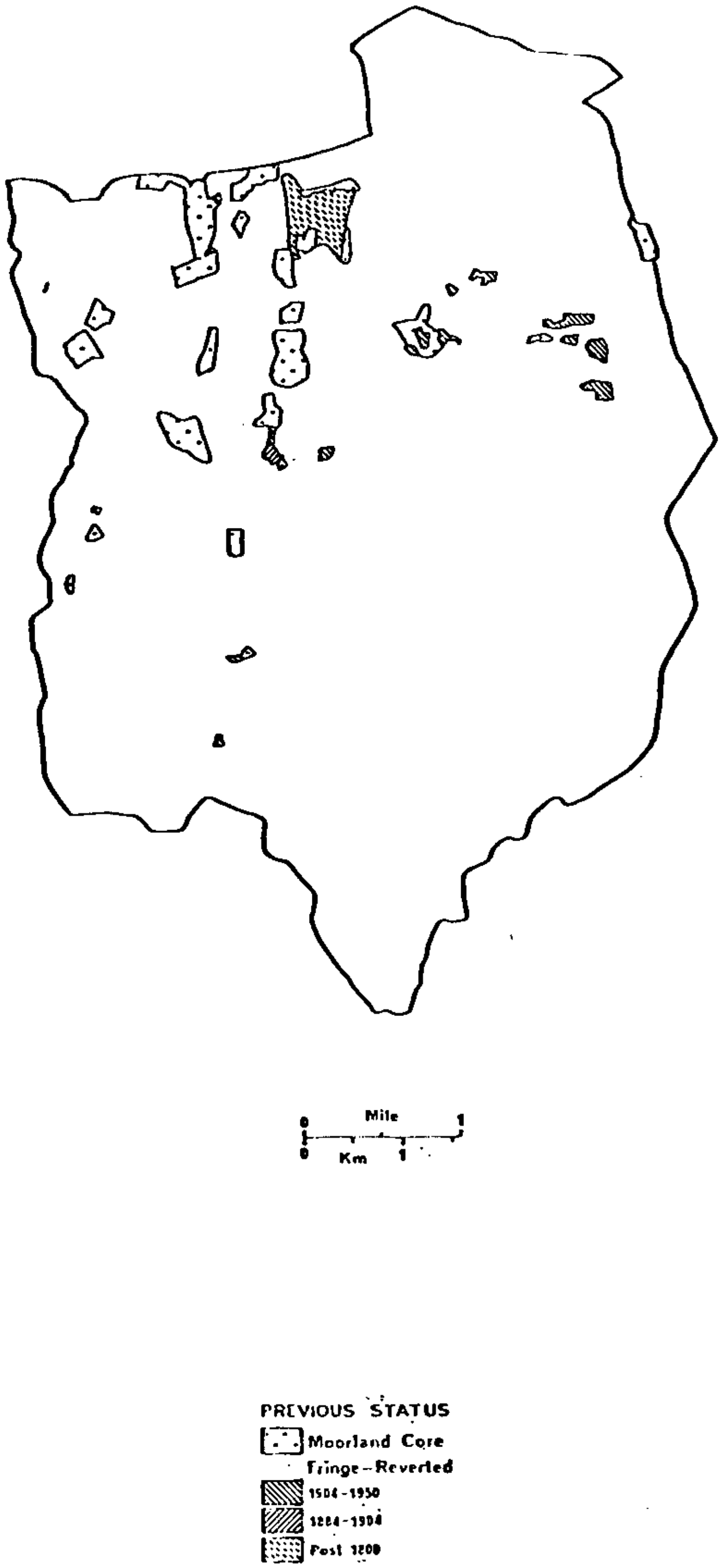
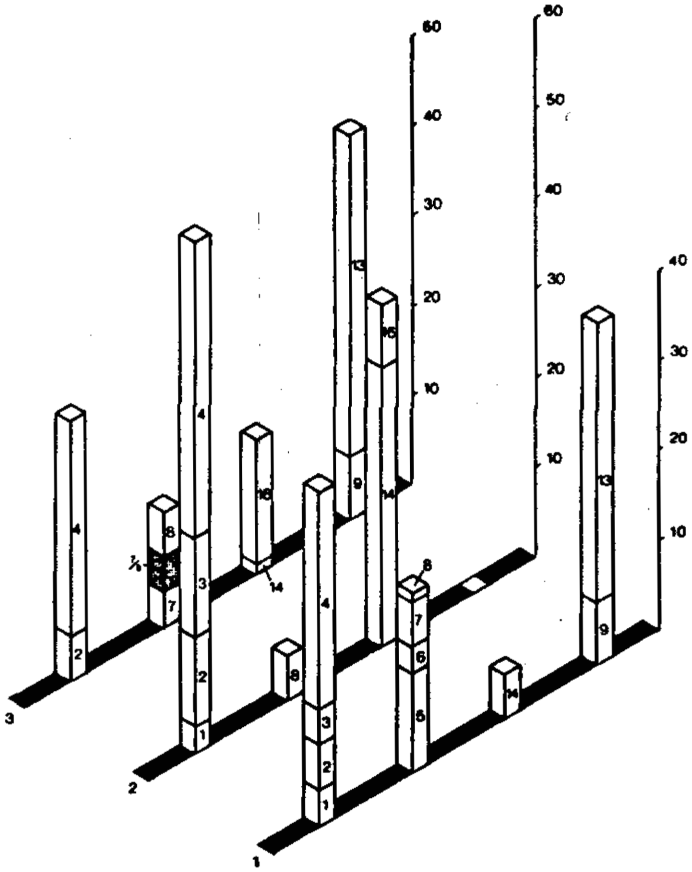


FIGURE 12.7 VEGETATION CLASS FREQUENCY AT MAIN SITES - WIDECOMBE

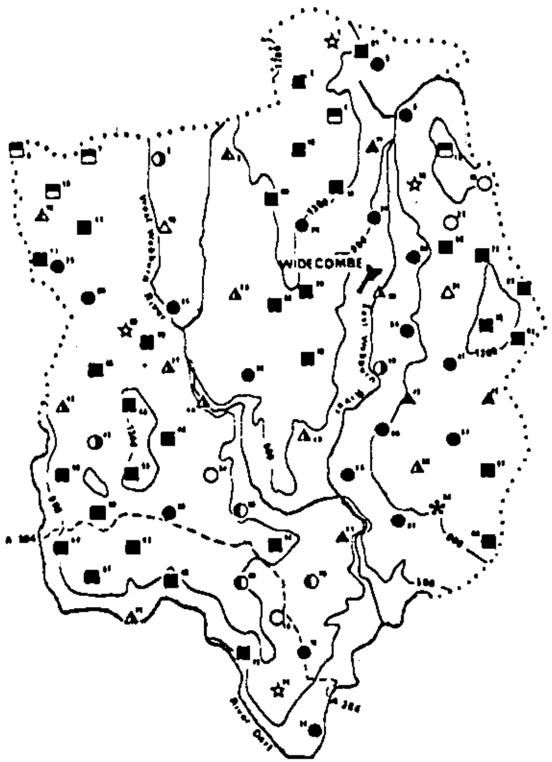



| Vegetation Group | Class | | % Main Sites in Vegetation Class 1 | 2 | 3 |
|---|---|---|---|---|---|
| Improved Pastures | 1 | Lolium/Holcus/Pteridium | 4 | 3 | - |
| | 2 | Lolium/Grassland | 5 | 10 | 5 |
| | 3 | Lolium/Trifolium | 4 | 11 | - |
| | 4 | Herb rich Lolium Grassland | 24 | 33 | 24 |
| Rough Pastures | 5 | Agrostis/Juncus | 11 | - | - |
| | 6 | Festuca/Juncus | 3 | - | - |
| | 7 | Agrostis/Holcus | 5 | - | 4 |
| | 8 | Festuca/Agrostis | 1 | 5 | 5 |
| | 7/8 | Agrostis/Holcus or Festuca/Agrostis | - | - | 4* |
| Grassy Heaths | 14 | Festuca/Vaccinium | 5 | 31 | 1 |
| | 16 | Festuca/Nardus/Molinia | - | 7 | 14 |
| Shrubby Heaths | 9 | Calluna/Molinia/Vaccinium | 7 | - | 7 |
| | 13 | Calluna | 31 | - | 36 |

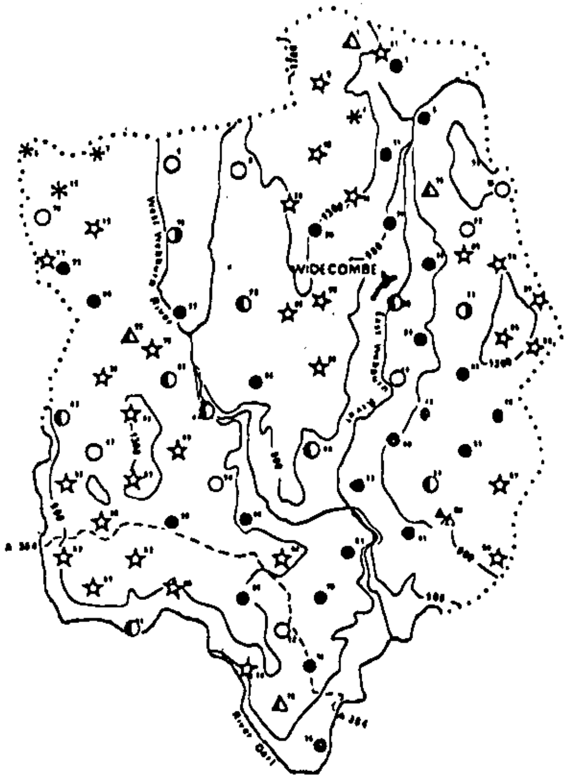
1. Recorded Main Sites, 1977.
2. Predicted Changes at Main Sites if Agriculture Increased, 10 + years.
3. Predicted Changes at Main Sites if Agriculture Decreased, 10 + years.

* Under a regime involving a reduction in the level of agriculture Class 3, Lolium/Trifolium, could move towards Class 7, Agrostis/Holcus or Class 8, Festuca/Agrostis. The shaded portion of the relevant histogram indicates this change.

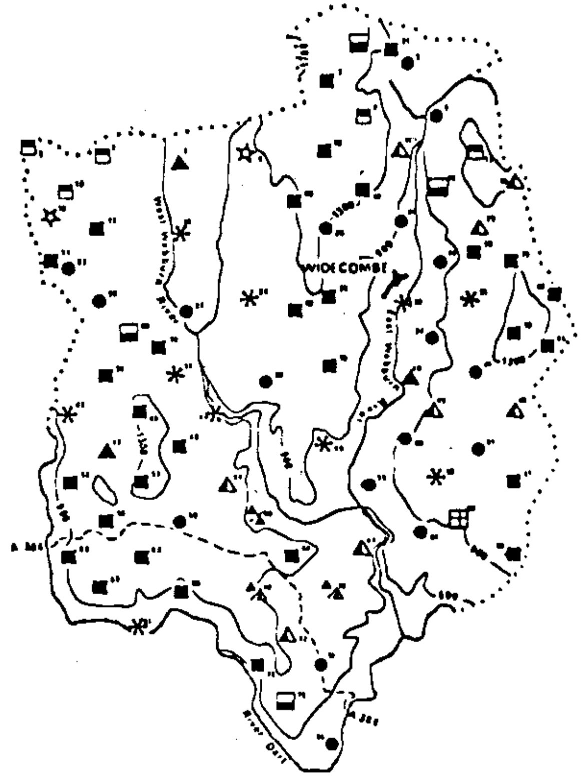
FIGURE 12.8 LOCATION AND CLASSIFICATION OF VEGETATION MAIN SITES - WIDECOMBE




1977

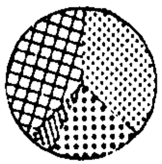


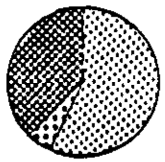

Predicted if Agriculture Increased

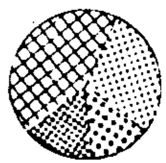



Predicted if Agriculture Decreased

Overall Frequencies of Vegetation Groups







KEY TO FIGURE 12.8

| | | |
|---|---|---|
| Group 1. Improved Pastures | Class 1 : | Lolium/Holcus/Pteridium |
| | Class 2 : | Lolium |
| | Class 3 : | Lolium/Trifolium |
| | Class 4 : | Herb — rich Lolium |
| Group 2. Rough Pastures | Class 5 : | Agrostis/Juncus |
| | Class 6 : | Festuca/Juncus |
| | Class 7 : | Agrostis/Holcus |
| | Class 8 : | Festuca/Agrostis |
| Group 3. Grassy Heaths | Class 14: | Festuca/Vaccinium |
| | Class 15: | Festuca/Nardus/Vaccinium |
| | Class 16: | Festuca/Nardus/Molinia |
| Group 4. Shrubby Heaths | Class 9 : | Calluna/Molinia/Vaccinium |
| | Class 10: | Vaccinium/Calluna |
| | Class 11: | Nardus/Sphagnum/Calluna |
| | Class 12: | Eriophorum/Calluna |
| | Class 13: | Calluna |

KEY TO FIGURES 12.8 AND 12.9

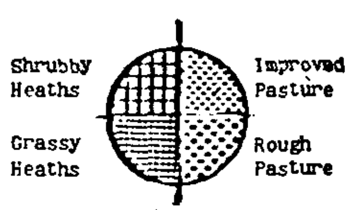
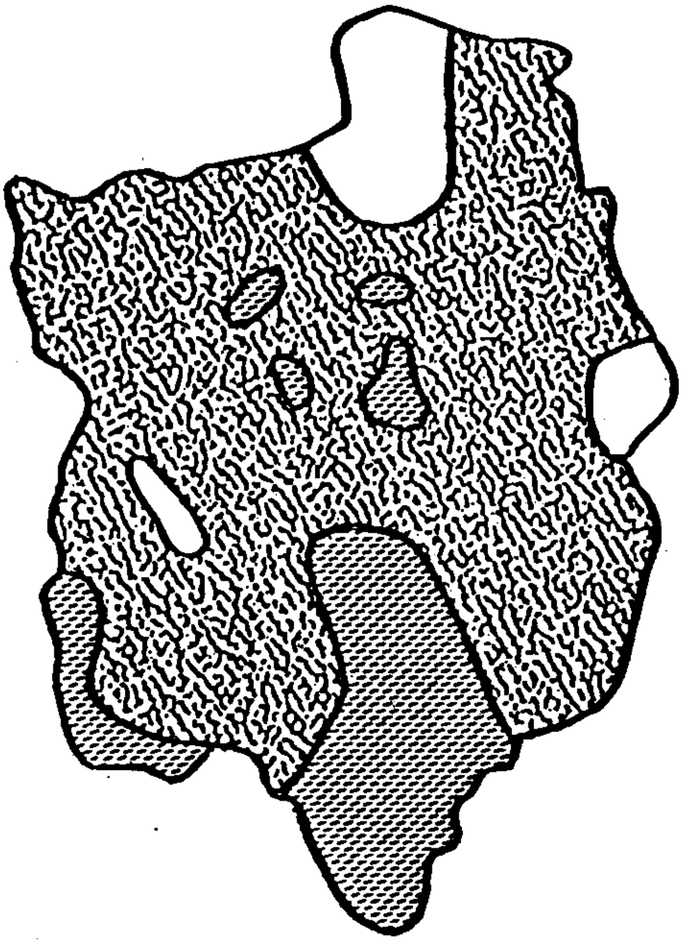


FIGURE 12.9 LAND GROUP-VEGETATION GROUP ASSOCIATIONS-WIDECOMBE



**VEGETATION GROUP FREQUENCIES AT SITES IN LAND GROUPS**

**PREDICTED CHANGES AT MAIN SITES**

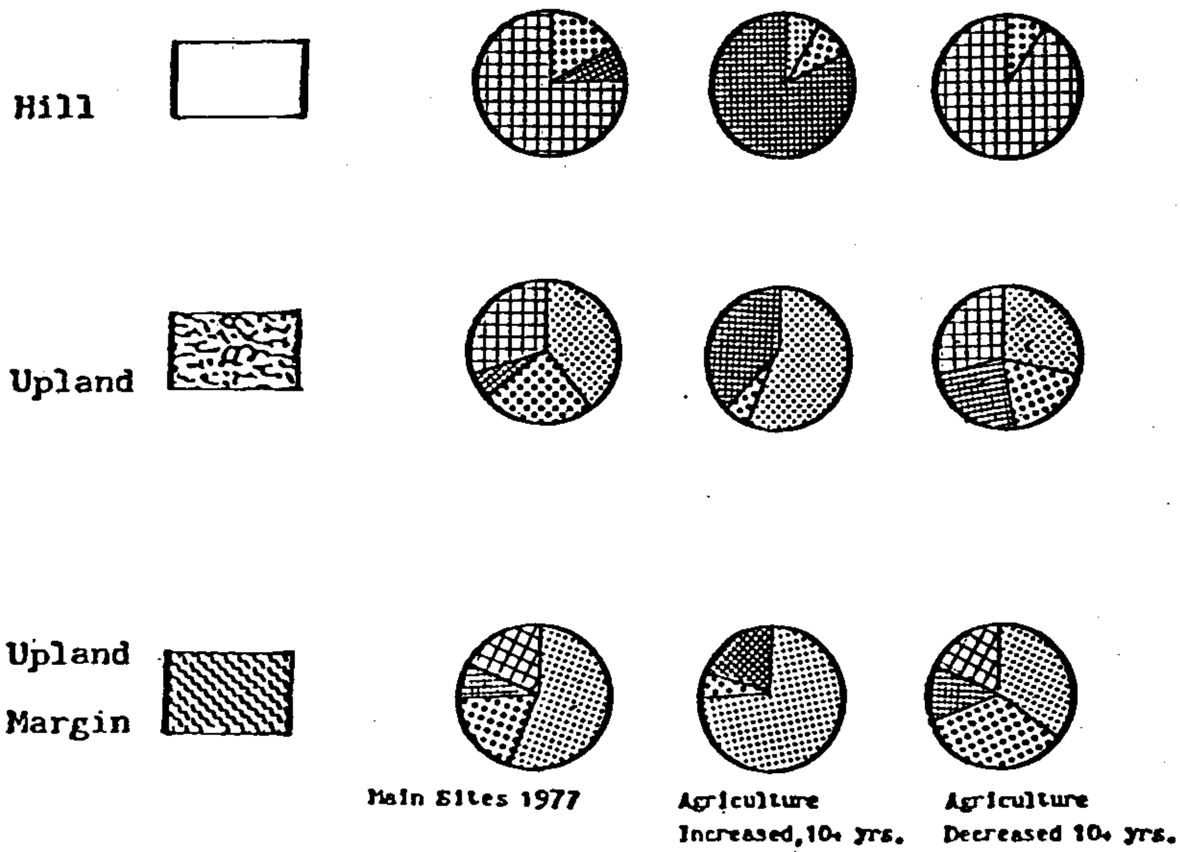
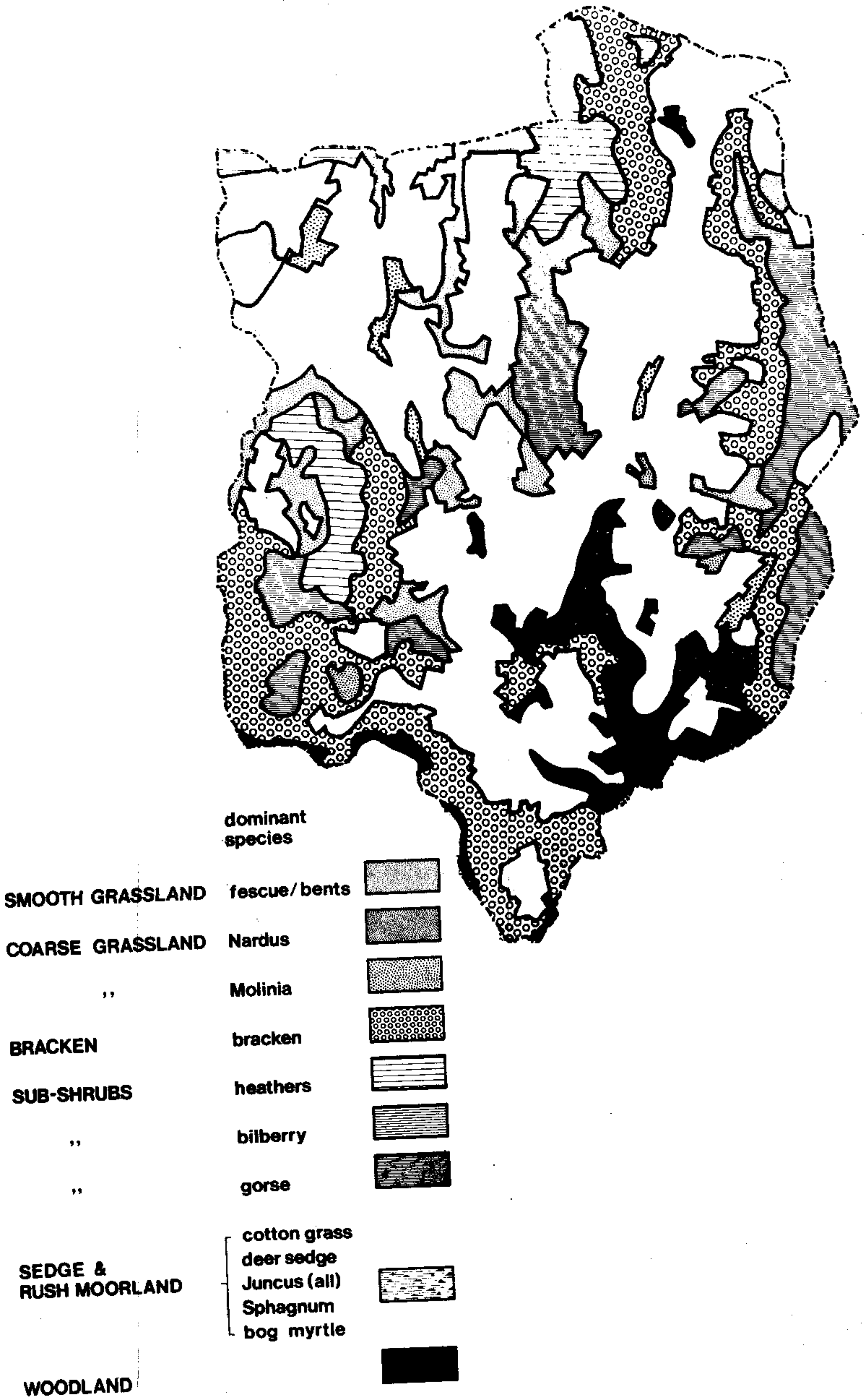


FIGURE 12.10 UPLAND LANDSCAPES STUDY VEGETATION MAP OF WIDECOMBE IN THE MOOR AND BUCKLAND IN THE MOOR




(Map by Geoffrey Sinclair, Environmental Information Services)

APPENDIX 1

## GRID REFERENCES OF VEGETATION SITES

The vegetation classification and the analysis of vegetation-land-history-management relationships are based on data recorded at sites in each area by the methods outlined in Chapter 3 or Part I of this report. Diagrammatic maps showing these sites and their vegetation class are included in each study area account.

In order that sites may be located more accurately from Ordnance Survey maps, their grid references are listed here. For 'main sites' recorded in 1977 or 1978 on which classification was based, 8-figure references are given; for additional sites sampled in 1979 there are 6-figure grid references. Woodland sites, not included on maps in the area accounts, are also given in these lists. The full vegetation data recorded at each site are held by ITE.

It must be emphasised that, as acknowledged elsewhere, field work at all sites was only carried out by ITE through the goodwill and permission of landowners and/or tenants. The listing of a site here gives no right of access without the agreement of the owner and/or tenant in each case.

**Alwinton**

| Site Number | Grid Reference | Site Number | Grid Reference | Site Number | Grid Reference |
|---|---|---|---|---|---|
| 1 | 88161704 | 40 | 81021093 | 79 | 86900280 |
| 2 | 86631543 | 41 | 81951067 | 80 | 87860250 |
| 3 | 86301443 | 42 | 82921034 | 81 | 834 128 |
| 4 | 88491479 | 43 | 87700880 | 82 | 847 123 |
| 5 | 89441448 | 44 | 88650845 | 83 | 830 118 |
| 6 | 90391420 | 45 | 89600818 | 84 | 835 115 |
| 7 | 91351490 | 46 | 91540754 | 85 | 798 112 |
| 8 | 84421518 | 47 | 81690960 | 86 | 868 110 |
| 9 | 85351480 | 48 | 83600902 | 87 | 854 091 |
| 10 | 86151390 | 49 | 86460814 | 88 | 889 087 |
| 11 | 83151445 | 50 | 87400783 | 89 | 861 085 |
| 12 | 84101415 | 51 | 90250692 | 90 | 858 082 |
| 13 | 87891290 | 52 | 79470938 | 91 | 877 083 |
| 14 | 92250637 | 53 | 80450900 | 92 | 884 083 |
| 15 | 93100600 | 54 | 82350840 | 93 | 888 080 |
| 16 | 81911378 | 55 | 84240780 | 94 | 919 074 |
| 17 | 82851348 | 56 | 87100694 | 95 | 909 070 |
| 18 | 83841317 | 57 | 88070660 | 96 | 857 063 |
| 19 | 84771286 | 58 | 89010630 | 97 | 864 064 |
| 20 | 86681226 | 59 | 89950601 | 98 | 886 067 |
| 21 | 87651194 | 60 | 91070585 | 99 | 912 066 |
| 22 | 88601162 | 61 | 81170775 | 100 | 921 068 |
| 23 | 89501132 | 62 | 83000715 | 101 | 841 059 |
| 24 | 81641282 | 63 | 84900653 | 102 | 887 060 |
| 25 | 82561252 | 64 | 86830597 | 103 | 892 028 |
| 26 | 83511222 | 65 | 87780565 | | |
| 27 | 84481190 | 66 | 89700508 | | |
| 28 | 85451163 | 67 | 90620479 | | |
| 29 | 86401140 | 68 | 81720650 | | |
| 30 | 87351100 | 69 | 86510500 | | |
| 31 | 85500846 | 70 | 89410410 | | |
| 32 | 91150978 | 71 | 82390522 | | |
| 33 | 80361219 | 72 | 84300465 | | |
| 34 | 82201161 | 73 | 84280434 | | |
| 35 | 85161065 | 74 | 86240405 | | |
| 36 | 87051009 | 75 | 87190374 | | |
| 37 | 88000975 | 76 | 88150345 | | |
| 38 | 88400942 | 77 | 90060285 | | |
| 39 | 79081150 | 78 | 85950306 | | |

**Woodlands**

| Site Number | Grid Reference |
|---|---|
| 1 | 88260880 |
| 2 | 89390667 |
| 3 | 89220338 |
| 4 | 87500365 |
| 5 | 87440268 |
| 6 | 88590305 |
| 7 | 89000300 |
| 8 | 88780282 |
| 9 | 90200613 |
| 10 | 90800569 |

Lunedale

| Site Number | Grid Reference | Site Number | Grid Reference | Site Number | Grid Reference |
|---|---|---|---|---|---|
| 1 | 84852930 | 37 | 90552345 | 72 | 87161978 |
| 2 | 84062870 | 38 | 91852334 | 73 | 88551954 |
| 3 | 85462852 | 39 | 92502246 | 74 | 83621955 |
| 4 | 83302814 | 40 | 82702398 | 75 | 84941939 |
| 5 | 84682792 | 41 | 84152372 | 76 | 86381913 |
| 6 | 86062775 | 42 | 85502355 | 77 | 87801897 |
| 7 | 87442750 | 43 | 86902336 | 78 | 85591854 |
| 8 | 92652389 | 44 | 88292313 | 79 | 86961830 |
| 9 | 82492753 | 45 | 89692298 | 80 | 86151775 |
| 10 | 83922734 | 46 | 91092272 | 81 | 944 237 |
| 11 | 85302718 | 47 | 80602348 | 82 | 926 232 |
| 12 | 86702693 | 48 | 81942337 | 83 | 919 231 |
| 13 | 80382707 | 49 | 90302216 | 84 | 905 216 |
| 14 | 81742692 | 50 | 84762290 | 85 | 905 210 |
| 15 | 83152675 | 51 | 87502250 | 86 | 898 211 |
| 16 | 94102374 | 52 | 88882235 | 87 | 876 211 |
| 17 | 85922636 | 53 | 91752190 | 88 | 865 207 |
| 18 | 79552650 | 54 | 81152273 | 89 | 928 231 |
| 19 | 80952632 | 55 | 82512256 | 90 | 931 236 |
| 20 | 82326181 | 56 | 83922229 | 91 | 915 233 |
| 22 | 85122579 | 57 | 85342215 | 92 | 896 222 |
| 23 | 81582552 | 58 | 86802191 | 93 | 859 206 |
| 24 | 82952530 | 59 | 88132176 | | |
| 25 | 84342515 | 60 | 89512159 | | |
| 26 | 85232491 | 61 | 84512150 | | |
| 27 | 88502450 | 62 | 87352116 | | Woodlands |
| 28 | 89862440 | 63 | 88702098 | | |
| 29 | 91292409 | 64 | 82372112 | 1 | 95822405 |
| 30 | 80762490 | 65 | 83852095 | 2 | 95552402 |
| 31 | 82152465 | 66 | 85152073 | 3 | 94602292 |
| 32 | 82532449 | 67 | 86562055 | 4 | 93642244 |
| 33 | 84952535 | 68 | 87922030 | 5 | 93022209 |
| 34 | 86352416 | 69 | 89302015 | 6 | 89802182 |
| 35 | 87672395 | 70 | 84302015 | 7 | 89952230 |
| 36 | 87102375 | 71 | 85751991 | 8 | 89902169 |
| | | | | 9 | 89012122 |
| | | | | 10 | 88692132 |

Shap Rural and Shap

| Site Number | Grid Reference | Site Number | Grid Reference | Site Number | Grid Reference |
|---|---|---|---|---|---|
| 1 | 53771766 | 28 | 56791470 | 54 | 46901155 |
| 2 | 54781770 | 29 | 57831468 | 55 | 48801175 |
| 3 | 56651770 | 30 | 58821470 | 56 | 49801175 |
| 4 | 52751670 | 31 | 58301416 | 57 | 50781170 |
| 5 | 53801668 | 32 | 48801374 | 58 | 51651183 |
| 6 | 54741670 | 33 | 49791378 | 59 | 52761173 |
| 7 | 55201708 | 34 | 50761371 | 60 | 53761173 |
| 8 | 55431672 | 35 | 51821375 | 61 | 54761170 |
| 9 | 55801669 | 36 | 52781375 | 62 | 55761169 |
| 10 | 56781669 | 37 | 53741370 | 63 | 57751165 |
| 12 | 50851560 | 38 | 54791370 | 64 | 58261166 |
| 13 | 51801570 | 39 | 55781368 | 65 | 58781165 |
| 14 | 52801570 | 40 | 56801370 | 66 | 46751119 |
| 15 | 53641576 | 41 | 57801370 | 67 | 57401116 |
| 16 | 54801570 | 42 | 48791276 | 68 | 58281115 |
| 17 | 55551565 | 43 | 49821278 | 69 | 45801078 |
| 18 | 56851572 | 44 | 50711271 | 70 | 47101073 |
| 19 | 57101550 | 45 | 51761271 | 71 | 47801075 |
| 20 | 57791567 | 46 | 52771271 | 72 | 48801075 |
| 21 | 49641498 | 47 | 53771269 | 73 | 49811075 |
| 22 | 50701473 | 48 | 54751268 | 74 | 50781078 |
| 23 | 51781470 | 49 | 55761268 | 75 | 51781078 |
| 24 | 52801468 | 50 | 56861267 | 76 | 52751075 |
| 25 | 53791470 | 51 | 57801270 | 77 | 53801072 |
| 26 | 54821470 | 52 | 57241219 | 78 | 54751071 |
| 27 | 55801470 | 53 | 44801176 | 79 | 55751069 |

Shap Rural and Shap (continued)

| Site Number | Grid Reference | Site Number | Grid Reference | Site Number | Grid Reference |
|---|---|---|---|---|---|
| 80 | 57771071 | 106 | 52770772 | 132 | 564 102 |
| 81 | 58781065 | 107 | 53790772 | 133 | 567 108 |
| 82 | 46561035 | 108 | 54780772 | 134 | 572 112 |
| 83 | 58251018 | 109 | 51800674 | 135 | 547 143 |
| 84 | 45800978 | 110 | 52780670 | 136 | 523 135 |
| 85 | 46900965 | 111 | 53800674 | 137 | 509 123 |
| 86 | 48800975 | 112 | 54800675 | 138 | 541 108 |
| 87 | 49800975 | 113 | 52800573 | 139 | 577 143 |
| 88 | 50830972 | 114 | 53800572 | 140 | 512 133 |
| 89 | 51770970 | 115 | 54800575 | | |
| 90 | 52800970 | 116 | 54830479 | | |
| 91 | 53780971 | 117 | 538 113 | | |
| 92 | 54750972 | 118 | 545 150 | | **Woodlands** |
| 93 | 55850971 | 119 | 537 151 | | |
| 94 | 56780974 | 120 | 533 150 | 1 | 48261361 |
| 95 | 48800875 | 121 | 535 145 | 2 | 48501403 |
| 96 | 49810874 | 122 | 486 135 | 3 | 49801525 |
| 97 | 50780873 | 123 | 549 046 | 4 | 50951317 |
| 98 | 51790872 | 124 | 552 080 | 5 | 51821359 |
| 99 | 52800871 | 125 | 554 074 | 6 | 52021405 |
| 100 | 53780870 | 126 | 548 111 | 7 | 50281415 |
| 101 | 54770871 | 127 | 532 103 | 8 | 50821445 |
| 102 | 55800870 | 128 | 505 121 | 9 | 50351526 |
| 103 | 49800774 | 129 | 513 132 | 10 | 51621573 |
| 104 | 50800769 | 130 | 523 140 | 11 | 54481085 |
| 105 | 51770772 | 131 | 539 157 | 12 | 53381060 |

Bransdale

| Site Number | Grid Reference | Site Number | Grid Reference | Site Number | Grid Reference |
|---|---|---|---|---|---|
| 2 | 60690100 | 79 | 64719602 | 155 | 62409284 |
| 3 | 61690100 | 82 | 61259553 | 159 | 63259254 |
| 6 | 60700000 | 83 | 61496546 | 160 | 64239254 |
| 7 | 61700000 | 85 | 61999535 | 161 | 64759250 |
| 8 | 60249950 | 86 | 63159550 | 162 | 65339267 |
| 9 | 61209950 | 87 | 63259552 | 165 | 65369247 |
| 10 | 61709950 | 89 | 64249552 | 166 | 65359245 |
| 11 | 62709950 | 94 | 63159520 | 167 | 65749254 |
| 15 | 62039915 | 95 | 61909508 | 168 | 64259202 |
| 16 | 60269905 | 97 | 62749502 | 169 | 641 954 |
| 17 | 60709903 | 99 | 63759505 | 170 | 641 957 |
| 19 | 61709905 | 101 | 64759505 | 171 | 638 958 |
| 20 | 62209904 | 106 | 61709455 | 172 | 628 973 |
| 21 | 62749905 | 107 | 62209460 | 173 | 624 988 |
| 24 | 61589885 | 108 | 63249455 | 174 | 624 992 |
| 28 | 60709852 | 109 | 63659460 | 175 | 612 989 |
| 29 | 61209852 | 111 | 63409430 | 176 | 639 927 |
| 31 | 62709855 | 112 | 63569440 | 177 | 632 943 |
| 32 | 63249855 | 115 | 64809430 | 178 | 614 957 |
| 35 | 60709805 | 117 | 65259450 | 179 | 622 974 |
| 36 | 61399799 | 118 | 61739407 | | |
| 39 | 62709804 | 119 | 62249405 | | |
| 44 | 63769782 | 120 | 62729405 | | |
| 46 | 62269752 | 122 | 63739405 | | Woodlands |
| 48 | 63239750 | 123 | 63959406 | | |
| 50 | 61469740 | 127 | 65209422 | 1 | 62289923 |
| 52 | 61369730 | 129 | 64359389 | 2 | 62269899 |
| 54 | 61769704 | 133 | 62229350 | 3 | 62199965 |
| 56 | 62729705 | 135 | 64269350 | 4 | 62199856 |
| 58 | 63749705 | 136 | 64759350 | 5 | 62199825 |
| 60 | 61409690 | 137 | 65099368 | 6 | 61489842 |
| 63 | 61129667 | 138 | 65259350 | 7 | 64919410 |
| 65 | 62229650 | 139 | 65609350 | 8 | 64709330 |
| 66 | 63239653 | 141 | 62669334 | 9 | 64989327 |
| 68 | 64239643 | 144 | 64339332 | 10 | 64159373 |
| 71 | 62799630 | 148 | 68759304 | 11 | 64209392 |
| 72 | 61289606 | 150 | 63709303 | 12 | 63689370 |
| 73 | 61729604 | 151 | 64709302 | | |
| 74 | 62289615 | 152 | 65489304 | | |
| 77 | 63739603 | 154 | 65049294 | | |

Heptonstall

| Site Number | Grid Reference | Site Number | Grid Reference | Site Number | Grid Reference |
|---|---|---|---|---|---|
| 1 | 91763327 | 32 | 94253026 | 64 | 98802880 |
| 2 | 92203327 | 33 | 94713026 | 65 | 96302830 |
| 3 | 92253278 | 34 | 95723024 | 66 | 96792840 |
| 4 | 92703275 | 35 | 96253034 | 67 | 97202835 |
| 5 | 92783225 | 36 | 96653034 | 68 | 98282835 |
| 6 | 93703230 | 37 | 93222980 | 69 | 98802831 |
| 7 | 91733182 | 38 | 93722980 | 70 | 98642750 |
| 8 | 92253175 | 39 | 94252982 | 71 | 98902750 |
| 9 | 93253175 | 40 | 94722980 | | |
| 10 | 94243175 | 41 | 95252980 | | |
| 11 | 94733175 | 42 | 96252982 | | |
| 12 | 91723125 | 43 | 96802980 | | Woodlands |
| 13 | 92723125 | 44 | 96742960 | | |
| 14 | 93743127 | 45 | 96602963 | 1 | 98982850 |
| 15 | 94743129 | 46 | 91672937 | 2 | 98932880 |
| 16 | 95003125 | 47 | 92702930 | 3 | 98502888 |
| 17 | 95563118 | 48 | 93222930 | 4 | 98132890 |
| 18 | 96043126 | 49 | 93602930 | 5 | 97762920 |
| 19 | 96393126 | 50 | 95242935 | 6 | 97252958 |
| 20 | 92223079 | 52 | 95782918 | 7 | 97202985 |
| 21 | 93153083 | 53 | 96262933 | 8 | 97163070 |
| 22 | 94243079 | 54 | 96782935 | 9 | 97103107 |
| 23 | 94723079 | 55 | 97252932 | 10 | 96603128 |
| 24 | 95203080 | 56 | 95722880 | 11 | 98502769 |
| 25 | 95733081 | 57 | 96302878 | 12 | 98232817 |
| 26 | 96233082 | 58 | 96762889 | 13 | 97412820 |
| 27 | 96703082 | 59 | 97282884 | 14 | 97122818 |
| 28 | 97133084 | 60 | 97462885 | | |
| 29 | 91723026 | 61 | 97422870 | | |
| 30 | 92683026 | 62 | 97752880 | | |
| 31 | 93723026 | 63 | 98252883 | | |

<u>Monyash and Hartington Middle Quarter</u>

| Site Number | Grid Reference | Site Number | Grid Reference | Site Number | Grid Reference |
|---|---|---|---|---|---|
| 1 | 16256714 | 32 | 13896495 | 63 | 09476618 |
| 2 | 16636622 | 33 | 14066452 | 64 | 09926535 |
| 3 | 16746556 | 34 | 14346408 | 67 | 08856647 |
| 4 | 17056531 | 35 | 14726318 | 68 | 09056610 |
| 5 | 17236482 | 36 | 12616660 | 69 | 07346856 |
| 6 | 15846690 | 37 | 13046564 | 70 | 07806761 |
| 7 | 16186604 | 38 | 13426483 | 71 | 07256788 |
| 8 | 16566513 | 39 | 13876384 | 72 | 07356748 |
| 9 | 14686806 | 40 | 14306293 | 74 | 06066905 |
| 10 | 15006770 | 41 | 12036679 | 75 | 06906723 |
| 11 | 15146720 | 42 | 12806500 | | |
| 12 | 15496630 | 43 | 13066449 | | |
| 13 | 15786564 | 44 | 13236401 | | |
| 14 | 15946536 | 45 | 13466366 | | **<u>Woodlands</u>** |
| 15 | 16186489 | 46 | 13616320 | | |
| 16 | 16376443 | 47 | 13876270 | 1 | 15836500 |
| 17 | 16606400 | 48 | 11756614 | 2 | 13076599 |
| 18 | 14456732 | 49 | 12206527 | 3 | 13796491 |
| 19 | 15646410 | 50 | 11496550 | 4 | 12256514 |
| 20 | 13826767 | 51 | 11686500 | 5 | 12456492 |
| 21 | 14006720 | 52 | 12106415 | 6 | 10256538 |
| 22 | 14206670 | 53 | 12296370 | 7 | 11246545 |
| 23 | 14566586 | 54 | 10426668 | 8 | 12396267 |
| 24 | 14706524 | 55 | 11246484 | 9 | 12656400 |
| 25 | 15026499 | 56 | 11626395 | 10 | 15716693 |
| 26 | 15256448 | 57 | 09546739 | | |
| 27 | 14356520 | 58 | 09806690 | | |
| 28 | 14726428 | 59 | 09956644 | | |
| 29 | 15196338 | 60 | 10196597 | | |
| 30 | 13156680 | 61 | 10596505 | | |
| 31 | 13756535 | 62 | 09116722 | | |

Llanfachreth

| Site Number | Grid Reference | Site Number | Grid Reference | Site Number | Grid Reference |
|---|---|---|---|---|---|
| 1 | 75232871 | 39 | 77232378 | 75 | 809 236 |
| 2 | 77252877 | 40 | 78222380 | 76 | 783 291 |
| 3 | 78252875 | 41 | 81252374 | 77 | 753 216 |
| 4 | 79292879 | 42 | 74782324 | 78 | 749 201 |
| 5 | 75472835 | 43 | 76752325 | 79 | 776 214 |
| 6 | 77752824 | 44 | 77722326 | 80 | 756 202 |
| 7 | 78752823 | 45 | 78702327 | 81 | 759 204 |
| 8 | 79732822 | 46 | 79742325 | 82 | 754 224 |
| 9 | 75062772 | 47 | 81762326 | 83 | 756 220 |
| 10 | 78242775 | 48 | 75232275 | 84 | 764 214 |
| 11 | 79252774 | 49 | 76152260 | 85 | 784 229 |
| 13 | 75242675 | 50 | 77242276 | 86 | 799 232 |
| 14 | 76282675 | 51 | 78232275 | 87 | 766 280 |
| 15 | 77252675 | 52 | 79252275 | 88 | 769 281 |
| 16 | 78262675 | 53 | 80252273 | 89 | 782 218 |
| 17 | 79402663 | 54 | 81252279 | 90 | 785 223 |
| 19 | 81252678 | 55 | 74762226 | | |
| 20 | 74272580 | 56 | 75752228 | | |
| 21 | 75232574 | 57 | 76742227 | | |
| 22 | 77252575 | 58 | 77742225 | | Woodlands |
| 23 | 78242574 | 59 | 78602225 | | |
| 24 | 79252574 | 60 | 74212172 | 1 | 81112326 |
| 25 | 80242574 | 61 | 76202166 | 2 | 81472328 |
| 26 | 81232575 | 62 | 77252179 | 3 | 78352067 |
| 27 | 76252474 | 63 | 78252175 | 4 | 75772323 |
| 28 | 77262473 | 64 | 79252175 | 5 | 75982283 |
| 29 | 78252472 | 65 | 73762125 | 6 | 74772156 |
| 30 | 79252470 | 66 | 74752125 | 7 | 76892089 |
| 31 | 80242473 | 67 | 75702125 | 8 | 76132028 |
| 32 | 81252472 | 68 | 73252076 | 9 | 77692098 |
| 33 | 82232474 | 69 | 75252078 | 10 | 77892061 |
| 34 | 75762427 | 70 | 76252085 | 11 | 78982079 |
| 35 | 80732425 | 71 | 77242088 | 12 | 78452112 |
| 36 | 82732426 | 72 | 75752625 | 13 | 80442382 |
| 37 | 75242373 | 73 | 74261973 | 14 | 80802346 |
| 38 | 76252378 | 74 | 75261973 | 15 | 74112100 |

## Ysbyty Ystwyth

| Site Number | Grid Reference | Site Number | Grid Reference | Site Number | Grid Reference |
|---|---|---|---|---|---|
| 1 | 85247553 | 37 | 78057245 | 73 | 72096975 |
| 2 | 83897522 | 38 | 78707226 | 74 | 71906905 |
| 3 | 84577501 | 39 | 80097185 | 75 | 72597089 |
| 4 | 85277483 | 40 | 80747170 | 76 | 745 717 |
| 5 | 85947465 | 41 | 81417149 | 77 | 749 713 |
| 6 | 82367490 | 42 | 82127134 | 78 | 756 704 |
| 7 | 83167463 | 43 | 75157254 | 79 | 774 702 |
| 8 | 83727455 | 44 | 75847235 | 80 | 722 695 |
| 9 | 84417436 | 45 | 78507160 | 81 | 730 700 |
| 10 | 84417436 | 46 | 79207140 | 82 | 740 699 |
| 11 | 85767395 | 47 | 79857120 | 83 | 747 703 |
| 12 | 86437379 | 48 | 81267081 | 84 | 731 707 |
| 13 | 80807460 | 49 | 74357210 | 85 | 737 704 |
| 14 | 81507440 | 50 | 74957190 | 86 | 741 712 |
| 15 | 82207425 | 51 | 75677170 | 87 | 743 715 |
| 16 | 82867400 | 52 | 79007071 | 88 | 745 718 |
| 17 | 83507384 | 53 | 79707050 | 89 | 756 718 |
| 18 | 84907349 | 54 | 80387030 | | |
| 19 | 85567327 | 55 | 81057015 | | |
| 20 | 80627390 | 56 | 73327160 | | **Woodlands** |
| 21 | 81987354 | 57 | 74067143 | | |
| 22 | 82687335 | 58 | 74747120 | 1 | 73287198 |
| 23 | 83357316 | 59 | 75457104 | 2 | 73107197 |
| 24 | 84707280 | 60 | 76107080 | 3 | 73607175 |
| 25 | 79037360 | 61 | 76797060 | 4 | 78307356 |
| 26 | 79757342 | 62 | 78207023 | 5 | 78017325 |
| 27 | 80447323 | 63 | 79506985 | 6 | 77777313 |
| 28 | 82437268 | 64 | 80866945 | 7 | 77707358 |
| 29 | 83207250 | 65 | 81526925 | 8 | 79287366 |
| 30 | 78237315 | 66 | 73047024 | 9 | 78827370 |
| 31 | 78887294 | 67 | 78636931 | 10 | 78507349 |
| 32 | 79537280 | 68 | 79286916 | | |
| 33 | 80277250 | 69 | 79986898 | | |
| 34 | 80927235 | 70 | 80686880 | | |
| 35 | 81637220 | 71 | 81366860 | | |
| 36 | 82307200 | 72 | 71446995 | | |

Glascwm

| Site Number | Grid Reference | Site Number | Grid Reference | Site Number | Grid Reference |
|---|---|---|---|---|---|
| 1 | 14196050 | 86 | 11665485 | 200 | 12805275 |
| 5 | 13395975 | 88 | 12665484 | 201 | 129 514 |
| 6 | 13605976 | 90 | 14655483 | 202 | 177 533 |
| 7 | 14135980 | 92 | 15635484 | 203 | 132 550 |
| 10 | 13405940 | 94 | 13665472 | 204 | 123 563 |
| 11 | 13705934 | 95 | 13705450 | 205 | 127 564 |
| 12 | 14205930 | 97 | 12305428 | 206 | 127 567 |
| 18 | 13765892 | 99 | 13195430 | 207 | 129 583 |
| 19 | 14625900 | 103 | 15155435 | 208 | 143 544 |
| 22 | 12675881 | 107 | 17155435 | 209 | 148 535 |
| 23 | 14705875 | 110 | 12605382 | 210 | 144 597 |
| 24 | 14455863 | 115 | 15655378 | 211 | 154 533 |
| 28 | 13005831 | 116 | 16145385 | 212 | 177 538 |
| 31 | 14205830 | 117 | 16635386 | 213 | 133 552 |
| 36 | 14055784 | 119 | 17645385 | 214 | 125 564 |
| 39 | 13255734 | 121 | 13155337 | | |
| 43 | 11895723 | 125 | 15155337 | | |
| 44 | 14555700 | 127 | 16145337 | | |
| 46 | 12605685 | 129 | 17125337 | | Woodlands |
| 50 | 14315688 | 132 | 12655289 | | |
| 53 | 11635634 | 134 | 13265284 | 1 | 12605592 |
| 54 | 12625634 | 136 | 14655286 | 2 | 12755593 |
| 56 | 13205650 | 138 | 15655285 | 3 | 12555573 |
| 58 | 14155632 | 139 | 16655284 | 4 | 13605733 |
| 62 | 15205602 | 141 | 13175239 | 5 | 12485702 |
| 63 | 11665585 | 143 | 14155236 | 6 | 12445751 |
| 65 | 12665585 | 145 | 15105235 | 7 | 12755762 |
| 69 | 14225579 | 148 | 12635190 | 8 | 14505266 |
| 71 | 15155575 | 150 | 13655185 | 9 | 14525175 |
| 72 | 15645584 | 152 | 14635187 | 10 | 14405235 |
| 75 | 14835561 | 154 | 15665185 | 11 | 12655370 |
| 78 | 12155535 | 155 | 16655185 | | |
| 80 | 13165536 | 150 | 14105138 | | |
| 82 | 14155533 | 161 | 15125138 | | |
| 83 | 15125534 | 167 | 12565772 | | |

Ystradgynlais Higher and Glyntawe

| Site Number | Grid Reference | Site Number | Grid Reference | Site Number | Grid Reference |
|---|---|---|---|---|---|
| 1 | 81772100 | 32 | 85301450 | 68 | 84801100 |
| 2 | 80782000 | 33 | 82801403 | 69 | 83301050 |
| 3 | 81782000 | 34 | 83771400 | 70 | 82801002 |
| 4 | 80701904 | 35 | 84781401 | 71 | 84181715 |
| 5 | 81791870 | 36 | 85351402 | 72 | 84151750 |
| 6 | 86721902 | 39 | 83291352 | 73 | 84601745 |
| 7 | 86751800 | 40 | 83791349 | 74 | 84731726 |
| 8 | 87751800 | 41 | 84281349 | | |
| 9 | 82781704 | 42 | 84751349 | | |
| 10 | 83781704 | 43 | 85311332 | | |
| 11 | 84751700 | 44 | 82791295 | | Woodlands |
| 12 | 85761700 | 45 | 83301298 | | |
| 13 | 86761700 | 47 | 84251298 | 1 | 82601302 |
| 14 | 87761700 | 48 | 84801298 | 2 | 82901318 |
| 15 | 84801649 | 49 | 85771300 | 3 | 83251344 |
| 16 | 85301649 | 52 | 82801253 | 4 | 84031223 |
| 17 | 82801600 | 53 | 83301249 | 5 | 84681200 |
| 18 | 84281598 | 54 | 83761254 | 6 | 84421208 |
| 19 | 85831583 | 55 | 84301250 | 7 | 83421266 |
| 20 | 86801600 | 56 | 85321252 | 8 | 85461637 |
| 21 | 87781600 | 57 | 86381243 | 9 | 85081647 |
| 22 | 84281548 | 58 | 82551216 | 10 | 84401578 |
| 23 | 82801500 | 59 | 83301195 | 11 | 84501570 |
| 24 | 83801500 | 60 | 83801195 | 12 | 84601590 |
| 25 | 84301495 | 61 | 85821202 | | |
| 26 | 84761500 | 62 | 86761205 | | |
| 27 | 86781500 | 63 | 83151135 | | |
| 28 | 86781495 | 64 | 83241098 | | |
| 29 | 87801497 | 65 | 85261152 | | |
| 30 | 84301448 | 66 | 82801098 | | |
| 31 | 84861450 | 67 | 83671065 | | |

**Lynton**

| Site Number | Grid Reference | Site Number | Grid Reference | Site Number | Grid Reference |
|---|---|---|---|---|---|
| 1 | 70704969 | 34 | 71004710 | 64 | 73344490 |
| 2 | 69734922 | 35 | 70644670 | 65 | 72864465 |
| 4 | 70934928 | 36 | 70094654 | 66 | 72404442 |
| 5 | 70344891 | 37 | 69624630 | 67 | 72984419 |
| 8 | 68724805 | 38 | 69244609 | 68 | 71524392 |
| 9 | 68324781 | 39 | 73444790 | 69 | 71204377 |
| 10 | 72824819 | 40 | 72654745 | 70 | 70654345 |
| 11 | 70814866 | 41 | 71654685 | 71 | 73554448 |
| 12 | 69844820 | 42 | 70824640 | 72 | 72654400 |
| 13 | 68994755 | 43 | 69894591 | 73 | 74224427 |
| 14 | 73644948 | 44 | 72807690 | 74 | 73794404 |
| 15 | 73384929 | 45 | 72344670 | | |
| 16 | 71854760 | 46 | 71964646 | | |
| 17 | 71824866 | 47 | 71464624 | | |
| 18 | 71404840 | 48 | 71014598 | | **Woodlands** |
| 19 | 70994815 | 49 | 70244544 | | |
| 20 | 70114773 | 50 | 73054647 | 1 | 69514506 |
| 21 | 69684743 | 51 | 72084600 | 2 | 74364882 |
| 22 | 69224725 | 52 | 71324548 | 3 | 73234903 |
| 23 | 68884680 | 53 | 70404500 | 4 | 74014912 |
| 24 | 73824920 | 54 | 72834580 | 5 | 69504883 |
| 25 | 72904869 | 55 | 72404554 | 6 | 69434945 |
| 26 | 72064822 | 56 | 71994534 | 7 | 71364710 |
| 27 | 71104766 | 57 | 71084488 | 8 | 70384626 |
| 28 | 70304725 | 58 | 70614460 | 9 | 73204730 |
| 29 | 69384675 | 59 | 70184430 | 10 | 74084802 |
| 30 | 71514509 | 60 | 73494562 | 11 | 73294713 |
| 31 | 73614849 | 61 | 72604510 | 12 | 71964843 |
| 32 | 73234828 | 62 | 71744464 | | |
| 33 | 72304778 | 63 | 73734513 | | |

**Widecombe in the Moor and Buckland in the Moor**

| Site Number | Grid Reference | Site Number | Grid Reference | Site Number | Grid Reference |
|---|---|---|---|---|---|
| 1 | 71428005 | 37 | 69957552 | 72 | 70437204 |
| 2 | 70937952 | 38 | 70107542 | 73 | 79927153 |
| 3 | 72007970 | 39 | 70987560 | 74 | 70827150 |
| 4 | 71437904 | 40 | 71947549 | 75 | 70457105 |
| 5 | 72407904 | 41 | 72937550 | 76 | 70927049 |
| 6 | 67007855 | 42 | 67547500 | 77 | 673 773 |
| 7 | 67927855 | 43 | 68437502 | 78 | 673 776 |
| 8 | 68927846 | 44 | 69467504 | 79 | 687 758 |
| 9 | 69927852 | 45 | 72337503 | 80 | 705 778 |
| 10 | 70927852 | 46 | 73457505 | 81 | 718 800 |
| 11 | 71957852 | 47 | 67987450 | 82 | 705 764 |
| 12 | 72957852 | 48 | 68987450 | 83 | 738 758 |
| 13 | 67487802 | 49 | 70897453 | 84 | 724 739 |
| 14 | 71427804 | 50 | 71987460 | 85 | 728 772 |
| 15 | 72507809 | 51 | 72927450 | | |
| 16 | 73447805 | 52 | 67507403 | | |
| 17 | 67967750 | 53 | 68467402 | | |
| 18 | 68987750 | 54 | 69557400 | | **Woodlands** |
| 20 | 70917750 | 55 | 71457400 | | |
| 21 | 71927758 | 56 | 72457405 | 1 | 71707790 |
| 22 | 72987750 | 57 | 73437405 | 2 | 72227910 |
| 23 | 67497698 | 58 | 67987350 | 3 | 72107918 |
| 24 | 72447702 | 59 | 68957350 | 4 | 72007938 |
| 25 | 73437703 | 60 | 69957350 | 5 | 72547845 |
| 26 | 67957651 | 61 | 72207337 | 6 | 70567349 |
| 27 | 69077640 | 62 | 67487303 | 7 | 71057368 |
| 28 | 69957650 | 63 | 68467302 | 8 | 70807364 |
| 29 | 70957650 | 64 | 70467300 | 9 | 71237420 |
| 30 | 71967650 | 65 | 71397310 | 10 | 71527377 |
| 31 | 72901650 | 66 | 73427305 | 11 | 71607356 |
| 32 | 73917652 | 67 | 67907260 | 12 | 72037217 |
| 33 | 68427603 | 68 | 68967253 | 13 | 69897148 |
| 34 | 72357596 | 69 | 69947250 | | |
| 35 | 73427603 | 70 | 70927250 | | |
| 36 | 67957550 | 71 | 68397203 | | |

APPENDIX 2

PREDICTED COURSES OF VEGETATION CHANGE AT MAIN SITES

In Part I of this report (5.74-5.77 and Figure 5-4) generalised trends of gradual vegetation change are considered which could follow from agricultural intensification or decline. In predicting possible change at the recorded main sites in each study area these trends have been applied in a standard way to all sites, ignoring their individual land and management considerations, since no adequate information is available to permit these to be taken into account.

The table shows the changes between vegetation classes which have been applied in these area discussions and in the generalised predictions of possible change in Part I.

| Present Vegetation Class | Predicted Vegetation Class | |
|---|---|---|
| | Following Agricultural Intensification | Following Agricultural Decline |
| **Improved Pastures** | | |
| 1 *Lolium/Holcus/Pteridium* grassland | 2 | 7 |
| 2. *Lolium* grassland | 2 | 2 |
| 3 *Lolium/Trifolium* grassland | 4 | 7 |
| 4 Herb-rich *Lolium* grassland | 4 | 4 |
| **Rough Pastures** | | |
| 5 *Agrostis/Juncus* grassland | 3 | 16 |
| 6 *Festuca/Juncus* grassland | 1 | 16 |
| 7 *Agrostis/Holcus* grassland | 4 | 8 |
| 8 *Festuca/Agrostis* grassland | 2 | 14 |
| **Grassy Heaths** | | |
| 14 *Festuca/Vaccinium* heath | 8 | 10 * |
| 15 *Festuca/Nardus/Vaccinium* heath | 5 | 10 |
| 16 *Festuca/Nardus/Molinia* heath | 5 | 11 |
| **Shrubby Heaths** | | |
| 9 *Calluna/Molinia/Vaccinium* heath | 16 | 9 |
| 10 *Vaccinium/Calluna* heath | 14 | 10 |
| 11 *Nardus/Sphagnum/Calluna* heath | 16 | 11 |
| 12 *Eriophorum/Calluna* heath | 12 | 13 |
| 13 *Calluna* heath | 14 | 13 |

* On agricultural decline class 14 is considered as likely to move to class 13, and class 16 to class 9 in Llanfachreth, Ysbyty Ystwyth, Lynton and Widecombe (See Figure 5-4 in Part I).

APPENDIX 3

## ASSOCIATIONS BETWEEN ULS VEGETATION MAPPING UNITS AND ITE VEGETATION CLASSES - COMBINED DATA FOR 11 AREAS

In the Upland Landscapes Study (ULS) recent changes in 'semi-natural' vegetation have been assessed as gains or losses in the extent of mapping units recorded by G. Sinclair during the 2nd Land Utilisation Survey (around 1967) and again during ULS (around 1978). It is desirable to consider what relationships exist between the mapping units recorded on the ULS maps and the ITE vegetation classification on which this Report is based, drawn from data collected at sites. Each ITE site can be treated as a sampling point which falls within a particular ULS mapping unit. From overlays of the ITE site locations on reductions of the ULS maps, correlation tables have been included in the area accounts showing the present balance of ITE classes at sites in each ULS mapping unit. By applying the standard predictions of vegetation change to each site the balance of classes in each present ULS unit that could follow agricultural intensification or decline are also given for study areas individually. In this Appendix, the overall correlations are given and discussed for 11 study areas combined. The 12th area, Monyash, has no ULS map because of its very small present extent of 'semi-natural' vegetation. We are grateful to Mr. G. Sinclair who made the comparisons possible by providing copies of the ULS maps for which reductions were made.

The units on the ULS maps were mapped by field identification of the cover, that is visual prominence, of plant species or combinations of species which characterise specific plant communities. Boundaries between these communities were drawn in the field and it has been noted by the surveyor that 'considerable generalisations are necessary to map constantly recurring patterns'. These generalisations inevitably become greater when a limited number of classes and/or reduced scale of maps are required. The mapping units are given in the keys to the reproduced maps (eg Figures 1-10 or 12-10), except that 'farmland' (white on the maps) is not listed. The unit names given are reasonably self-explanatory but descriptions are given in ULS, 1980 (4. Appendix).

ITE vegetation classes have been determined by computer analysis of species lists recorded from 5000 $m^2$ quadrats. The classification is based entirely on species presence, rather than cover, so, as discussed in Part I, 3.2, it differs fundamentally in its methodology from the field-assessed map units of ULS. The ITE classes apply to detailed records of vegetation at a series of sites within each study area, and do not aim to provide information about the vegetation between these sites. The ULS maps aim to convey information about the vegetation of the whole of a study area while accepting that the compression of information needed inevitably means that some mapping units in some areas are more homogeneous than others.

Tables 1a and b correlate the number of sites in each ITE vegetation class (Table 1a) or group (Table 1b) with the ULS map unit in which they are plotted as falling from map overlays. To simplify consideration of associations, subsequent Tables consider ITE vegetation groups only. Tables 2a and b relate the 2 vegetation groupings in 2 ways:- as the percentage of the sites in each ITE vegetation group that fall in each ULS mapping unit (Table 2a), and as the percentage of all sites located in each ULS mapping unit that are in each ITE vegetation group (Table 2b).

*From* Table 2a, improved pastures clearly fall almost entirely within the mapped 'farmland'; rough pastures have almost half their sites in 'farmland' with a further third in the 'smooth grassland' and 'bracken' mapping units; grassy heaths are quite evenly spread across 6 of the 9 mapping units; and rather more than half the shrubby heath sites fall in the 'sub-shrubs/heathers' and 'sedge and rush moorland' units, with most of their remaining sites in the 'coarse grassland' and 'bracken' units. Looked at from the different angle of Table 2b and simplifying the ITE classes to simply consider a pasture/heath ratio, we have the following general position:

| | |
|---|---|
| In areas mapped as farmland: | The probability that a site will be pasture is about 7 times greater than that it will be heath. |
| In areas mapped as smooth grassland: | Pasture or heath are about equally probable at a site. |
| In areas mapped as coarse grassland/ *Nardus*, bracken or sub-shrubs/ gorse: | Heaths are about 3 times as probable at a site as pastures. |
| In areas mapped as coarse grassland/ *Molinia*, or sub-shrubs/bilberry: | A site is about 6 times more likely to carry heath than pasture. |
| In areas mapped as sedge and rush moorland, or sub-shrubs/heathers | A site is about 15 times more likely to carry heath than pasture |

In accounting for the range of ITE classes occurring in some ULS mapping units there are a number of points to consider.

1 The rapid method of locating ITE sites in respect of ULS classes by overlaying map reductions in the office may be too inaccurate to be certain that the actual locations of ITE sites are always being correctly correlated to the position of map unit boundaries. This is likely to some extent, and particularly so for small mapped areas, but the quite close correlation between ITE classes and the ULS map units of sub-shrubs/heathers, sedge and rush moorland, and farmland, suggests that this is not a major issue.

2 ULS units other than the 3 mentioned above may in fact be very heterogenous in terms of their contained vegetation. This has been to a degree accepted by the surveyor as inevitable in summarising a complex situation - the method of mapping is said to have a resolution of approximately 5 ha, ie the size of the ITE quadrat - itself often a mosaic of smaller areas of contrasting plant communities. It is thus certain that this accounts for some of the complexity of associations seen in the Tables, but it is unlikely to be the complete explanation.

3 ULS units based on prominence of certain species, for example bracken or gorse, combine together assemblages in which the named species are certainly dominant but in which subordinate species can show considerable contrast. This aspect accounts for the wide range of ITE classes in, for example, the bracken unit. Bracken can be a prominent species on a wide range of generally freely drained soils as a component of contrasting improved pasture, rough pasture or heath communities.

4 ITE classes group together plant assemblages which from a visual point of view are conspicuously different, and split things which are visually similar. This, to a degree the converse of 3, is undoubtedly a factor. For example 'smooth grassland' which may contain a wide range of species, is united by its characteristic prominence of short, dominantly grass species, heavily grazed, in relatively dry situations. Grassy heaths and rough pastures of 3 ITE classes in which short-growing *Festuca* grasses are prominent occur widely at sites mapped in this unit (Table 1a).

Points 3 and 4 indicate the complementary character of the different approaches. The ULS map units may relate more directly to the visual impact of current vegetation in the study area landscapes, the ITE vegetation records and classes may give a firmer basis from which potential change can be assessed.

It would clearly be possible, and perhaps desirable, to pursue this topic further, for example initially by ensuring a more accurate plot of site location in respect of map unit boundaries, then by explaining further apparent contrasts between vegetation classes within the same ULS map unit in different areas. There could also be consideration of the correlation between ITE classes determined on a cover basis (not used in this Report) and the ULS units, and finally consideration of the pattern of distribution of particular vegetation within the 5000 $m^2$ quadrats used by ITE, and within the broader units used by ULS. Meanwhile however, there is sufficient information here to allow at least a provisional interpretation, where it is required, of the likely relationship between the ITE vegetation classes used in this report, and the mapping units on available ULS vegetation maps.

## REFERENCE

Upland Landscapes Study. 1980. *Upland Landscapes Study: Autumn 1977 - Spring 1980, Draft Final Report.* Unpublished report to the Countryside Commission.

APPENDIX 3: TABLE 1a CORRELATION OF ULS VEGETATION MAPPING UNITS WITH ITE VEGETATION CLASSES AT SITES - 1

| ULS Mapping Unit | ITE Vegetation Class | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Improved Pastures | | | | Rough Pastures | | | | Grassy Heaths | | | Shrubby Heaths | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 14 | 15 | 16 | 9 | 10 | 11 | 12 | 13 |
| Smooth Grassland | 1 | 1 | 1 | 1 | 3 | 8 | 3 | 24 | 17 | 15 | 8 | 1 | 2 | 5 | | 6 |
| Coarse Grassland/*Nardus* | | 1 | | | | 5 | | 13 | 15 | 5 | 16 | | 5 | 20 | 1 | 3 |
| Coarse Grassland/*Molinia* | | | 2 | 1 | 1 | 2 | 3 | 5 | 18 | 1 | 21 | | 7 | 13 | 18 | 2 |
| Bracken | 2 | 1 | | 1 | 3 | 3 | 8 | 11 | 27 | 3 | 19 | 2 | 15 | 3 | | 13 |
| Sub-shrubs/Heathers | 1 | 1 | | | | 1 | | | 16 | 12 | 9 | 5 | 25 | 25 | 50 | 6 |
| Sub-shrubs/Bilberry | | 1 | 1 | | | | | | 4 | 3 | | | 4 | 1 | 2 | |
| Sub-shrubs/Gorse | | | | | | 1 | 3 | | 1 | | | 2 | | | 1 | 9 |
| Sedge and Rush Moorland | | | | 1 | 3 | 1 | 1 | 2 | 3 | | 19 | 1 | 11 | 26 | 34 | |
| Farmland | 19 | 23 | 38 | 104 | 19 | 16 | 19 | 36 | 8 | 3 | 16 | 1 | 5 | 1 | | 6 |

As the number of sites in each ITE class falling in each ULS unit

APPENDIX 3: TABLE 1b   CORRELATION OF ULS VEGETATION MAPPING UNITS WITH ITE VEGETATION GROUPS AT SITES - 2

| ULS Mapping Unit | ITE Vegetation Class | | | |
|---|---|---|---|---|
| | Improved Pastures | Rough Pastures | Grassy Heaths | Shrubby Heaths |
| Smooth Grassland | 4 | 38 | 40 | 14 |
| Coarse Grassland/*Nardus* | 1 | 18 | 36 | 29 |
| Coarse Grassland/*Molinia* | 3 | 11 | 40 | 40 |
| Bracken | 4 | 25 | 49 | 33 |
| Sub-shrubs/Heathers | 2 | 1 | 37 | 111 |
| Sub-shrubs/Bilberry | 2 | | 7 | 7 |
| Sub-shrubs/Gorse | | 4 | 1 | 12 |
| Sedge and Rush Moorland | 1 | 7 | 22 | 72 |
| Farmland | 184 | 90 | 27 | 13 |

As the number of sites in each ITE group falling in each ULS unit

APPENDIX 3: TABLE 2a CORRELATION OF ULS VEGETATION MAPPING UNITS WITH ITE VEGETATION GROUPS AT SITES - 3

| ULS Mapping Unit | ITE Vegetation Class | | | |
|---|---|---|---|---|
| | Improved Pastures | Rough Pastures | Grassy Heaths | Shrubby Heaths |
| Smooth Grassland | 2 | 20 | 16 | 4 |
| Coarse Grassland/*Nardus* | | 9 | 14 | 9 |
| Coarse Grassland/*Molinia* | 2 | 6 | 16 | 12 |
| Bracken | 2 | 13 | 19 | 10 |
| Sub-shrubs/Heathers | 1 | | 14 | 34 |
| Sub-shrubs/Bilberry | 1 | | 3 | 2 |
| Sub-shrubs/Gorse | | 2 | | 3 |
| Sedge and Rush Moorland | | 4 | 8 | 22 |
| Farmland | 92 | 46 | 10 | 4 |
| All ULS units % | 100 | 100 | 100 | 100 |

As the % of all sites in each ITE vegetation group that fall in each ULS mapping unit

APPENDIX 3: TABLE 2b CORRELATION OF ULS VEGETATION MAPPING UNITS WITH ITE VEGETATION GROUPS AT SITES - 4

| ULS Mapping Unit | ITE Vegetation Groups | | | | All ITE Groups % |
|---|---|---|---|---|---|
| | Improved Pastures | Rough Pastures | Grassy Heaths | Shrubby Heaths | |
| Smooth Grassland | 4 | 40 | 42 | 14 | 100 |
| Coarse Grassland/*Nardus* | 1 | 21 | 43 | 35 | 100 |
| Coarse Grassland/*Molinia* | 3 | 11 | 43 | 43 | 100 |
| Bracken | 4 | 23 | 44 | 29 | 100 |
| Sub-shrubs/Heathers | 1 | 1 | 24 | 74 | 100 |
| Sub-shrubs/Bilberry | 12 | | 43 | 45 | 100 |
| Sub-shrubs/Gorse | | 24 | 6 | 70 | 100 |
| Sedge and Rush Moorland | 1 | 7 | 22 | 70 | 100 |
| Farmland | 58 | 29 | 9 | 4 | 100 |

As the % of sites in each ULS mapping unit that are classified in each ITE vegetation group