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INSTITUTE OF TERRESTRIAL ECOLOGY
(NATURAL ENVIRONMENT RESEARCH COUNCIL)

DOE/NERC CONTRACT DGR/483/23
ITE PROJECT 522
Draft Report to Department of Environment

ECOLOGY OF VEGETATION CHANGE IN UPLAND LANDSCAPES
Part II. Study Area Summaries

D F Ball (Project Leader)

Bangor Research Station
Penrhos Road
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Gwynedd

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N O T E

Although reports on each of the 12 study areas are planned, only 2 are included in the present draft to allow comment on the format and content before final preparation of the complete series.

O W HEAL

C O N T E N T S

ECOLOGY OF VEGETATION CHANGE IN UPLAND LANDSCAPES

PART II: STUDY AREA SUMMARIES

INTRODUCTION

Part I of this report - General Synthesis - identifies the classes of pasture and heath vegetation that are important in the farmland-moorland mosaic that typifies the uplands of England and Wales. It considers the environmental, historical and management factors which control the occurrence of these vegetation classes and how they can affect directions and rates of gradual change between classes. The data were obtained by a sampling programme in 12 study areas geographically spread through the uplands of England and Wales. These areas are:

1 Alwinton, Northumberland
2 Lunedale, Durham
3 Shap Rural and Shap, Cumbria
4 Bransdale, North Yorkshire
5 Heptonstall, West Yorkshire
6 Monyash and Hartington Middle Quarter, Derbyshire
7 Llanfachreth, Gwynedd
8 Ysbyty Ystwyth, Dyfed
9 Glascwm, Powys
10 Ystradgynlais Higher and Glyntawe, Powys
11 Lynton, Devon
12 Widecombe in the Moor and Buckland in the Moor, Devon

An exhaustive account of the physical and social character, landscape, and land use of each area has been provided in reports by the Upland Landscapes Study (ULS). In separate accounts for each area which make up Part II of this report, only a summary of environmental and recent historical information is provided to set the scene for a consideration of the vegetation data gathered.

It must be emphasised that in the Institute of Terrestrial Ecology (ITE) study field work in the study areas was necessarily limited to vegetation recording at a series of pre-selected sites. It is not possible therefore to provide in these accounts a comprehensive picture of the total vegetation of each area, nor to relate each site to quantitatively identified local management methods, past and present, or, for example, to a full assessment of soil character. The main purpose of the programme was to get an adequate sampling of the main vegetation range in the 12 areas as a group and to consider from the composite data the general relationships of vegetation to its controlling factors.

What is possible is i) to outline the physical environment of each area and its overall recent land use pattern; ii) to present the proportions in which the recognised vegetation classes occur among the sampled sites and show the location of these sites; and iii) from a representative cross-section through each study area suggest what potential for change is likely to be

realised for sites adjacent to this transect, in the light of the general principles set out in Part I and of conclusions drawn by the ULS about farming intentions in these areas.

The format of each study area account is to lead from sections on the Physical Environment and Recent Land Use History to a consideration of the sample site data in a section on Vegetation, and then to a concluding section covering Potential Vegetation Change.

In the section covering Physical Environment, computer maps are used to illustrate the types of distribution display which can be readily obtained for land characteristics recorded and stored, and land classes classified, as described in Part I, Chapter 4. Sources for information on rainfall, geology, soils and Agricultural Land Classification are respectively, national published maps by the Meteorological Office, The Institute of Geological Sciences, the Soil Survey of England and Wales, and the Ministry of Agriculture, Fisheries and Food, to which references are given in Part I.

STUDY AREA 2: LUNEDALE, DURHAM

Physical environment

The forest of Lunedale covers 133 km^2 of the Northern Pennines region in County Durham (Figures 2.1a and b). It is located west of Middleton in Teesdale between the headwaters of the Rivers Lune and Tees and is a relatively high altitude area, entirely above 144 m (800 ft) and with 74% above 427 m (1 400 ft). Virtually all the area is dominated by moderate and gentle slopes.

Climatically, in relation to the other study areas, Lunedale is cold and wet (Part I, 2.32). The annual average daily sunshine hours are very low, at 3 hours daily, and the number of days a year for which snow lies are high, at 60 days. Some local temperature and humidity data are given in a study of the possible influence of the water surface presented by the Selset reservoir on these factors in an upland situation (Gregory & Smith 1967). A steep east-west rainfall gradient gives a wide rainfall range within the study area (Figure 2.2), with most of it having fairly high and high rainfall (1 201-1 600 mm and 1 601-2 200 mm pa (48-64, 64-88 in pa)). In Smith (1956) the length of the growing season for grass in this region has been estimated at 189 days (25 April-31 October) at 315 m.

Geologically almost the whole area is of rocks of Carboniferous age. North of the Lune, a sequence of limestones, shales and sandstones occurs, including many thick sandstones, and one prominent limestone running approximately east-west across the area just north of the Lune Valley. To the south are hard sandstones with shales in the Millstone Grit series. The other locally important rock is the dolerite, an intrusive basic igneous rock, of the Whin Sill in the north-eastern part of the area around Cronkley Fell. Locally the more nutrient-rich dolerite and the outcrops of limestone or metamorphosed limestone adjacent to the dolerite support a diversity of plant species of ecological importance, but there is a general cover of solid rocks by peat. The formation of this has been influenced by high rainfall and low temperatures, moderate to gentle slopes, and the preponderance of nutrient-poor, slow-weathering, sandstones and shales. 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, poorly-drained mineral soils and peaty topped poorly-drained soils occur 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 with only a small area of grade 4 land in the south-east between Laithkirk and Wemmergill, the bulk of the parish being classified in the lowest grade (5).

Topographically, Figure 2.3 illustrates the area's limited road access, settlement pattern and extent of land in intensive agricultural use. All these are concentrated along the line of the B6276 Brough to Middleton road, north of the Selset reservoir in the east of the area. Mapped roads (though

the map does not show the significant recent extension of estate access roads to the grouse moors) occur in only 20% of the grid squares which comprise the area; buildings are limited to a small sector closely paralleling that of frequent field boundaries, though some mine buildings occur more remotely; and frequent field boundaries are only present over 13% of the area.

The distribution of land types is seen in Figure 2.4. Eighty per cent of the area falls into the hill land group, mainly in the hill and high plateau land types, with the remainder divided almost equally betweeen upland and upland margin, found principally along the glacial drift land of the Lune valley.

Recent 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 considered, marginal for farming. For example, in this region, between 1918 and 1939, oats were rarely grown at altitudes above 210 m, and the area is even marginal for hay crops above 335 m. More intensive agriculture in earlier centuries had only been possible very locally as a result of temporary combinations of economic, social and environment factors. As noted in Part I (2.33), Lunedale is the one study area out of the 12 which falls entirely in the climatically sub-marginal zone as assessed nationally by Parry (1978).

Farming and settlement followed the presence of minerals, iron having been smelted in the area in the 13th century, and lead-mining possibly first having been carried out in Roman times. The peak of lead-mining activity occurred in the mid-nineteenth century when 'nine-tenths of the population of Teesdale were connected with the mines' (Hunt 1970) and there was an associated increase in the number of farm holdings between 1803 and 1851, but the population never became concentrated in a village, or even a hamlet, in Lunedale. Farming concentrated on the breeding of sheep (Swaledales) and some cattle to sell to lowland farmers for fattening. Each holding had upland grazing on the commons but by the 19th century stocking rates on these common grazings had become so high that stock numbers had for the first time to be limited. In 1823, however, over 1 200 ha (3 000 acres) of Lunedale Fell, were converted from common to single ownership rights.

By the time of the first large-scale maps of the area prepared by the Ordnance Survey (OS) 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. Agricultural land use has been relatively unchanged in the area from then through the 20th century, with cattle and sheep numbers showing little change between 1910 and 1965 in the graphs of Figures 4-5 and 4-6 (Part I).

Figure 2.5 shows the extent of moorland fringe identified from successive editions of OS maps, available recent air photographs, and the 1st land utilization survey of County Durham (Temple 1941). Moorland core covers

most of the area (86%) with intensive farmland occupying only 9% and moorland fringe 5%. The fringe areas are highly concentrated in the low proportion of the more favourable land types, 50% of the fringe area being in the 11% of Lunedale classified in the 3 upland land types and 40% in the 9% classified as upland margin.

Other than the limited extent of agriculture, the principal land uses of Lunedale are for water supply and the management of the moorland as a sporting estate for grouse shooting. The Grassholme reservoir was built in 1915 and the Selset reservoir was constructed in the late 1950s and completed in 1960, both of these causing a loss of farms, farmland and population. Subsequent replacement of pastures by improving poorer vegetation has been concentrated in the vicinity of the reservoirs and their lost land. The particular impact of grouse moor management on vegetation is through the 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. Any trend to change from shrubby to grassy heaths through grazing is therefore checked while grouse moor management is efficiently maintained.

Upland landscapes study (ULS 1979) data show a fall in the amount of land under crops and managed grass from 11% of the area in 1854 to 6% in 1968, much of this fall being caused by reservoir construction, with an increase to 8% in 1978. The reservoirs themselves occupy 1.6% of the area, with woodland covering less than 1%.

Vegetation

Figure 2.6 shows the frequency of occurrence of vegetation classes at the 79 main sites recorded in Lunedale, and Figure 2.7 shows the location of these sites and their vegetation classes.

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 improved pastures (1%). Improved pastures occur near the reservoirs and the rough pastures also mainly follow the valley of the Lune. Management of these rough pastures by traditional methods as hay meadows adds considerably to the interest and character of this sector of the Lunedale landscapes. The grassy heaths are particularly found in the north-west. How far this situation near the valley of the Tees results from environmental influences such as 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 heaths, 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, out of the 12 study areas. The most frequent grassy heath class, *Festuca/Nardus/Vaccinium* heath (class 15, Part I, 3.16), 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, 3.14).

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 approximately 25 and 80 years old, and regeneration is limited, being noted in about half of the 10 woodland sites recorded. Eighty per cent of the woodlands were classified as upland acid woodlands, the remainder as lowland basic woodlands, these perhaps being influenced by local limestone outcrops.

Table 2.1 details the relationship of vegetation class at recorded main sites in Lunedale to the land type of the grid squares in which the site is situated, while Figure 2.8 sketches the association of vegetation and land groups. The most prominent feature is that the hill and high pleateau land which dominate the area are in turn doninated by *Eriophorum/Calluna* shrubby heath.

Potential vegetation change

ULS concludes that 90% of the rough grazing in Lunedale is agriculturally 'generally unimprovable' and that 'the agricultural keynote of Lunedale is stability'. It was considered that while grouse moor management by the Strathmore Estate, which owns about 90% of the parish, is maintained with the present heather-burning cycle and level of grazing it is unlikely that there will be substantial modification of the greater part of the present vegetation pattern, that of the moorland core, over the remainder of this century. Only a small amount of reclamation, concentrated on the 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 farmed sector 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.

As noted above, the most frequent vegetation classes at the recorded main sites in this parish are *Festuca/Agrostis* grassland (class 8, Part I, 3.14) of the rough pastures; *Festuca/Nardus/Vaccinium* heath (class 15, Part I, 3.16) in the grassy heaths; and *Eriophorum/Calluna* heath (class 12, Part I, 3.18) in the shrubby heaths. The general trends of change summarised in Figure 5-5 of Part I suggest that the *Festuca/Agrostis* grassland could, in a declining use situation in this northern environment, move through *Festuca/Vaccinium* heath to the *Festuca/Nardus/Vaccinium* heath, which typifies the limited extent of grassy heath in this area. This trend could run in the reverse direction with intensifying management of the areas of grassy heath. Considering change of the grassy heaths in a declining use situation, Figure 5.5 suggests that *Festuca/Nardus/Calluna* grassy heath would change first to *Vaccinium/Calluna* heath and, because surface wetness increases as peat accumulates, this heath could slowly move through to the *Eriophorum/Calluna* which now typifies the moorland of Lunedale. In general this shrubby heath is unlikely to change in any direction while some degree of natural or imposed burning and the present level of grazing sustains heather regrowth.

Figure 2.9 shows a north-south transect across Lunedale from the slopes which lead up from the Tees in the north to and across the valley of the Lune, with marked along it the location of 14 of the main site recording points

which occur within 1 km of the transect line. The hypothetical vegetation class changes which might occur as a result of a possible intensification or decline in the present level of agricultural use are shown, following the general principles of change discussed in Part I, 5.75 *et seq.*, and not from any consideration of the local land characteristics. In an intensified agriculture situation it is suggested that there would be an increase in rough pasture along the transect at the expense mainly of grassy heath, with only a small proportionate inroad into the shrubby heaths, but that 50% of the sites along the transect would change from one vegetation group to another. In a declining agriculture situation some 70% of the sites along the transect would be unchanged. In both cases shrubby heath would remain the most frequent vegetation element. In the discussion of a hypothetical scheme in which agriculture was maximised in accord with assumptions about the potential of different land types (Part I, 5.79 *et seq.*), although grassy heaths could become the most important vegetation group in Lunedale, shrubby heaths would still remain at 24% of the sites examined. In the discussion of a 'maximise forestry' set of assumptions based on a broad assessment of land type potential for forestry, Lunedale would have a balance of 12% forestry and 13% agriculture but still retain 75% moor.

Conclusion

The natural environment of Lunedale is such that among the studied areas it is one of those in which general vegetation changes are least likely to be extensive. This natural situation is reinforced by a land management policy which has its main interest in maintaining shrubby heaths of the present type since they are essential for the well-being of grouse. This policy is unlikely to lead to any major expansion of intensified agricultural use, or to extensive forestry planting, the natural potential for both of which is in any case limited through most of the area. Thus it is probable that a dominance of shrubby heaths will persist over the rest of this century with only at most small changes between the proportions of the vegetation groups.

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TABLE 2.1 CORRELATION OF VEGETATION CLASSES AND LAND TYPES IN LUNEDALE

The number of sites of each vegetation class in each land type is given

Vegetation group and class		Land group and type						
		Hill			Upland			
		Steep hill (1)*	Hill (3)*	High plateau (4)*	Steep plateau (5)*	Upland (7)*	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							

* Numbers as used in computer maps of land type distribution (Figure 2.4)

FIGURE 2.1a LOCATION OF LUNEDALE STUDY AREA

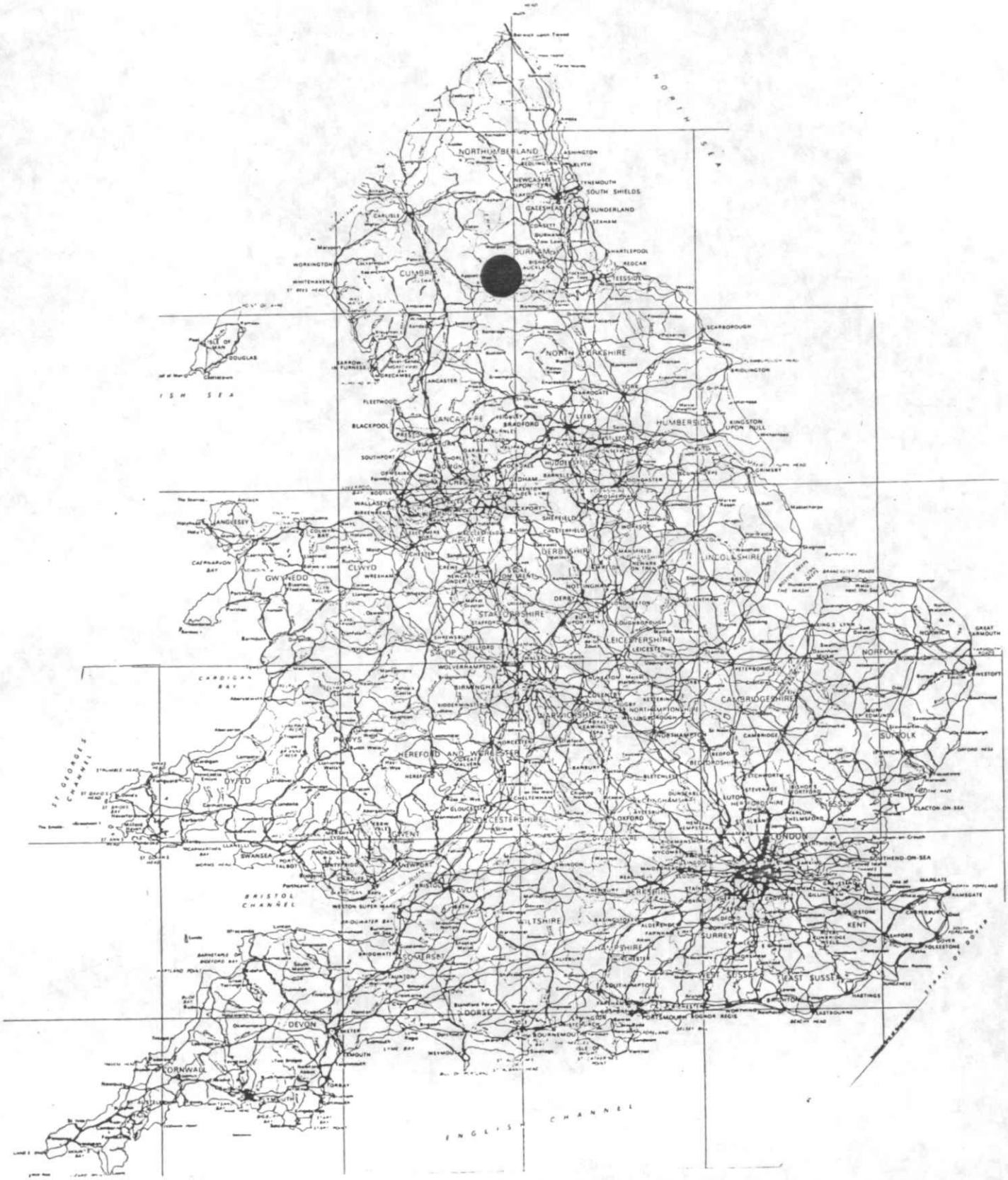
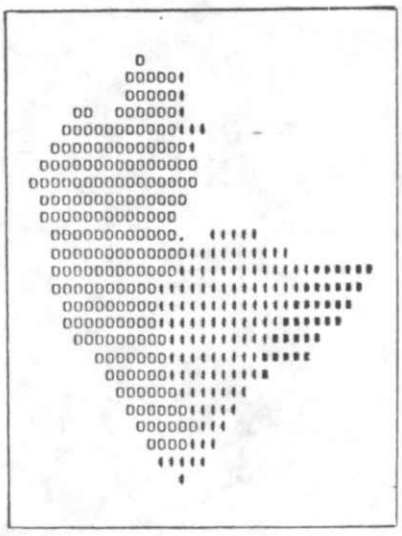


FIGURE 2.1b THE STUDY AREA OF LUNEDALE

FIGURE 2.2 RAINFALL SECTORS

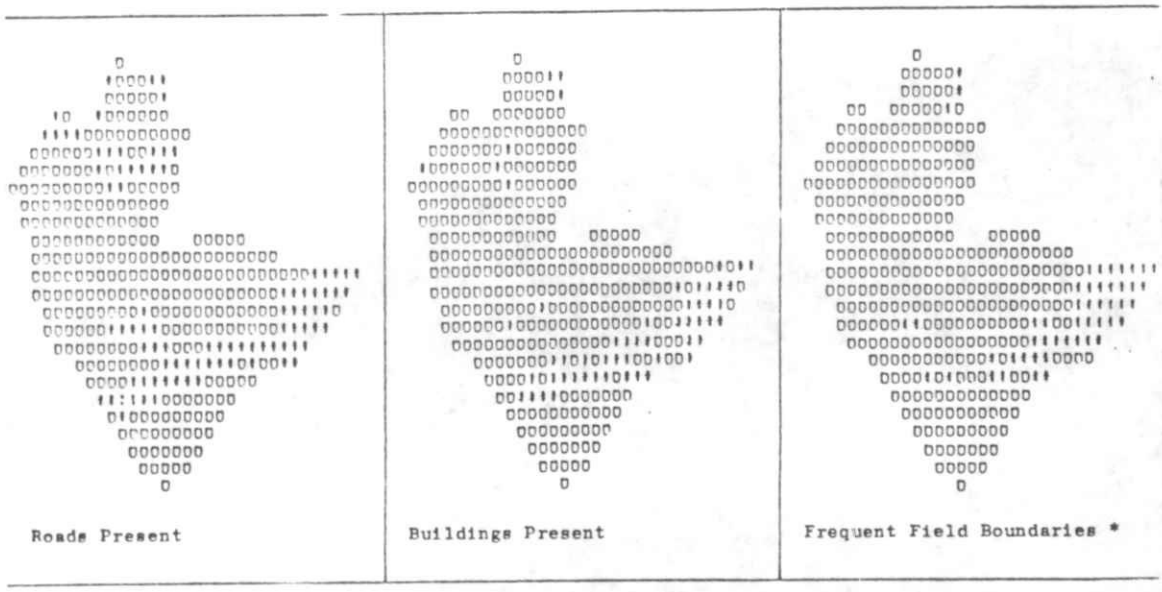


● Sector dominated by moderate rainfall

≠ Sector dominated by fairly high rainfall

O Sector dominated by high rainfall

FIGURE 2.3 TOPOGRAPHIC CHARACTERISTICS



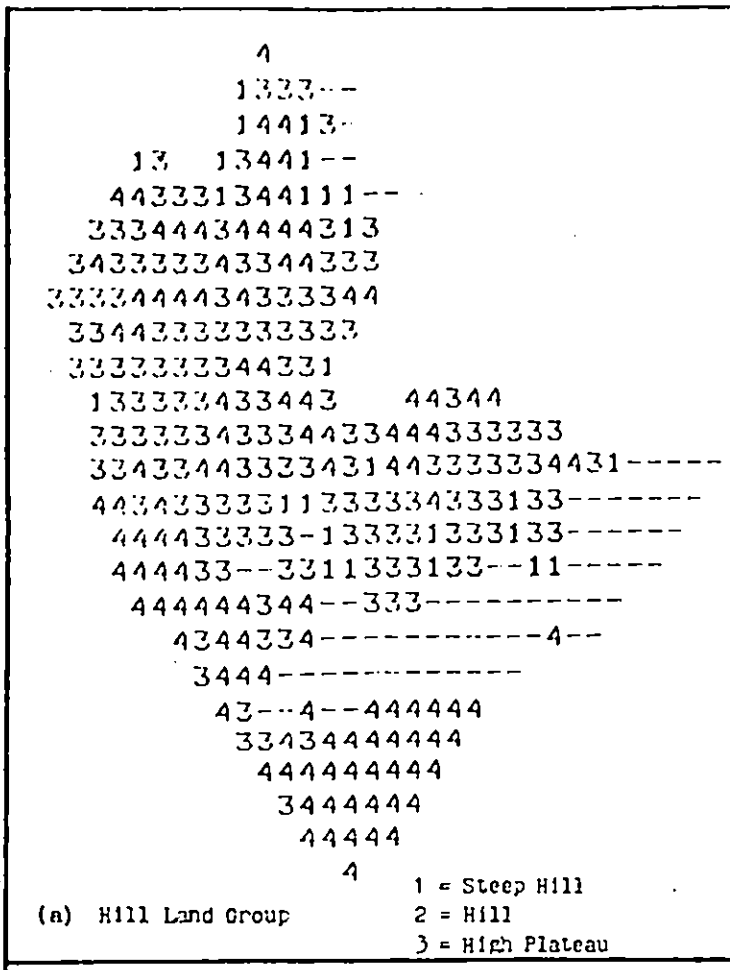
Roads Present

Buildings Present

Frequent Field Boundaries *

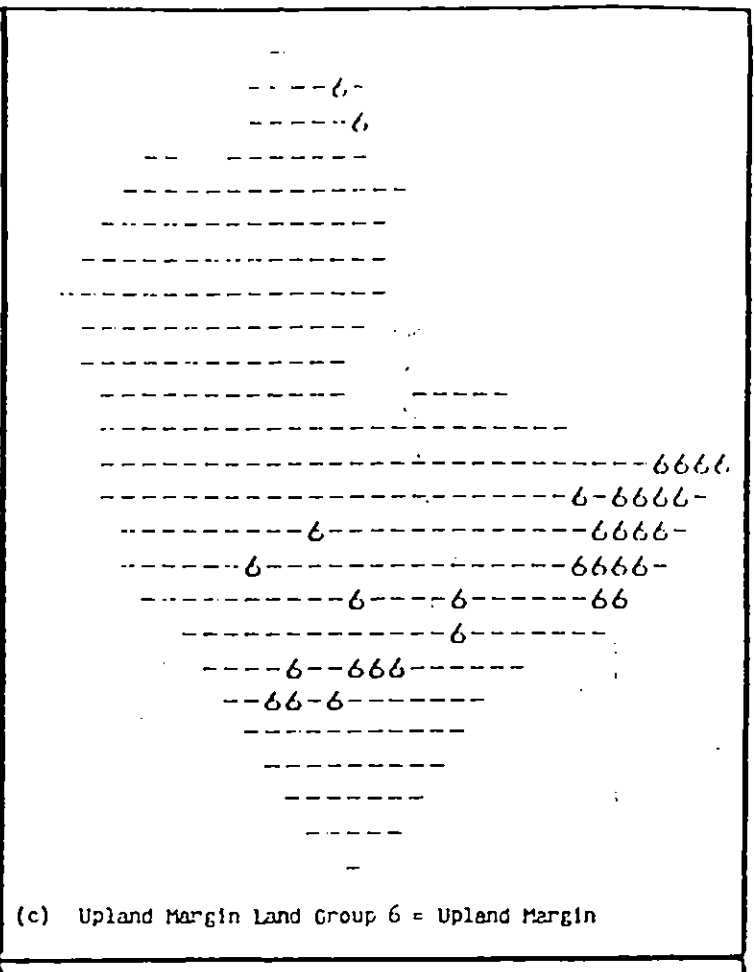
* Score >10, on scale 0-25

FIGURE 2.4 LAND TYPES

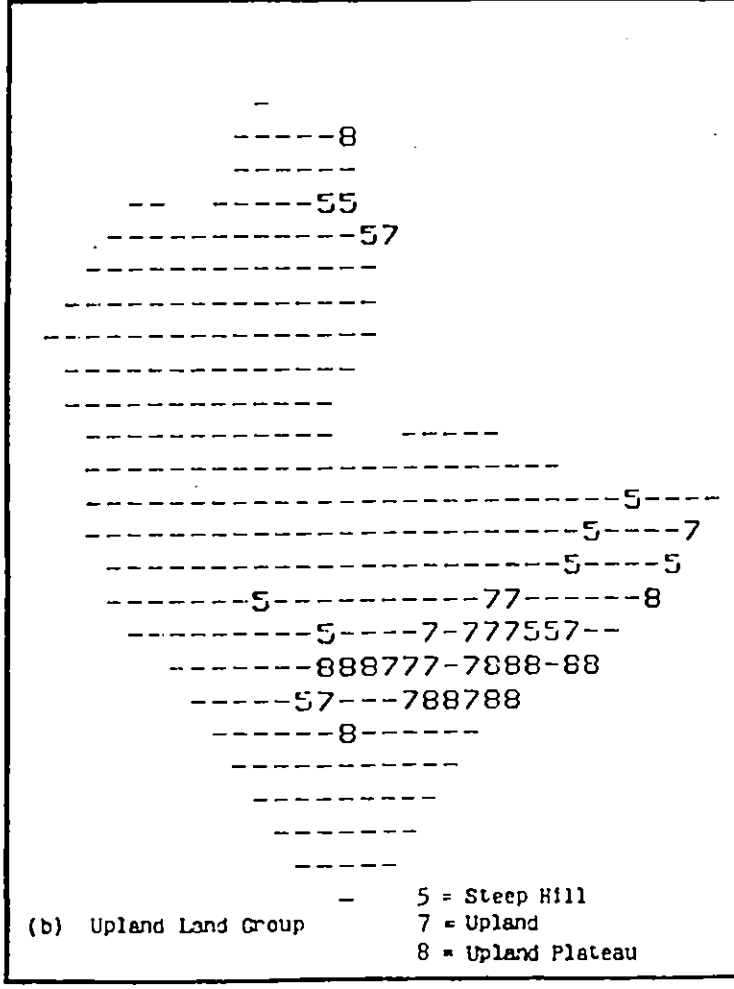


(a) Hill Land Group

1 = Steep Hill
2 = Hill
3 = High Plateau

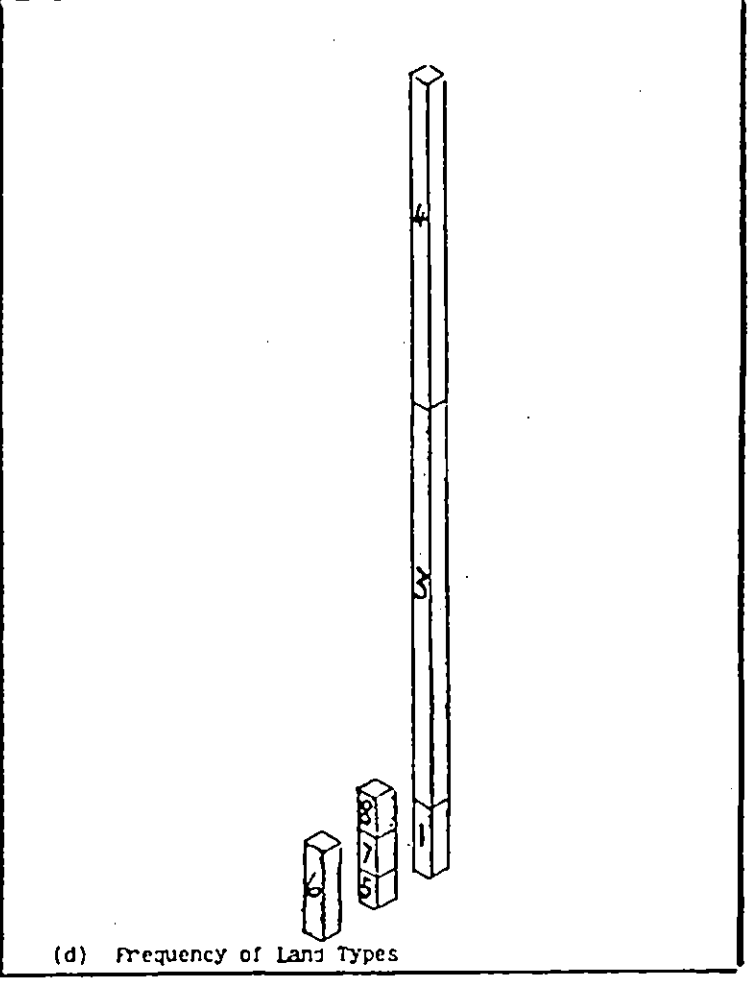


(c) Upland Margin Land Group 6 = Upland Margin



(b) Upland Land Group

5 = Steep Hill
7 = Upland
8 = Upland Plateau



(d) Frequency of Land Types

FIGURE 2.5 MOORLAND - FARMLAND CHANGE

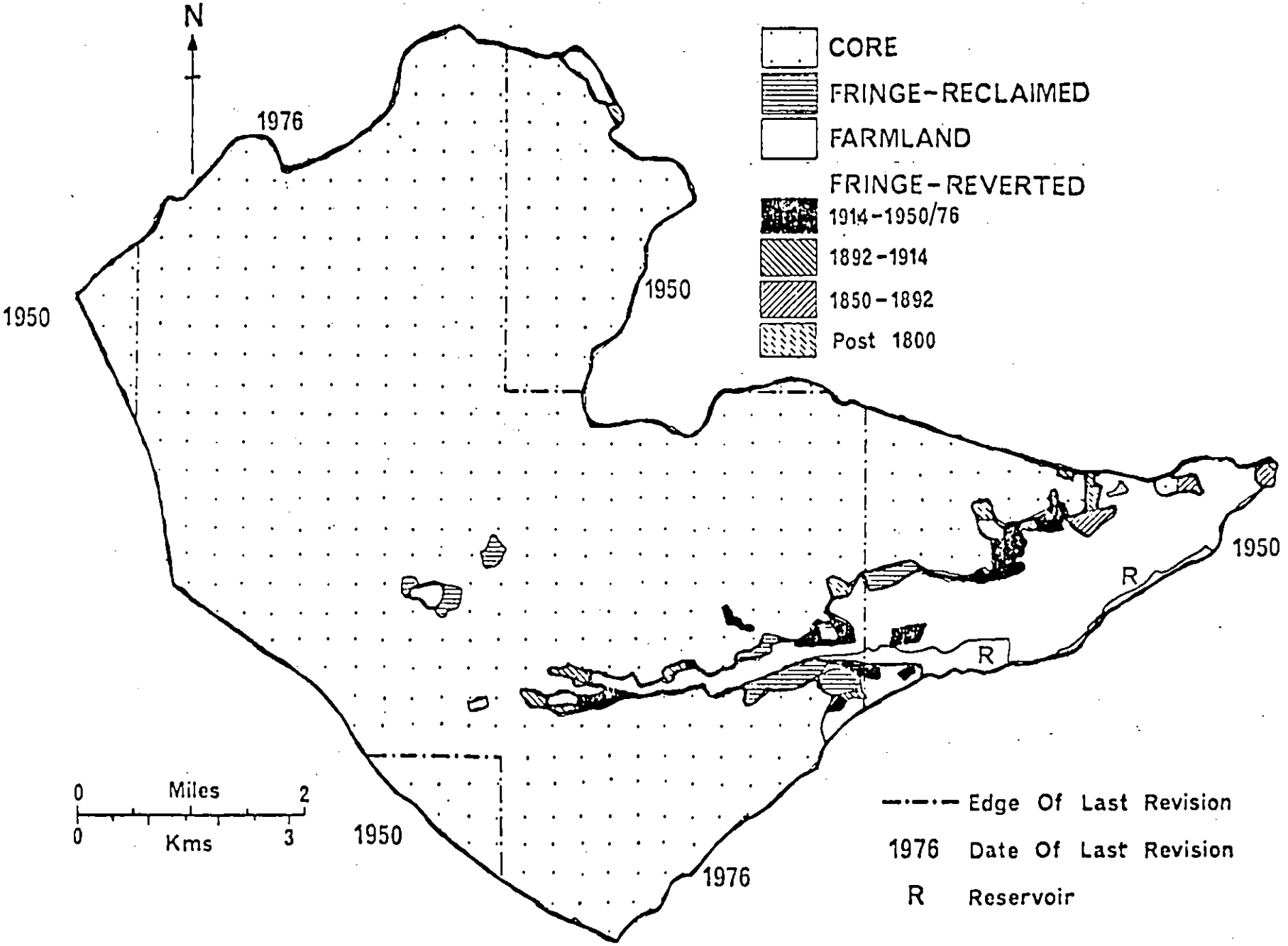
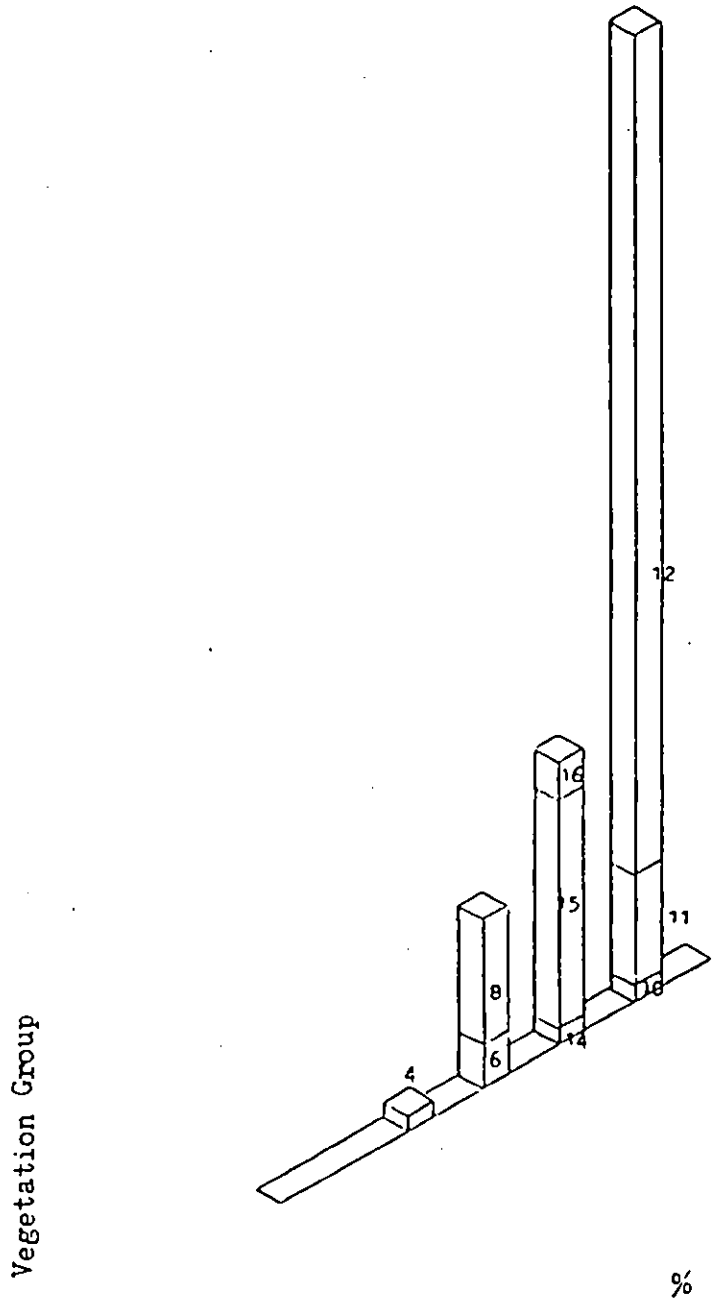
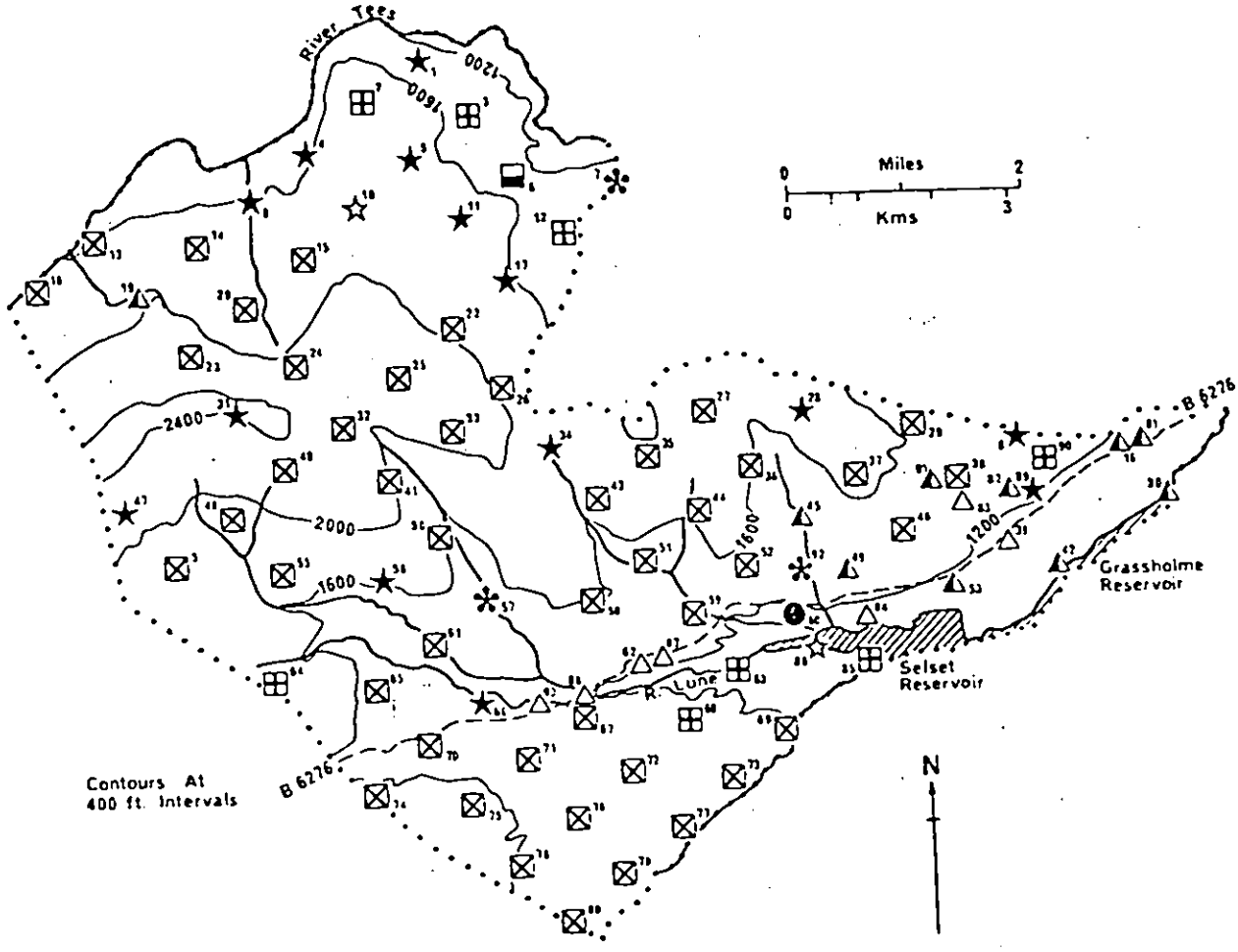


FIGURE 2.6 VEGETATION CLASS FREQUENCY AT RECORDED MAIN SITES



			%
1	Class 4	Herb rich Lolium grassland	1
2	Class 6	Festuca/Juncus	3
2	Class 8	Festuca/Agrostis	9
3	Class 14	Festuca/Vaccinium	1
3	Class 15	Festuca/Nardus/Vaccinium	16
3	Class 16	Festuca/Nardus/Molinia	3
4	Class 10	Vaccinium/Calluna	1
4	Class 11	Nardus/Sphagnum/Calluna	8
4	Class 12	Eriophorum/Calluna	58

FIGURE 2.7 LOCATION AND CLASSIFICATION OF VEGETATION MAIN SITES



KEY:

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/Hardus/Vaccinium	
	Class 16 Festuca/Nardus/Molinia	
Group 4 Shrubby Heaths	Class 9 Calluna/Holinia/Vaccinium	
	Class 10 Vaccinium Calluna	
	Class 11 Nardus/Sphagnum/Calluna	
	Class 12 Eriophorum/Calluna	
	Class 13 Calluna	

FIGURE 2.8 LAND TYPE - VEGETATION ASSOCIATIONS

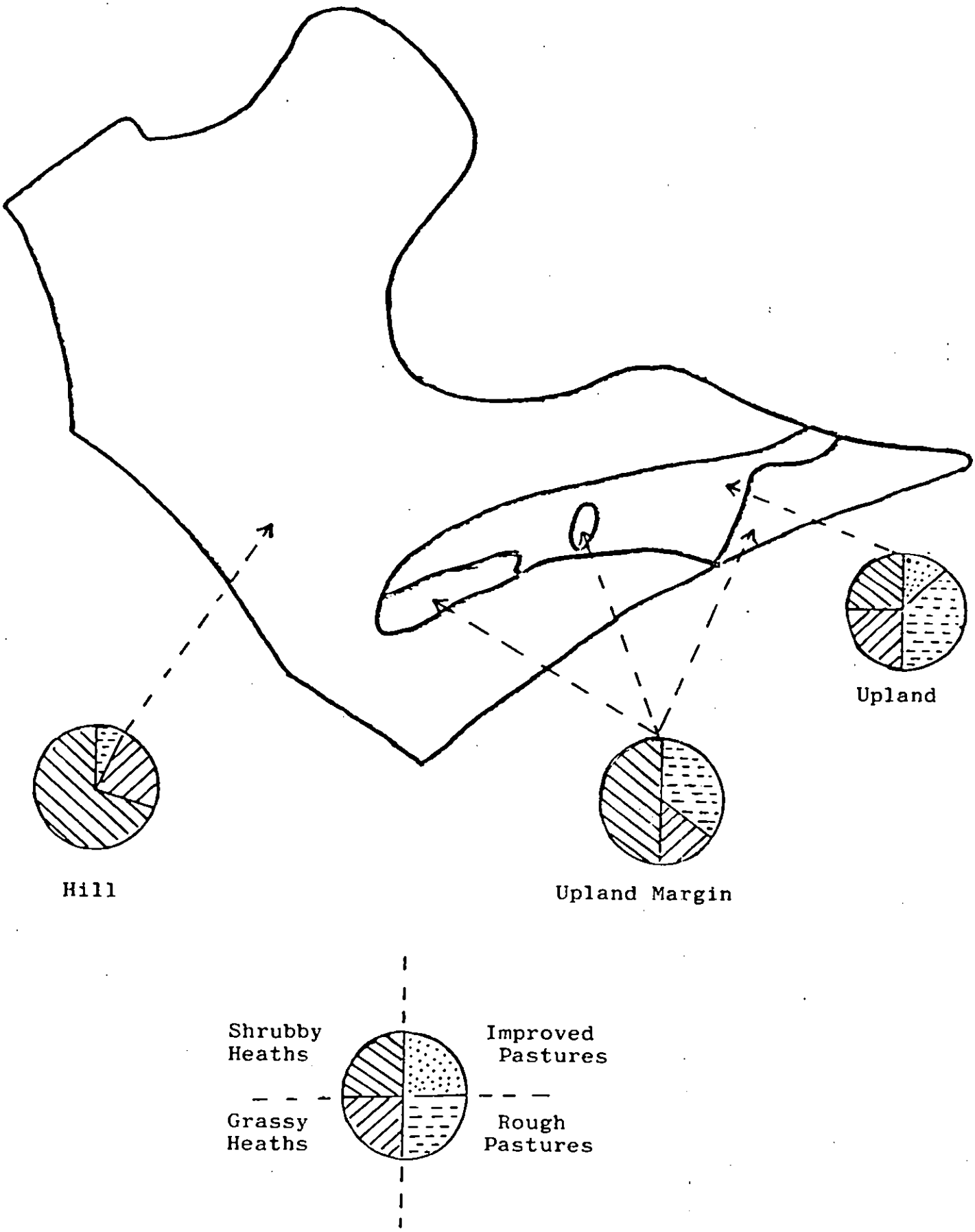
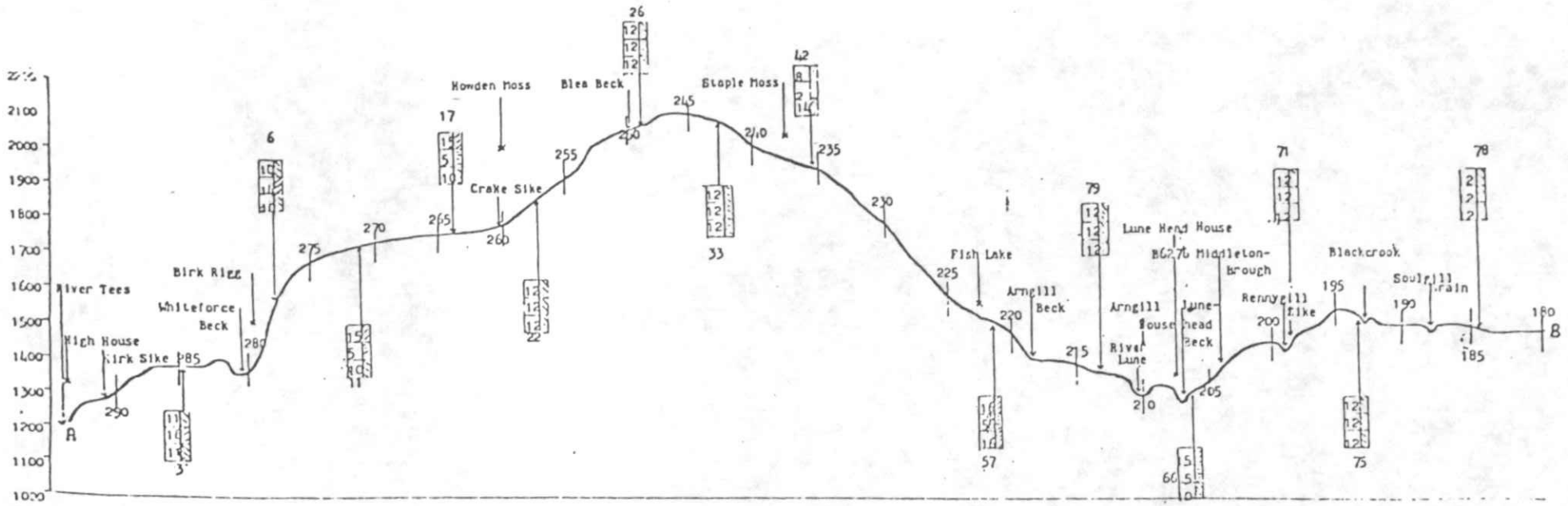
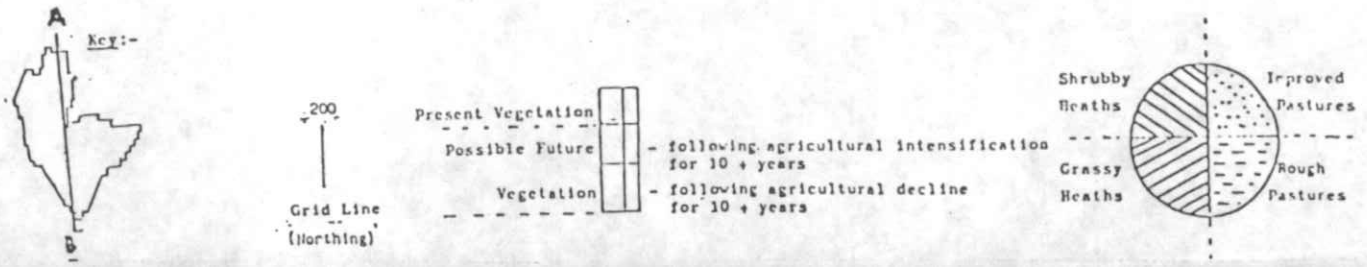


FIGURE 2.9 POSSIBLE VEGETATION CHANGE AT SITES ALONG A TRANSECT



PROPORTION OF VEGETATION GROUPS AT SITES ALONG TRANSECT



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

Physical environment

The study area of Widecombe in the Moor and Buckland in the Moor (Widecombe), 51 km^2 in extent, is situated in Devon and lies wholly within the Dartmoor National Park (Figures 12.1a and b).

Altitudes between 122 and 401 m (400-1 400 ft) dominate the area (Figure 12.2). A small sector of low ground including altitudes below 122 m is situated around Buckland and Hannaford Manor in the south, while there is a higher altitude sector including land above 401 m in the north, on Hamel Down. Most of the area, some 65%, is dominated by moderate slopes, but there is also a significant part (15%) dominated by steep and very steep slopes, especially along the valley of the Dart in the south-west, and also along the valley sides of the Webburn and East Webburn Rivers and the eastern slopes of Hamel Down.

Climatically Widecombe is relatively moderately wet but warm (Part I, 2.32). January and October monthly mean temperatures, from approximate data off national maps, are 3.1 and 10.1°C. With a height difference of around 280 m between the south and the north of the area, mean temperatures are likely to be the order of 1.7°C colder in the highest sectors than they are in the lowest. The length of growing season for grass has been calculated (Smith 1976) as ranging between about 293 days (8 March-26 December) at about 80 m and 257 days (25 March-7 December) at 240 m in the South Devon-Dartmoor areas.

Geologically the south-eastern corner, approximately south of a line Poundsgate-Buckland, overlies weakly metamorphosed Carboniferous shale and grit rocks (Culm Measures) while the greater part of the area overlies Dartmoor granite. The only 'drifts' mapped on the Institute of Geological Sciences (IGS) surveys 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 quite variable. The main extent of the granite carries naturally moderately acidic soils which are intergrades between the typically lowland Brown Earths and the acid leached moorland soils. The national soil map shows a mapping unit dominated by these Brown Podzolic Soils, with associated Brown Earths, over most of Wideceombe and Buckland. A unit of more acid moorland soils, dominated by Peaty Podzols ('Stagnopodzols') 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 north-western margin of the area, from Hamel Down westwards. In the south-east, coinciding with the Culm Measure outcrop, a sector is shown on the national soil map as dominated by Brown Earths, with subordinate pooly drained Gley Soils and, particularly on the steep wooded valley sides, Brown Podzolic Soils again.

In the classification of agricultural land by the Ministry of Agriculture, the best quality of land in the area is a small sector of grade 3 around Spitchwick, in the lower altitude, Brown Earth area in the south. Grade 4

land is widespread around Poundsgate, Buckland and Widecombe and is mapped along the valleys of the East and West Webburn Rivers. A complex relationship between grade 4 and grade 5 land occurs over the remainder of the area, with grade 5 occupying most of the higher land.

Topographic characteristics are shown in Figure 12.3. Road access is good, at least in terms of road frequency, throughout the area and this has its impact by providing easy access for visitors to virtually the whole area. Settlement has also spread widely, with concentrations in Widecombe, Ponsworthy, Buckland and Poundsgate. The land use pattern, as assessed by the frequency of field boundaries, also emphasises the widespread use of the area in intensive agriculture in the present or past, only the common lands (see Upland Landscapes Study (ULS) map W6) being generally free of a close network of field boundaries.

The distribution of land types is shown in Figure 12.4. The upland group comprises 64% of the area, mainly of the upland land type with moderate slopes, with some steep upland particularly along the valley sides such as that of the Dart, and upland plateau particularly in the north-west. Upland margin land is important in the south over the area previously noted as of lower altitude on Culm Measure shaly and sandstone rocks. Hill land is of limited extent, with the largest tract covering the common land of Hemel Down in the north.

Recent land use history

The study area was first surveyed on a large scale by the Ordnance Survey (OS) 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 extent in the mid-seventies of core, fringe and farmland in Widecombe and Buckland to be 48, 12 and 40% respectively. The distribution of moorland core particularly follows that of the common lands along the eastern, south-western and north central borders of the area (ULS map W6) 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 by 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 steep upland and upland margin. 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).

Change in the extent of land in intensive agricultural use under crops and improved grassland has been assessed as a slight increase from 34% of the area in 1884 to 36% in 1966, and a sharper increase to 42% in 1977 (ULS Table 2.11.1 (W)). Farmland, 'mostly in exclusive use' is estimated by ULS as occupying 53% of the area, commons 39% and private forestry 6%. For

changes in the extent of tillage and in stock numbers, Ministry of Agriculture statistics for the study area as a whole have been summarised for 5-year intervals between 1900 and 1965 (Part I, Figures 4-4 to 4-7). For tillage, the graph shows a slow fall over this period, interrupted by a temporary increase between 1940 and 1945 and a sharp fall between 1960 and 1965. For livestock, there are contrasting patterns. Sheep have slowly declined in numbers 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.

During the 1960s and 1970s much moorland has been reclaimed for agriculture. As shown in Figure 12.6, part of this land was former fringe, but significant areas have been reclaimed from land that has persisted as moorland since at least around 1800. This active reclamation for agriculture from moorland core rather than from existing fringe is clearly important in ecological and landscape terms, since moorland core differs in soil and, as is shown in discussion in Part I, Chapter 5, usually also differs in vegetation from formerly farmed land that has reverted to moor.

Vegetation

Figure 12.7 shows the frequency of vegetation classes which occur at the 75 main sites recorded in this area. The location and classification of each site are given in Figure 12.8. (Plates to be produced for illustration) Vegetation of the recorded sites in Widecombe has two particular features - a low proportion (5%) of grassy heaths, limited to *Festuca/Vaccinium heath*, class 14 (Part I, 3.16), occurring in scattered patches throughout the area; and a high proportion of *Calluna* heath (class 13) which has the highest percentage occurrence (31%) of any class among the recorded sites. This dry heather moor shows a strong south-western 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 have noted an increase of heather moor on the common land between 1966 and 1977 associated with a fall in grazing pressure on these commons. *Calluna/Molinia/Vacinnium* heath (class 9), which may be considered as a wetter phase of *Calluna* heath, is also present in the northern part of the area, particularly the north-western corner.

In Widecombe, the end groups of the main vegetation range, improved pastures (44% of sites) and shrubby heaths (31% of sites), 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 Webburn and East Webburn Rivers. The improved pastures are mainly herb-rich *Lolium* grassland, 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

respectively), which have some degree of soil drainage impedance. Bracken, *Pteridium aquilinum*, is a constituent of all 4 of the rough pasture classes and also can occur in the most frequent improved pasture class, so that bracken is therefore widespread and prominent in the vegetation of the valley sides. ULS noted a substantial expansion in the prominence of bracken cover between 1966 and 1977.

Of the woodlands, especially concentrated along the valleys of the Webburn and Dart in the south, vegetation was recorded at 13 sites. The 3 woodland groups present in the 12 study areas all occur in Widecombe. The most common type (40% of the sites recorded) is pedunculate oak/ash woodland. Oak dominates all types of woodland in the area. These woods are survivors of what ULS have identified as a major replanting of deciduous woods to conifers which has been in progress since the period 1946-1951.

Examples of roadside verge vegetation which were examined were of 2 types: the majority, along the valleys, are embanked hedges, often with ditches present, many of which have developed closed tree canopies; others on the open moorland are walled boundaries, sometimes topping embankments, again with ditches fairly frequent. The closed canopy hedges include woody species such as hazel, hawthorn, sloe, dog rose and willows, and their herbaceous vegetation reflects very much the surrounding vegetation in its constituent species.

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 shows schematically the broad relationship between vegetation and land groups. Hill land is dominated by *Calluna* heath but includes the few grassy heaths. The dominant upland land group, and the upland land type within this, has a complex of improved pastures, rough pastures, and again, *Calluna* heath. The marginal upland is dominated by improved pastures but also includes smaller extents of other vegetation groups.

Potential vegetation change

In an area like Widecombe and Buckland in which a dominant agriculture and a substantial tourist pressure interact in a National Park to give often competing pressures on land uses and vegetation, it is difficult to predict trends in vegetation over the next 20-30 years with any confidence. It could be assumed that policies of the National Park authority would aim to sustain something like the present *status quo* in vegetation and land use and that this might ensure stability. In the ULS report it is stated that 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 would lead to further grassland improvement schemes, particularly likely to involve upgrading present rough pastures. An assessment by ULS using the methods of the Agricultural Development and Advisory Service (ADAS) Hill Land Classification Scheme (ULS map W7, Table 6.2.1 (W)), given 55% (1 319 ha) as improvable. Stocking densities could be increased, particularly on moorland areas held by individual farmers on a freehold basis, and this would involve further change from shrubby heath to grassy heath and piecemeal reclamation of land

to intensive agriculture. ULS have drawn attention to the possibility of legislation leading to substantial changes in the management of common grazings which could eliminate much of the shrubby heaths of this area. Intensification of management could also involve the use of herbicides for the 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 do not intend to initiate much major changes in farming practice, and with the National Park in mind, as well as the trend to higher energy costs, it is possible that the scale of eventual change might be accommodated with less impact on the landscape.

Pressure from increased tourism is another factor. The effects of walking, riding and camp fires in favoured open land locations could initiate fundamental changes in the composition of heath vegetation similar to those caused by increased grazing pressures.

The general potential trends of change can be considered in relation to the principal vegetation classes present and to the outline given in Part I, Figure 5-5. 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 'best' end of the improved pastures succession, representing a recently reseeded grassland. The suggested trends of agricultural stability or expansion would 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 to go to scrub and woodland as a result of the substantial sources of tree seed available rather than change to rough pastures. 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. These may well represent an end-point of improvement under less favourable economic conditions, but in a climate of agricultural intentisfication could be cultivated, reseeded, fertilised and drained where necessary to become improved pastures available to sustained use. The grassy heaths and shrubby heaths of classes 14 and 13 are suggested in Part I, Figure 5-5 to be linked and to change between each other in response to changes in grazing and burning regimes. Under increased use a change of the *Festuca/Vaccinium* heath towards rough pastures is more likely to lead to a drier rough pasture community such as *Festuca/Agrostis* grassland (class 8) than to the *Agrostis/Juncus* grassland typical of the present most widespread rough pasture type.

Figure 12.10 shows a transect across Widecombe and Buckland, with, located along it, those vegetation recording sites that are situated within c. 1 km either side of the transect line. For each site, the present vegetation class at the site is shown, and also alternative vegetation classes which might result from more intensive or less intensive agricultural management.

These hypothetical changes are based on the general principles of trends of change discussed in Part I, 5.75 *et seq.* and not on specific data of actual site and management conditions at each location. For the 10 sites adjoining this transect it is predicted that with intensification of agricultural use, rough pasture and shrubby heaths would disappear, giving a pattern of improved pastures and grassy heaths only. With a decline in agricultural intensity, grassy heaths would appear in place of some rough pastures; and rough pastures at the expense of some improved pastures. Thirty per cent of the main sites are predicted as remaining unchanged after an intensification of agriculture, with 70% of them unchanged on a declining agriculture hypothesis. The immediate landscape effect of vegetation change will thus be much greater if agriculture expands in this area than if it declines.

This accords with the discussion in Part I of what could happen on an assumption of maximum agricultural expansion (Table 5-17) in which shrubby heaths are predicted as practically disappearing from Widecombe. In that discussion also, the maximise forestry option would lead to a balance of 39% forest, 55% agriculture and only 6% unplantable moor, a possibility giving an equally great, but contrasting change in vegetation and landscape in this area.

Conclusion

Widecombe and Buckland is an area of relatively favourable environment and widely spread settlement and use in which agricultural intensification is reasonably possible. It also is an area of intensive recreational pressure under the planning aegis of a National Park. How these conflicting interests of agricultural expansion and landscape conservation will balance out over the next 20 years is uncertain. To add to the uncertainty, the future of the common land which virtually sustains a strong heath vegetation component in the landscape is unknown. Unless active preservationist policies retain heath vegetation on these commons the present diversity between heaths on moorland ridges and grassland in wooded valleys will be blunted if it does not disappear.

References

SMITH, L.P. 1976. *The Agricultural Climate of England and Wales.* Tech. Bull., 35, Min. of Agric., Fisheries and Food. HMSO.

UPLAND LANDSCAPES STUDY 1979. *Upland Landscapes Study - Widecombe & Buckland in the Moor Parish Report* and *Parish Report - Maps.* Unpublished report to the Countryside Commission, June 1979.

TABLE 12.1 CORRELATION OF VEGETATION CLASSES AND LAND TYPES IN WIDECOMBE AND BUCKLAND

The number of sites of each vegetation class in each land type is given

Vegetation group and class		Land group and type: Hill			Upland		
		Steep hill (1)*	Hill (3)*	High plateau (4)*	Steep plateau (5)*	Upland (7)*	Upland plateau (8)*	Upland margin (6)*
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

* Numbers as used in computer maps of land type distribution (Figure 12.4)

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

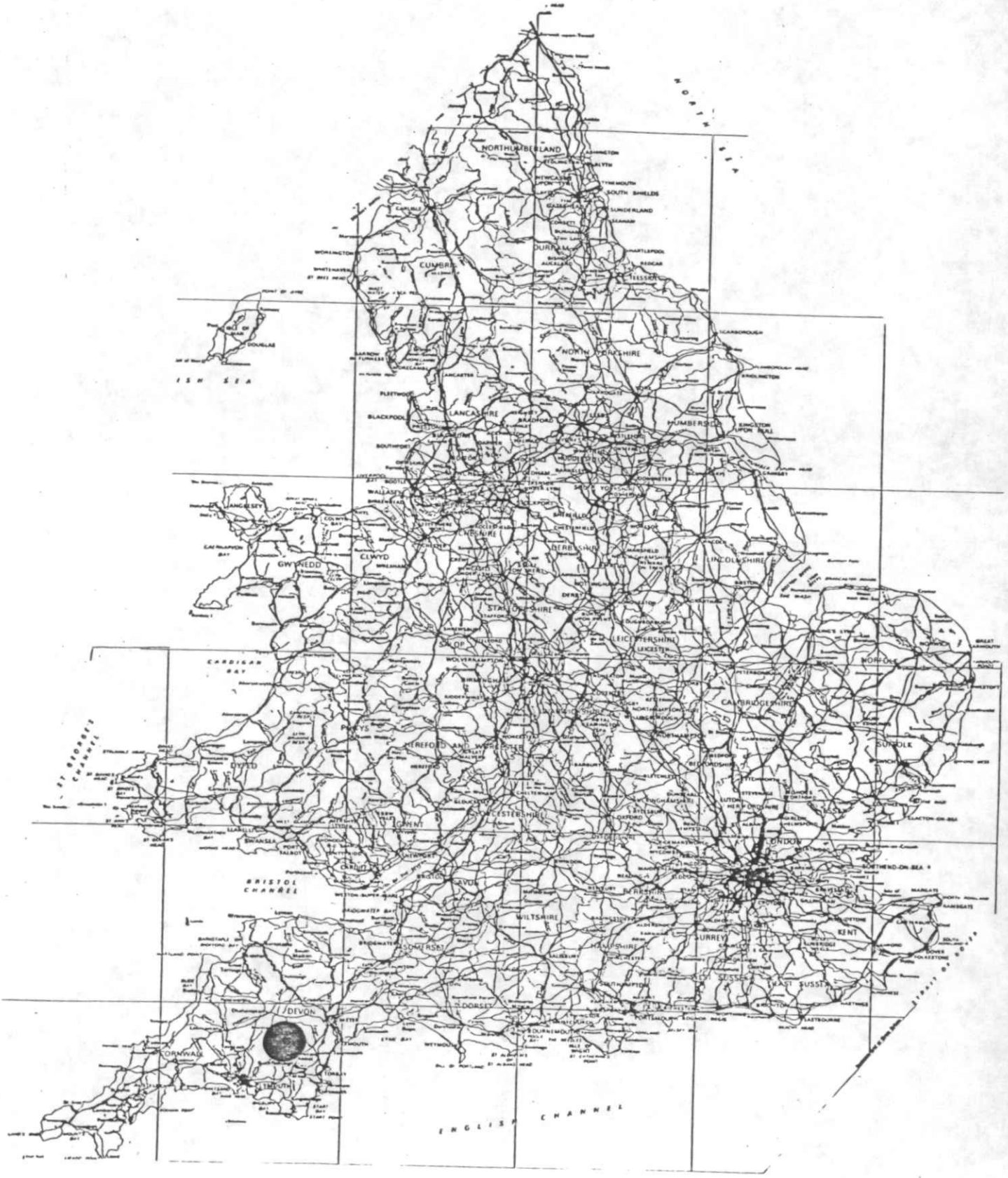
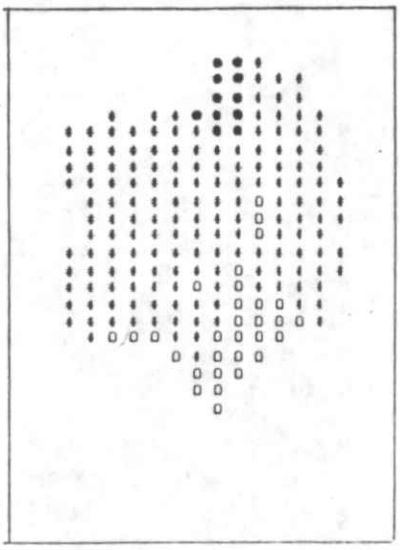


FIGURE 12.1b THE STUDY AREA OF WIDECOMBE AND BUCKLAND

FIGURE 12.2 ALTITUDE SECTORS

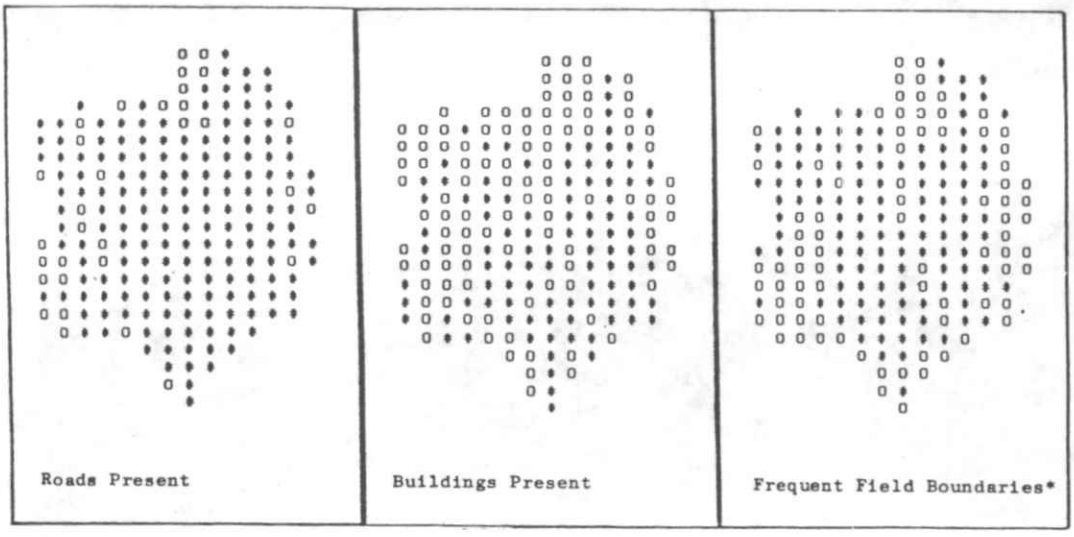


Sector dominated by land <244 m (800 ft)

Sector dominated by land between 244 and 427 m (800-1 400 ft)

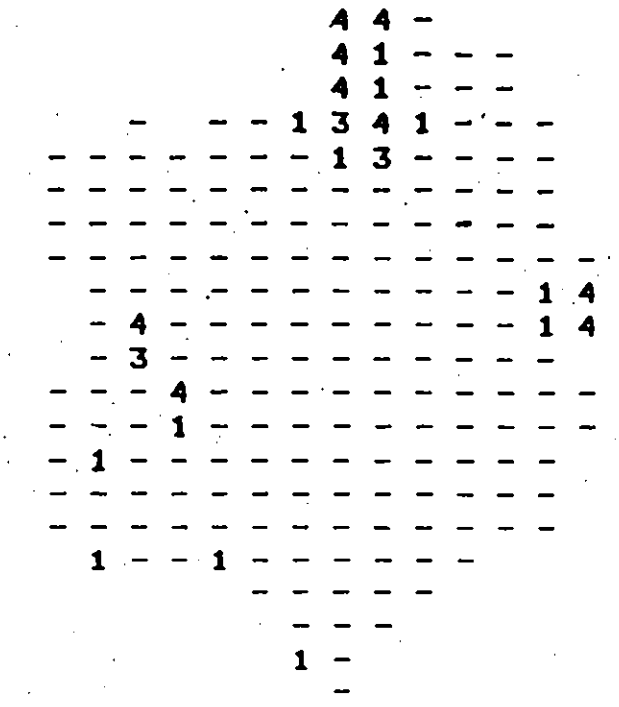
Sector dominated by land >427 m (1 400 ft)

FIGURE 12.3 TOPOGRAPHIC CHARACTERISTICS

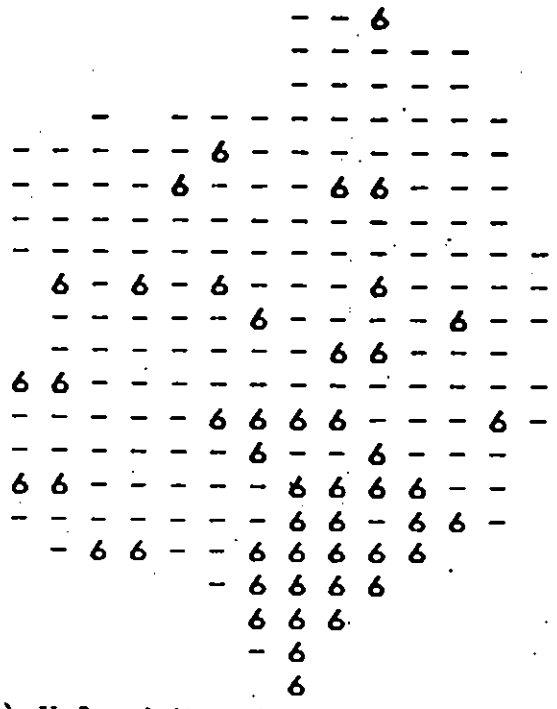


* Score >10, on scale 0-25

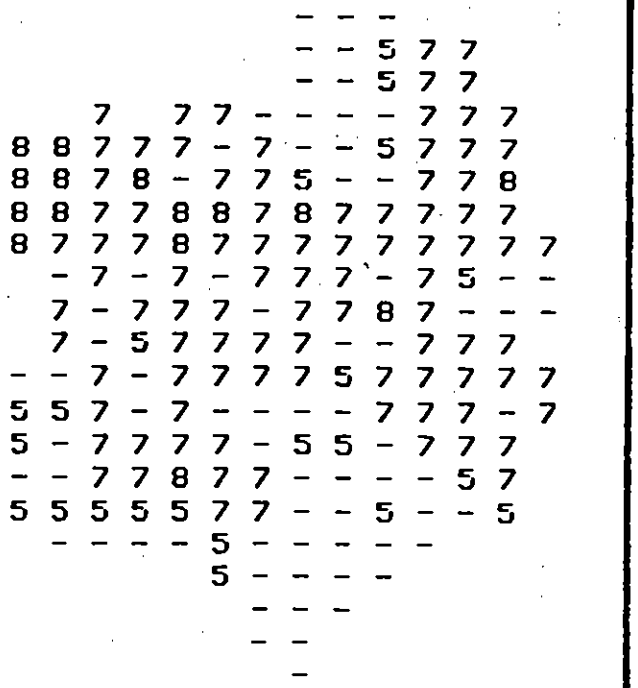
FIGURE 12.4 LAND TYPES



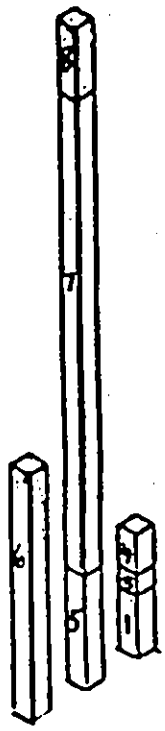
a) Hill Land Group 1 = Steep Hill
3 = Hill
4 = High Plateau



c) Upland Margin Land Group
6 = Upland Margin



b) Upland Land Group 5 = Steep Hill
7 = Upland
8 = Upland Plateau



d) Frequency of Land Types

FIGURE 12.5 MOORLAND - FARMLAND CHANGE

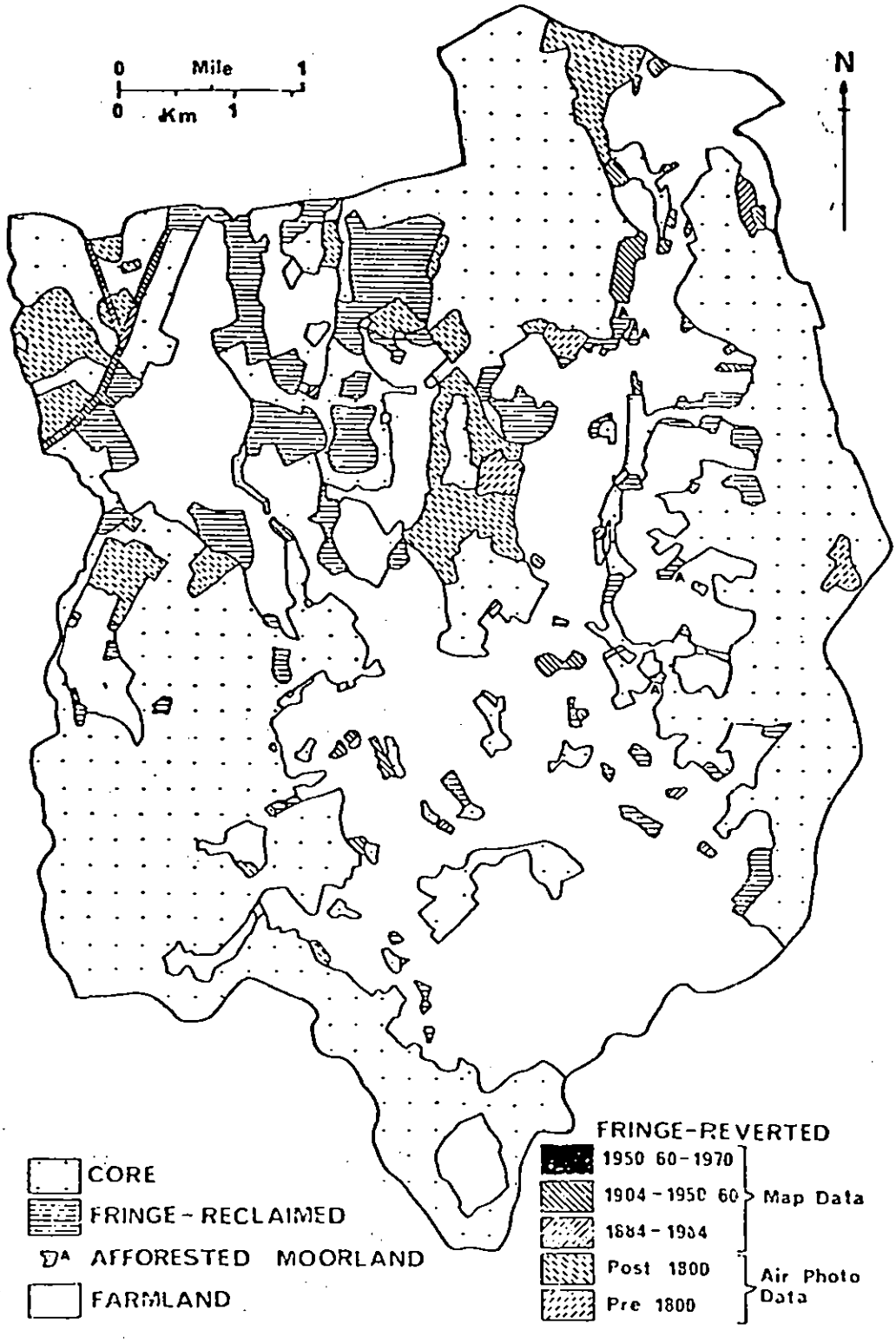


FIGURE 12.6 LAND RECLAIMED FOR AGRICULTURE 1960-1975

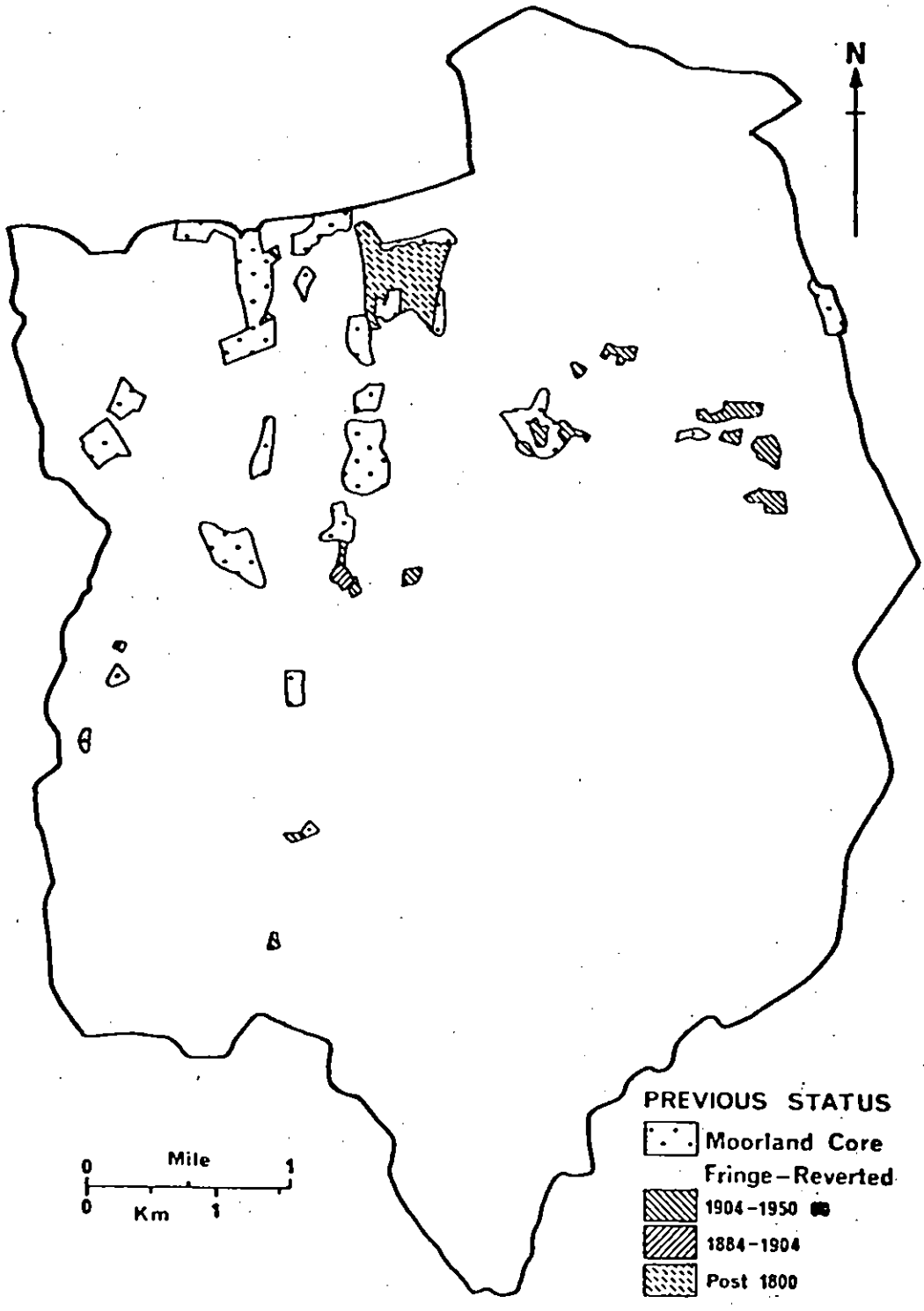
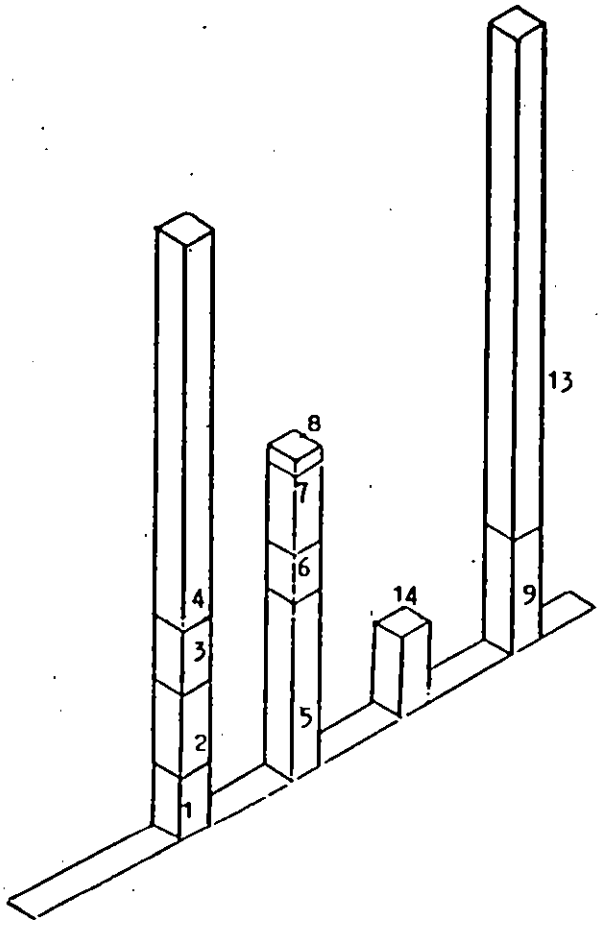


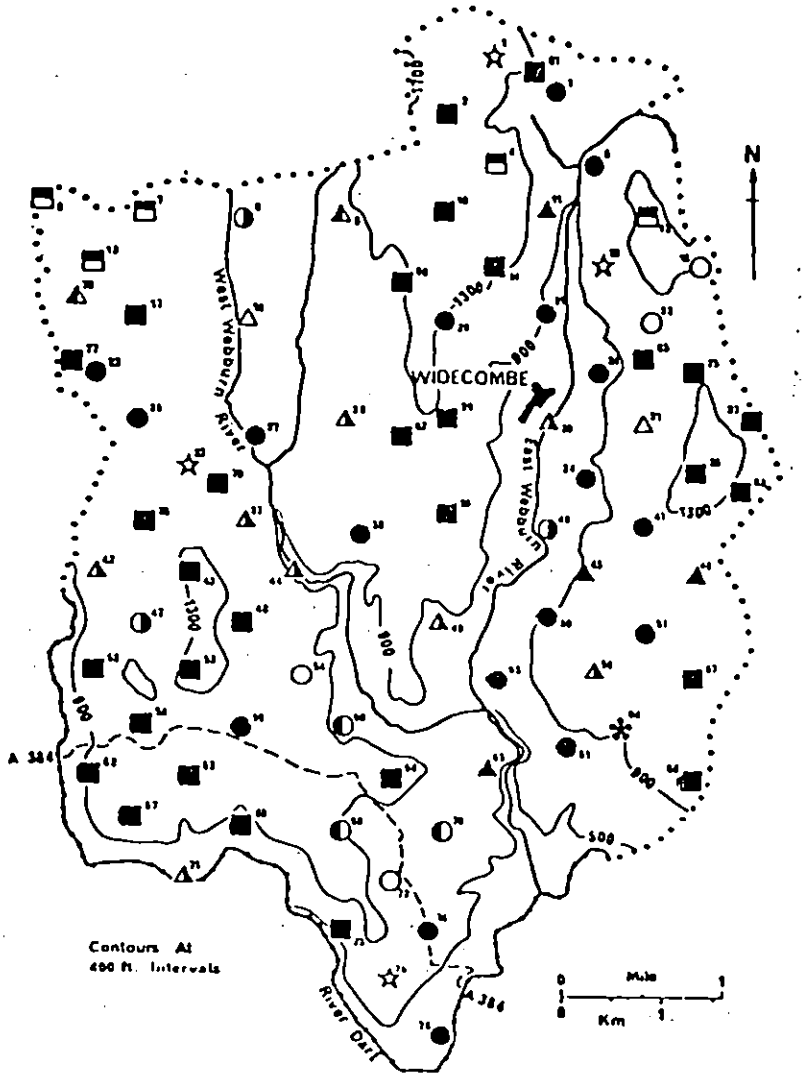
FIGURE 12.7 VEGETATION CLASS FREQUENCY AT RECORDED MAIN SITES



Vegetation Group

		%
1	Class1: Lolium/Holcus/Pteridium	4
1	Class2: Lolium	5
1	Class3: Lolium/Trifolium	4
1	Class4: Herb rich Lolium grassland	24
2	Class5: Agrostis/Juncus	11
2	Class6: Festuca/Juncus	3
2	Class7: Agrostis/Holcus	5
2	Class8: Festuca/Agrostis	1
3	Class14: Festuca/Vaccinium	5
4	Class9: Calluna/Molinia/Vaccinium	7
4	Class13: Calluna	31

FIGURE 12.8 LOCATION AND CLASSIFICATION OF VEGETATION MAIN SITES



KEY:

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	■

FIGURE 12.9 LAND TYPE - VEGETATION ASSOCIATIONS

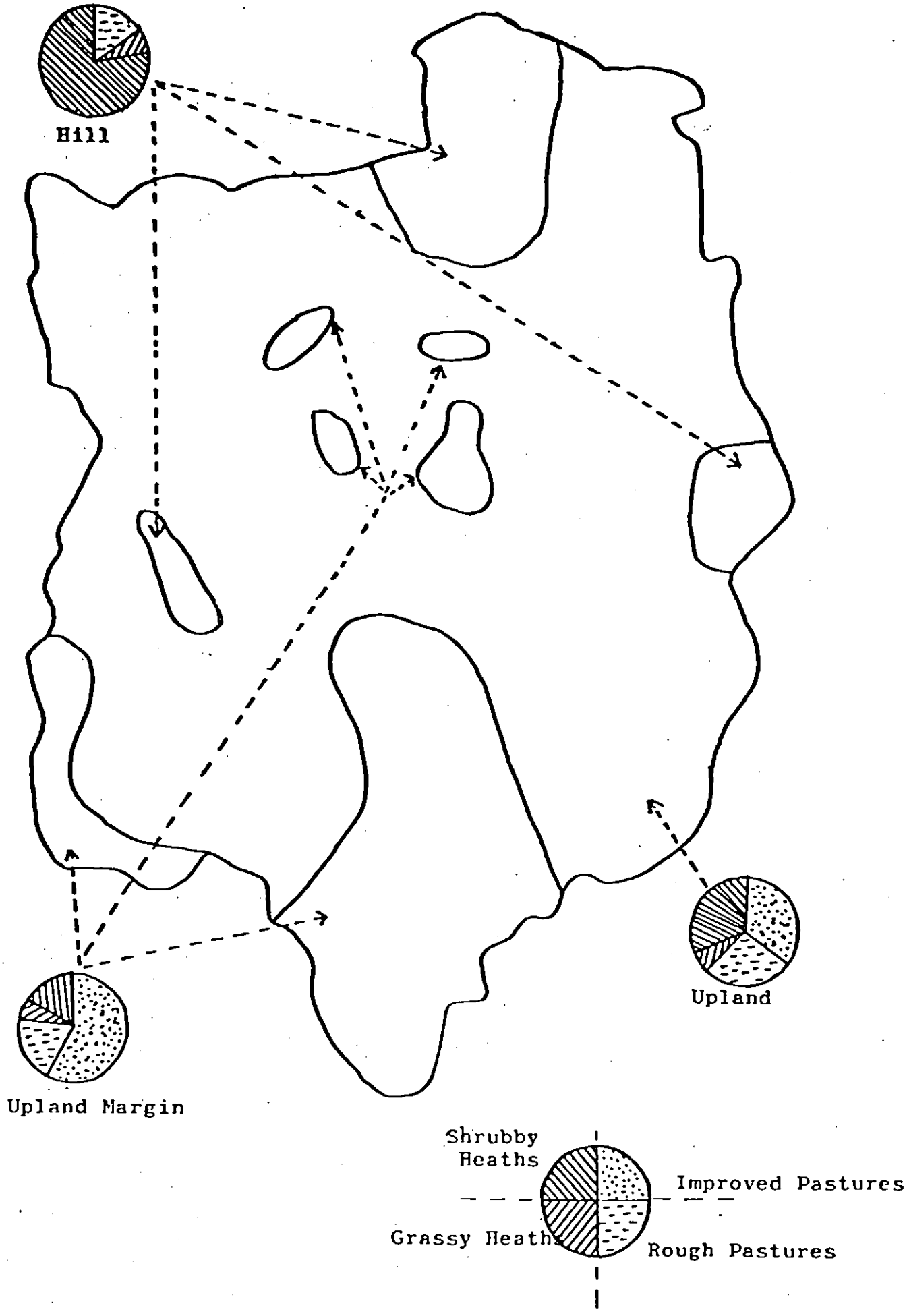
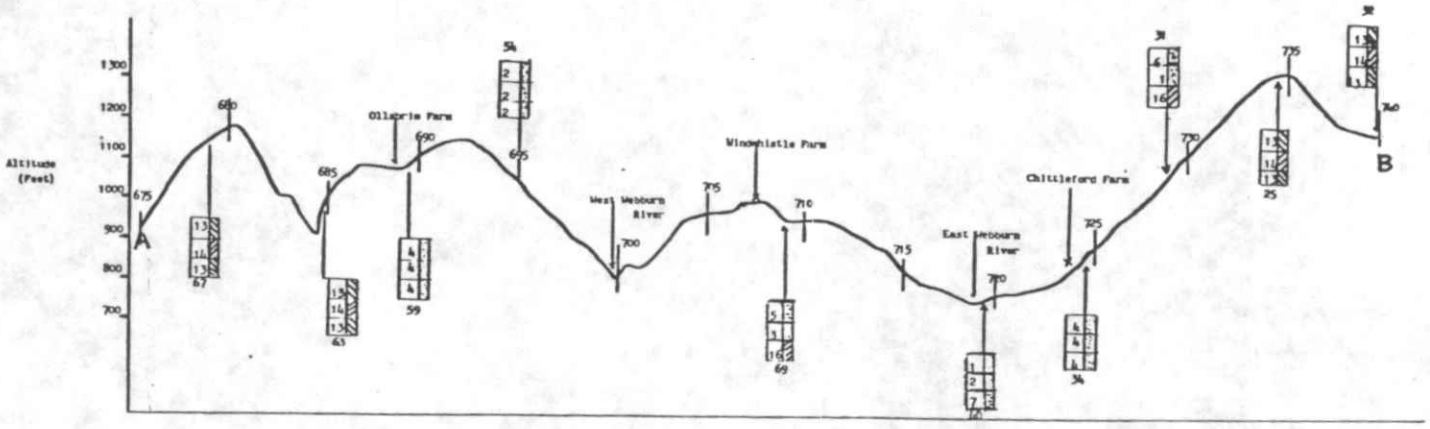
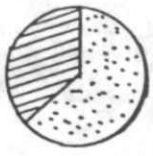


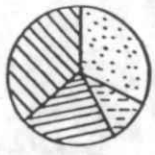
FIGURE 12.10 POSSIBLE VEGETATION CHANGE AT SITES ALONG A TRANSECT



Present



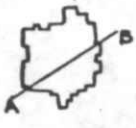
After More Intensive Agriculture



After Less Intensive Agriculture

PROPORTION OF VEGETATION GROUPS AT SITES ALONG TRANSECT

Key:-



Transect

Grid Line (easting)